

Southwest Region University Transportation Center

**Public-Private Partnerships for Providing ITS:
Case Studies in Transportation and Other Industries**



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16. Abstract The report begins by presenting motivating factors for the use of public-private partnerships in ITS. It then explains stages of partnership development - formation, experimentation, and sustention - before introducing the seven case studies. The body of the report is a discussion of the seven case studies: Heavy Vehicle Electronic License Plate, Incorporated (HELP, Inc.), Advantage CVO, the I-95 Corridor Coalition, and the Multi-jurisdictional Automated Preclearance System (MAPS), the Microelectronics and Computer Technology Corporation (MCC), the Semiconductor Manufacturing Technology Initiative (SEMATECH), and the Partnership for a New Generation of Vehicles (PNGV). Separate chapters dedicated to each case study present analysis of each program's motivating factors, formation and development, planning efforts, organizational structure, membership and funding characteristics, past and current issues of importance, interaction between partners, and keys to success or reasons for failures. The final chapter pulls together the findings from the case study analysis. It presents common trends, successful practices, and potential pitfalls in regard to elements of public-private partnerships including planning, participation, organization, and funding.					
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by

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Center for Transportation Research
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EXECUTIVE SUMMARY

Over the past decade, numerous innovative business partnerships aimed at developing and disseminating new technology have formed in the United States. As transportation infrastructure providers - state and local government agencies - begin to implement intelligent transportation systems (ITS) technology, they too are faced with challenges involving the development and deployment of high technology systems. Many are exploring partnerships with other government agencies and industry to facilitate ITS deployment. These partnerships are following development patterns and struggling with issues similar to those of collaborative ventures in other industries, such as automotive and electronics. With recent political pressures to downsize and privatize or reform many government functions, it is probable that partnerships between government and industry will become increasingly common.

This report examines public-private partnerships and their potential application to the provision of ITS. The report evaluates seven case studies of public-private partnerships to determine common points and lessons learned which may be applied to future partnerships. Four of these case studies represent a cross section of partnerships for providing ITS services for commercial vehicle operations. The remaining three case studies are consortia in the computer, electronics, and automotive fields. The report compares various elements of the partnerships to determine successful and unsuccessful practices as well as common trends and issues. These elements include motivating factors, program formation and development, planning and goal setting, organizational structure, the role of leaders, interaction between partners, problems and stumbling blocks, outcomes, current issues of importance, and future outlook. Transportation officials will be able to apply the findings in the formation of new partnerships for the provision of ITS services and in improving existing partnerships.

ABSTRACT

The report begins by presenting motivating factors for the use of public-private partnerships in ITS. It then explains stages of partnership development - formation, experimentation, and sustention - before introducing the seven case studies.

The body of the report is a discussion of the seven case studies: Heavy Vehicle Electronic License Plate, Incorporated (HELP, Inc.), Advantage CVO, the I-95 Corridor Coalition, and the Multi-jurisdictional Automated Preclearance System (MAPS), the Microelectronics and Computer Technology Corporation (MCC), the Semiconductor Manufacturing Technology Initiative (SEMATECH), and the Partnership for a New Generation of Vehicles (PNGV). Separate chapters dedicated to each case study present analysis of each program's motivating factors, formation and development, planning efforts, organizational structure, membership and funding characteristics, past and current issues of importance, interaction between partners, and keys to success or reasons for failures.

The final chapter pulls together the findings from the case study analysis. It presents common trends, successful practices, and potential pitfalls in regard to elements of public-private partnerships including planning, participation, organization, and funding.

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CHAPTER 1: INTRODUCTION

Over the past decade, numerous innovative business partnerships aimed at developing and disseminating new technology have formed in the United States. As transportation infrastructure providers - state and local government agencies - begin to implement intelligent transportation systems (ITS) technology, they too are faced with challenges involving the development and deployment of high technology systems. Many are exploring partnerships with other government agencies and industry to facilitate ITS deployment. These partnerships are following development patterns and struggling with issues similar to those of collaborative ventures in other industries, such as automotive and electronics. With recent political pressures to downsize and privatize or reform many government functions, it is almost certain that partnerships between government and industry will become increasingly common. This report examines public-private partnerships and their potential application to the provision of ITS. The report evaluates seven case studies of public-private partnerships to determine common points and lessons learned which may be applied to future partnerships.

ORGANIZATION

The primary objective of this report is to perform a comparative analysis of recent partnerships in industry and government in order to identify common trends and issues of importance to public-private partnerships. In doing so, the report examines seven partnerships, four ITS/CVO-related partnerships and three from outside industries. The four ITS/CVO-related partnerships are Heavy Vehicle Electronic License Plate, Incorporated (HELP, Inc.), Advantage CVO, the I-95 Corridor Coalition, and the Multi-jurisdictional Automated Preclearance System (MAPS) and are described in chapters two through five, respectively. The three industry related cases, discussed in chapters six through eight, are the Microelectronics and Computer Technology Corporation (MCC), the Semiconductor Manufacturing Technology Initiative (SEMATECH), and the Partnership for a New Generation of Vehicles (PNGV). Chapter 9, the conclusion, reviews the key findings.

Based on experiences in both the ITS and outside industry case studies, partnerships tend to evolve through three stages of development: a formation phase, an experimentation phase, and a sustention phase. The formation phase refers to an individual's or group's original conception of the partnership and the forces and influences that come into play in setting-up the partnership. The experimentation phase is the first few years of a partnership program's life in which a large amount of evaluation and transition occurs. The focus and goals, as well as the organization, of the partnership may change. Furthermore, the program has not yet proven to be successful so its future remains unclear. Finally, the sustention phase begins when the program

has overcome early difficulties to become a functional entity. Its organizational structure and processes for dealing with problems and issues are established. Focus shifts to sustention and growth of the organization and to meeting the program's goals. This report identifies key factors that affect each phase of development, issues that have to be determined, and problems that are overcome in the case studies. Therefore, both historical factors and current characteristics of each case study are examined.

The case studies are at varying stages of development, with the outside industry case studies tending to be more advanced. Therefore, the outside industry case studies presented are more historically focused. Each of these case studies has a brief introduction, followed by a section about the program's formation. This section looks at the key motivational factors and initiation of the program; the early vision for the program; the original organizational, membership and funding structures; and other issues of importance to the program's formation. Then, a section entitled *Program Development and Evolution* describes the case study's progression through the experimentation phase and into the sustention phase (if it reaches this point). A brief section on the current situation orients the reader to the partnership's level of development today. Each chapter ends with a *Summary and Conclusions* section.

The ITS-related case studies are oriented more toward their current situations in order to facilitate cross-comparisons and because many of these case studies have shorter histories. These chapters first orient the reader to the current characteristics and levels of development of the program. Following the introduction of each chapter are sections on current services and level of development, organizational structure, and membership and funding characteristics. Next comes a historical section which describes the program's formation and experimentation stages. Current issues of importance to the organization are discussed toward the end of each chapter, immediately followed by sections on the future outlook for the program and the *Summary and Conclusions*.

CASE STUDIES

The seven case studies represent a variety of approaches and depict a range of experiences in the development of public-private partnerships. Many are pioneering efforts, which challenge traditional business practices and relationships. These partnerships face greater challenges than those that follow them. The four ITS-related case studies represent a cross-section of programs set-up to provide the same service: electronic clearance for commercial vehicles at state weight stations and inspection facilities. This facilitates comparisons between the programs and shows how a variety of approaches can be applied to the same task. The outside industry case studies are large, complex partnerships that represent radical departures from traditional business practices. The radical nature of the organizations brings forth a number of issues of importance to public-private partnerships. These case studies are each research

consortiums and have had varying levels of success in their operations. This allows for comparisons between them and identification of the key elements that have led to the success or failure of each. The case studies are briefly described below.

HELP, Inc. was the first partnership between the trucking industry and state regulatory agencies to provide electronic clearance services at state weigh stations and inspection facilities. The program grew out of a Federal Highway Administration (FHWA) sponsored operational test of commercial vehicle data collection technology integrated across multiple states. Today, HELP, Inc. is a non-profit organization that leverages private funds to provide electronic clearance services at state weigh stations and inspections facilities. It is the oldest and largest program providing this service in the U.S., with 64,000 trucks enrolled and 55 operational sites.¹

Advantage CVO also provides electronic clearance services, but is state funded. It, too, developed out of an FHWA operational test, which ended in 1997. Advantage CVO is now in transition as it attempts to sustain its program without federal funding. It recently merged with MAPS, a program with which it shares similar goals and operating characteristics. Advantage CVO provides interesting comparisons with HELP, Inc. due to fundamentally different organizational philosophies.

The Interstate-95 Corridor Coalition is different from the other ITS case studies because providing electronic clearance service is not its primary mission. Instead, it helps facilitate the coordination and integration of ITS programs across multiple jurisdictions along the I-95 corridor in the Northeastern U.S. It takes a bottoms-up approach, providing research and information, but leaving its members free to develop their own ITS programs. This partnership receives most of its funding from the federal government.

MAPS is a relatively new partnership to provide electronic clearance and regional permitting in the states of Washington, Oregon, Idaho and Utah. Like Advantage CVO, it is state-funded. Due to the similarities between the two program, MAPS recently merged with Advantage CVO.

MCC was the first major research and development consortium in the United States. It was formed in 1983 by 10 computer and electronics firms to address the gain in strength of Japanese computing and electronics. The consortium's original intent was to conduct precompetitive research and transfer findings to its member companies, whose responsibility it was to commercialize and market the technologies. Its funding came entirely from its member companies, and the government was not involved with MCC until many years into the partnership's existence. MCC suffered from lack of a role model. Its 15-year history is marked by struggles in defining its purpose and retaining member support.

SEMATECH is an example of a more successful research consortium. Formed in 1987, it involved U.S. semiconductor manufacturing firms and technology suppliers in an effort to bolster the industry's declining world-wide market share. The U.S. government participated as a

partner in SEMATECH for its first decade of operation, providing half its budget. SEMATECH has succeeded in meeting all of its goals and continues to grow today. The consortium provides a valuable comparison with MCC which was largely unsuccessful in meeting its objects and struggles to survive today.

The PNGV is a partnership between the federal government and the big three auto-manufacturers in the U.S aimed at revitalizing the U.S. automobile industry to increase its national competitiveness in manufacturing, implement technological advancements, and develop dramatically cleaner and more fuel efficient vehicles. Its primary objective is to develop vehicles with three times the fuel efficiency of 1994 family sedans, but comparable to these vehicles in terms of safety, performance, size, and cost. The PNGV was initiated by President Clinton and receives support from a number of U.S. agencies. The program takes advantage of existing federal funding sources, without requiring any new government appropriations. The partnership has accomplished its interim milestones, but it will be several years before its ultimate success is determined.

BACKGROUND AND JUSTIFICATION

The roles of government and the private sector in serving the nation's transportation needs have remained relatively distinct throughout most of the 20th century. Government has been responsible for developing and maintaining transportation infrastructure while the private sector has provided vehicles. For the most part, government and private sector transportation interests have operated independently of one another. However, that is changing today as government and industry are realizing the necessity of working together to develop and deploy new transportation technology.

Applications of ITS often require public-private cooperation. Many of these technologies revolve around interaction between vehicles and infrastructure. Thus, the responsible parties must work together to ensure that the vehicles and infrastructure elements function as an integrated system. For instance, in-vehicle navigation systems require an infrastructure element to monitor traffic conditions and an in-vehicle device to relay this information to the driver. Automatic tolling systems depend on transponders within vehicles and compatible readers as part of the infrastructure, along with computing systems to process and store data. Cooperation between government authorities as owners of the public infrastructure, private entities as suppliers of technology, and vehicle drivers as primary users of a service are essential for the success of any ITS application.

Secondly, ITS technologies represent win/win solutions for multiple parties. For example, electronic clearance for commercial vehicles at weigh station and inspection facilities directly benefits motor carriers by decreasing their travel times. It also increases the efficiency of vehicle inspections, reducing the number of government personnel required and allowing those

personnel to concentrate on non-compliant vehicles. This provides safer roadway conditions and more effective use of government funds. In addition, technology suppliers have a new market for their products. Other ITS applications have similar prospects. With mutual potential benefits, parties have incentives to cooperate in order to realize possible gains for all.

Research and development of ITS has been a joint effort by the public and private sectors. Between 1991 and 1997 under the Intermodal Surface Transportation Efficiency Act (ISTEA), the federal government spent approximately \$1.3 Billion on ITS programs.² State and local governments contributed through matching federal funds on joint projects and funding their own ITS programs. In addition, the private sector has invested substantial amounts in developing ITS technologies. Operational field tests have provided many instances for these parties to work together to integrate their research efforts.

As ITS applications move from the research phase into wide-scale deployment, new opportunities arise for public-private cooperation. Deployment of ITS technologies can require substantial investment by public agencies. Even though recent studies indicate that the benefits gained from ITS applications are greater than the costs of deployment, and that ITS can achieve transportation system improvements at lower prices than new construction,³ acquiring government funding for ITS can be difficult. Government agencies are pressed with many competing demands for limited available funds. ITS often has a difficult time competing for this funding pool when the competition is more familiar and strongly politically backed. Therefore, ITS advocates are searching for alternative means for financing deployment. One approach is to shift the burden of payment to the users of ITS through user fees or subscriptions. Complete privatization of ITS service provision is also being explored. A notable example is HELP, Inc., a non-profit agency set up to provide ITS services. Its first service, PrePass provides electronic clearance at state weigh stations and ports-of-entry. Lockheed-Martin, the technology supplier, provides venture capital for the technology investment, which is then repaid by charging per-use fees to the motor carriers who utilize the service. Creative institutional arrangements, such as HELP, Inc., will play an important role in the future of ITS. In fact, it is projected that the private sector will represent 80 of the market for ITS in the future.⁴

Another reason why public-private cooperation is beneficial in the ITS field is that each side brings unique characteristics into a partnership. The private sector provides technology expertise, knowledge of marketing products and services, and sometimes financial backing. Public partners provide access to transportation facilities and information. They also have expertise in transportation issues and knowledge of government processes.

In addition to public-private cooperation, the provision of ITS services often requires coordination across different government jurisdictions. Neighboring and overlapping government jurisdictions must support compatible technologies and often agree on certain standards in order to provide seamless ITS service. In some cases, standardization and coordination will be

necessary for non-transportation issues, such as law enforcement or regulatory processes, as well as transportation issues.

Transportation officials have had relatively little experience with the types of partnerships emerging in the ITS field. Although the private sector has provided services to government transportation agencies for some time on a contract basis, partnerships in which the government and private sector parties are on equal footings are rare. These types of partnerships are complex. They require each partner to recognize and promote the needs of the other. In many cases, previously adversarial parties must work together, for instance, the trucking industry and government regulatory agencies in the case of commercial vehicle applications of ITS. Coordinating the interests and practices of multiple government jurisdictions also poses challenges. Because these types of partnerships are expected to increase in the near future, it is important to establish guidelines and have models to emulate.

Although the transportation industry may not provide a lot of examples of unusual and complex public-private partnerships for study, these types of partnerships do exist in other industries. This paper examines a subset of pioneering partnerships in the computer, semiconductor, and automotive industries. It also provides a comparative analysis of different institutional arrangements by studying four different organizations established to provide the same service - electronic clearance. Two of these programs, HELP, Inc. and Advantage CVO, are among the oldest and most-established providers of ITS/CVO services in the country; significant lessons can be learned from their experiences.

NOTES

¹ Heavy Vehicle Electronic License Plate, Incorporated, "About PrePass: PrePass Status," PrePass web site [cited February 28, 1999], available from: <http://www.cvo.com/status.htm>; INTERNET.

² "ITS Funding: FY 1991-1997" prepared by the Intelligent Transportation Society of America (ITS America), Washington, DC, March 1999. (computer printout)

³ ITS America, *Intelligent Transportation Systems National Investment and Market Analysis*, prepared by Apogee Research, Inc. (Washington, DC, May, 1997); and Proper, Allen T. and Melvyn D. Cheslow, *ITS Benefits: Continuing Successes and Operational Test Results*, prepared for the Federal Highway Administration by Mitretek Systems, Inc. (Washington, DC, October, 1997).

⁴ ITS America, *Intelligent Transportation Systems National Investment and Market Analysis: Executive Summary*, prepared by Apogee Research, Inc. (Washington, DC, May, 1997), p. 2.

CHAPTER 2. HEAVY VEHICLE ELECTRONIC LISCENCE PLATE, INC.

Heavy Vehicle Electronic License Plate, Inc. (HELP, Inc. or HELP), which grew out of the HELP/Crescent Demonstration project, is the pioneer in public-private partnerships for commercial vehicle operations (CVO). With a history dating back to the early 1980's, HELP progressed through operational testing and has been commercially providing electronic clearance services at weigh stations since 1993. It was the first major partnership between the trucking industry and state regulatory agencies and the first program to test an integrated, multi-state intelligent vehicle highway system for commercial vehicle operations. Today, HELP, Inc. is the longest established and largest of the CVO programs providing electronic clearance, with 64,000 trucks enrolled and 55 operational sites in ten states.¹ HELP, Inc. is also unique in its status as a non-profit agency hoping to become fully self-supportive through user fees. The organization's vision and mission are as follows:

Vision: Commercial vehicles operate on North American highways systems with the same ease as passenger vehicles, while ensuring regulatory compliance and user safety.

Mission: Develop and deploy advanced technology systems to create a cooperative operating and regulatory environment which improves the efficient and safe movement of commercial vehicles and the performance of the highway system.²

This chapter explores current, past and future characteristics of HELP, Inc. First, it looks at elements of the program today, including service offerings and research efforts, level of deployment, current organizational structure, relationship to its members and private partners, and funding mechanism. Then a historical section describes the important elements of HELP, Inc.'s formation, how it evolved over time, and the difficulties encountered. Following the discussion of historical issues of importance, the chapter outlines modern issues and challenges that the organization faces. The chapter concludes with a brief section on the future outlook for HELP, Inc. and summary and conclusions.

SERVICES

HELP, Inc.'s initial product is an electronic clearance service, called PrePass, which the organization offers on a pay-per-pass basis to motor carriers. In addition, HELP, Inc. is participating in research efforts to develop international border crossing and electronic

credentialing technologies. New services may be developed based on the outcomes of these test projects. The organization is also looking into other future service options.

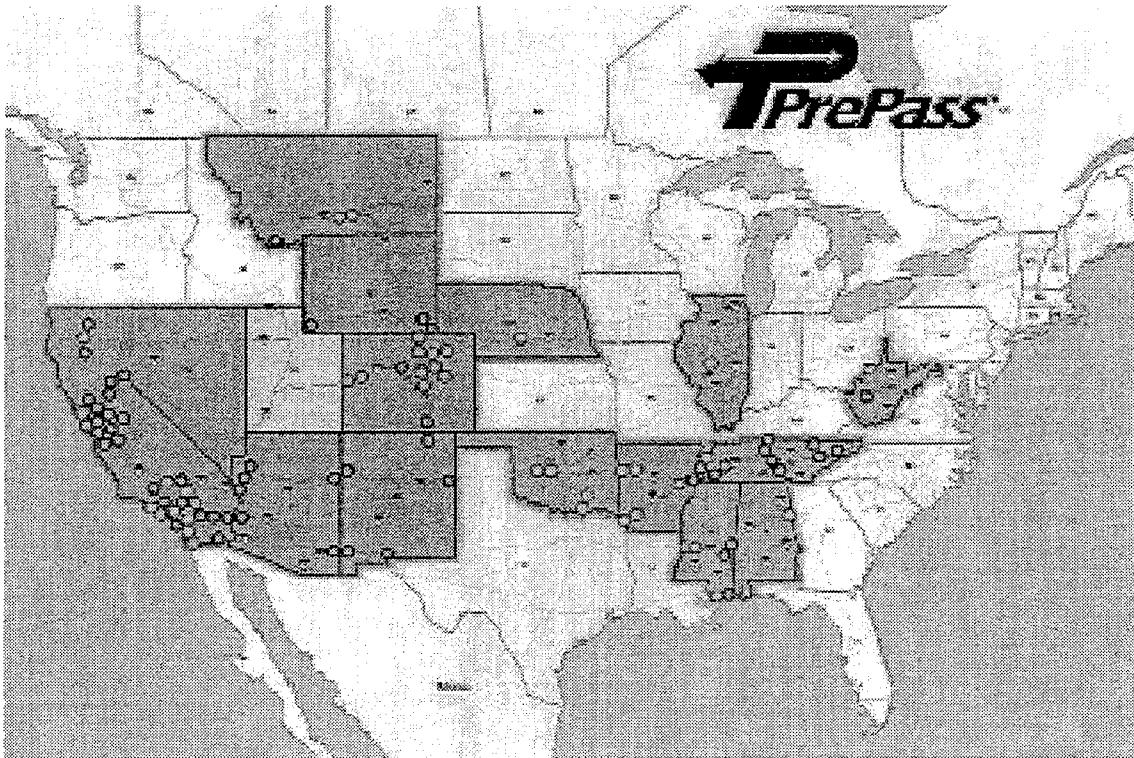
PrePass

PrePass allows participating trucks that have proper credentials and are lawful to bypass state inspection facilities and ports of entry. As a participating truck approaches an enforcement site equipped with PrePass, an in-cab transponder identifies the vehicle to the inspection facility computer. The computer, which is connected to an external database, verifies that the truck has proper state-mandated credentials and safety and registration requirements. At the same time, the truck passes over a high-speed weigh-in-motion sensor embedded in the roadway which counts and measures the distance between axles and calculates the truck's total gross- and axle-weights and relays this information to the facility computer. The computer then sends distinct audio and visual signals back to the in-cab transponder to indicate whether the truck can pass the inspection facility or must pull-in. Bypass services are provided for some facilities in the main lines of the roadway, while others take place in-station.³

CURRENT LEVEL OF DEPLOYMENT

HELP's PrePass system is experiencing rapid growth both in the number of operational sites and its enrollment of carriers. In fact, the number of transponder equipped trucks increased from 27,500 to over 61,500 during 1998, contributing to a 600 percent increase in the number of bypasses for the year; 2.5 million bypasses were recorded by the PrePass system in 1998. The number of PrePass equipped sites grew to 55 with an additional 44 sites committed for future development within the 14 participating PrePass states (see Figure 2.1).⁴

FIGURE 2.1: PREPASS SIGHT DEPLOYMENT (MARCH 1999)



SOURCE: HELP, Inc., "System Map," PrePass web site [cited March 31, 1999], available from: <http://www.cvo.com/map.htm>; INTERNET.

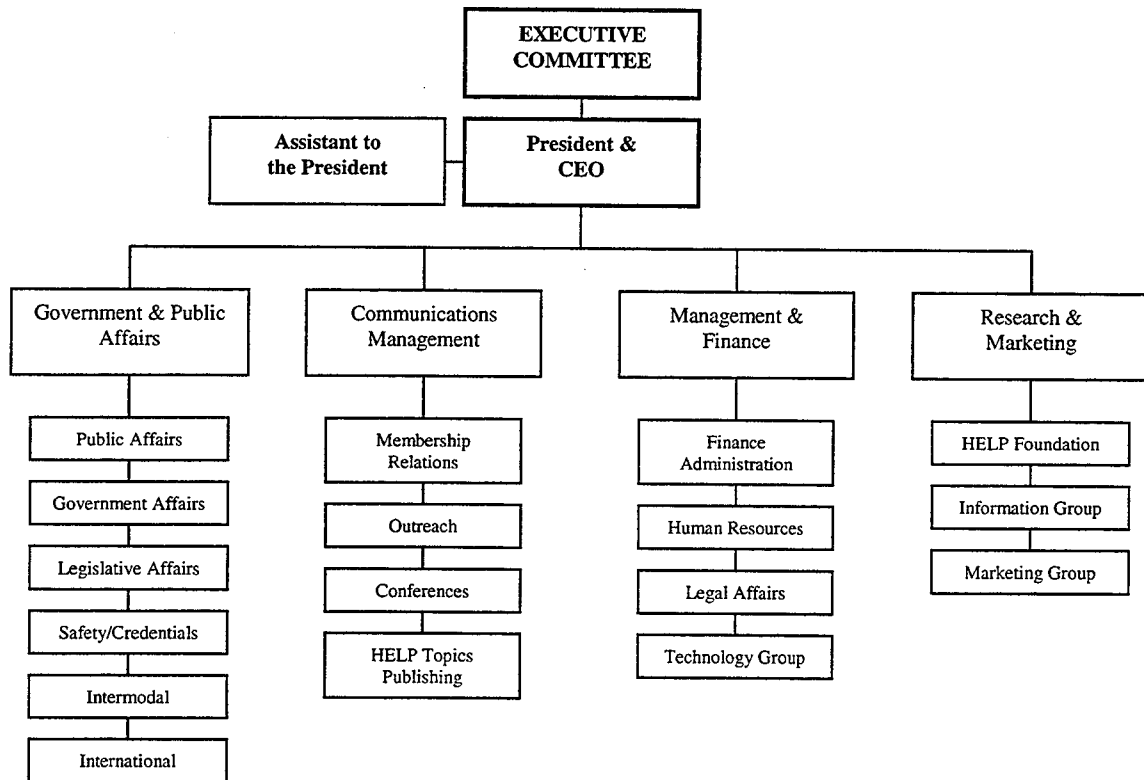
ORGANIZATIONAL STRUCTURE

HELP, Inc. is an Arizona based not-for-profit organization that facilitates the development of Intelligent Transportation Services (ITS) for Commercial Vehicle Operations (CVO) within its member states. It provides a linkage between the member states and the franchised system developer and operator, Lockheed Martin Information Management Systems (LMIMS). HELP, Inc.'s Board of Directors, comprised of one government and one motor carrier industry representative from each member state, makes collective technology deployment decisions for the states and oversees and advises LMIMS. Each member state enters into contract with HELP, Inc. This type of institutional arrangement streamlines the decision making and contracting processes, leverages a variety of funds, provides regional consistency and interoperability, and allows for rapid functional and geographic expansion for the provision of ITS/CVO services.

HELP, Inc.'s governing bodies include a Board of Directors (the Board), and an Executive Committee. Standing committees, full-time staff, and consultants assist the Board and Executive

Committee in daily operations and program implementation. Figure 2.2 shows HELP, Inc.'s organizational structure.

FIGURE 2.2: HELP, INC. ORGANIZATIONAL CHART



SOURCE: HELP, Inc., "Strategic Business Plan" (draft), July 6, 1998. p. 12.

The Board, comprised of one government and one motor carrier industry representative from each member state, leads HELP, Inc. The state governor, top official, or designee appoints these representatives. The Board meets semi-annually to monitor and vote on programs, and approve HELP, Inc.'s budget. Special meetings of the Board can be called by the Board Chairman. Officers of the Board are elected annually.

The four elected officers of HELP, Inc. are the Chairman of the Board, the Vice-Chairman of the Board, the Secretary/Treasurer, and a Member-at-Large. All except the Member-at-Large are elected for two-year terms, with the Vice-Chairman moving into the Chairman position at the end of the first year in office. Members-at-Large serve only one-year terms. Currently there is only one Member-at-Large position. However, the number of actively serving Members-at-Large will increase to reflect HELP membership as deemed appropriate during annual reviews by the

Board. In addition to the duties of their offices, the officers serve on the Executive Committee along with the Chairmen of each of HELP, Inc.'s standing committees.

HELP, Inc. committees can be established by the Board of Directors, Executive Committee or Chairman. Committee members are appointed by the Chairman and approved by the Executive Committee. Current standing committees are the Advanced Technology Committee, the Safety Enforcement Committee and the Strategic Planning Committee.

HELP, Inc.'s permanent staff include a President and Vice President. The President is hired through a national search and serves at the pleasure of the Board. The President acts as Chief Executive Officer and hires all other staff members including the Vice President. Currently, the Vice President serves as Chief Financial Officer. Consultants are hired on an as-needed basis to perform evaluations, assist with planning and render other services.⁵

Partnership with Lockheed Martin Information Management Systems

Lockheed Martin Information Management Systems (LMIMS) serves as operator, manager, and maintainer for the HELP system. In accordance with a franchise agreement created on December 1, 1997, LMIMS's services to the system include, but are not limited to:

- Administration, accounting, billing, crediting, collecting, insurance, purchasing, advancement and payment of operating expenses, clerical and other services necessary to administration;
- Operational, engineering, maintenance, repair, and such other technical services necessary to the optimal operation of the HELP system;
- Modifications and enhancements to the software and hardware; and
- Sales, advertising, and other promotional services necessary to the marketing of the HELP system.

The term of this agreement is from the initial agreement date until its anniversary in the year 2020. Both partners agree to make reasonable efforts toward marketing the system. HELP agrees to pay a fee for LMIMS's services while LMIMS, in turn, agrees to pay an annual franchise fee to HELP, Inc. for the right to operate the system.⁶

MEMBERSHIP

HELP, Inc. membership is open to any state, province, or territory in the United States, Canada, Mexico or the District of Columbia and their jurisdictional Motor Carrier Representatives. Three HELP, Inc. membership options are currently available: Active Membership, Affiliate Membership, and Associate Membership. All three levels of membership allow states to enter

into a Memorandum of Agreement with HELP, Inc. to deploy HELP technology. Active Member states currently pay \$27,000 in annual membership dues and are eligible for representation on the HELP, Inc. Board of Directors and can vote and hold elective office. Affiliate Member states pay \$10,000 in annual membership dues and can receive all membership services except the right to vote at Board meetings or hold membership in the Executive Committee. Associate Membership recently became available for those states that want to test HELP technologies before committing to Active Membership. These states are not eligible for membership in the Executive Committee and do not have voting privileges in Board meetings.⁷ As of March, 1999, Active Member states are Arizona, California, Colorado, Montana, New Mexico, Tennessee, Wyoming, and Utah while Nevada is an Affiliate Member. Alabama, Arkansas, Illinois, Mississippi, Nebraska, Oklahoma, and West Virginia also participate in PrePass.⁸

FUNDING

HELP, Inc. is a non-profit organization whose goal is to be self-supporting from revenue generated through its services. Bypass fees assessed to motor carriers revert to LMIMS as payment for its services and investment. Two pricing schedules are available. Plan I is a capped, pay-per-pass plan where carriers are assessed a \$.99 fee per successful bypass, not to exceed \$3.96 per day per truck. Any additional bypasses are free of charge. The alternative is a monthly fee of \$85 per truck with unlimited bypasses. Motor carriers receive transponders from HELP, Inc. free of charge. HELP, Inc.'s operating revenue comes from membership dues from participating states and a franchise fee paid by LMIMS for the right to operate PrePass. Government grants also assist HELP in the research and development of new ITS/CVO services.⁹

The current HELP system represents a significant investment by the franchisee, LMIMS, who uses its own funds to develop, deploy, and maintain the system technology. While fees generated to-date have not been adequate to repay HELP, Inc.'s debt to LMIMS,¹⁰ the fact that the company recently entered into a 20-year contract with HELP, Inc. is testament to its confidence that HELP, Inc. will eventually be able to retire its debt and become self-sustaining.

HISTORY AND DEVELOPMENT

HELP, Inc. emerged out of a FHWA-sponsored operational test and technology demonstration known as the HELP program and Crescent Demonstration. HELP progressed through three stages of development before becoming the non-profit agency, HELP, Inc. in 1993. The program evolved from concept papers, to technical studies, to a full-scale operational test.

Each phase brought changes in organization and a chance for the program to refocus and restructure.

Formation

The original concept for the HELP program focused on improving and streamlining the data collection processes for commercial vehicle operations. Federal, state, and local governments and the motor carrier industry all required similar data but had separate data collection practices. Trucking data was important to the government agencies for highway planning and design, safety measures, and tax administration. The motor carrier companies used data to monitor vehicles and ensure effective operational management. Without an automated system, data collection was cumbersome, inefficient, and often imprecise. The HELP system was envisioned as a tool to aid this process by automatically weighing, classifying, and identifying commercial vehicles at selected locations and storing the resultant data, which could then be accessed by the government and the trucking industry.

Louis Schmitt and Loyd Henion from the Arizona and Oregon Departments of Transportation (ADOT and ODOT) were the first to discuss an integrated system such as HELP. The duo began publicly speaking about the project in 1981 and submitted two concept papers to FHWA in 1983. The concept papers lead to FHWA providing grants for ADOT to undertake a feasibility study and ODOT to perform a proof of concept demonstration. These concluded in December, 1984 and found that the basic system concepts were technically feasible and offered potential benefits to both truckers and states. The feasibility study also outlined a multi-state development and testing program for the system technology.¹¹

Early Partners

The early activities generated significant support for the system. In 1985, a HELP program partnership was formalized to further test and develop the technology. Initial partners included Arizona, California, Colorado, Idaho, Iowa, Minnesota, Nevada, New Mexico, Oregon, Pennsylvania, Utah, Virginia, Washington, FHWA, Transport Canada, and the province of British Columbia. Later, Alaska, Texas, and the Port Authority of New York and New Jersey participated in the Crescent Demonstration Phase of HELP. While some partners actively participated in the HELP program, others primarily provided funding.

Membership in HELP was open to any state that contributed financially to support the program and involved participation by both a state representative and a representative from a state-associated motor carrier industry. The state participants played a role in funding, implementing, operating and maintaining technologies within their states during the testing phase. Motor carrier representatives were involved at early stages in anticipation of their importance later during deployment.

The FHWA provided funding and technical assistance to the program, aided the program evaluation, and made sure HELP's goals were aligned with national priorities and other projects. The Arizona DOT played the role of coordinator, recruiter, and administrator during this time period.¹²

Early Organizational Structure

The early HELP partnership was organized into a Policy Committee, an Executive Committee, and subcommittees with specific tasks. The Policy Committee developed the program's budget, approved the overall work program, and appointed the Executive Committee members. Voting members of the Policy Committee consisted of the Chief Administrative Officers or their designees from all contributing states or authorities in the program; a representative from the motor carrier industry in each participating state; and representatives from the FHWA, Transport Canada, and the Canadian motor carrier industry. The Executive Committee was to approve requests for proposals (RFPs) and consultant selection, confirm technical consultant contracting products, update the project's budget and work program, and make recommendations to the Policy Committee.

The Policy Committee selected Arizona as the lead state and Louis Schmitt as the lead state project manager. Responsibilities of the lead state and project manager included administering project funds, drafting and distributing RFPs, developing a consultant selection process, ranking proposals, and contract management. A policy consultant and management consultant were hired to assist with administrative processes.¹³

Funding

It is estimated that the HELP program and Crescent Demonstration cost over \$27 million dollars between 1985 and 1993. Direct contributions from states accounted for \$11.5 million of this total, while the FHWA provided \$5.85 million. The balance of funding came from in-kind contributions for such items as state-funded research, equipment purchases, state and industry participants' time, and manufacturers' support.¹⁴

Technical Studies

In 1985, after the completion of the feasibility study and the formation of the HELP partnership, the program entered its second phase in which a series of technical studies was undertaken to test potential elements of the HELP system. Besides testing and developing specifications for related technologies, such as Automatic Vehicle Identification (AVI), Automatic Vehicle Classification (AVC), and Weigh-in-Motion (WIM), studies were commissioned to evaluate management options, system design, and site selection for a demonstration. A motor carrier industry workshop was also conducted. Activities during this phase were guided by specific objectives established by the HELP partnership. The studies were conducted by various

consulting firms, university research institutes, and state agencies. The technical study phase lasted through 1988.¹⁵

Operational Test

The next major transition for the HELP program occurred when it changed from a technical research project to an operational test. Adjustments to the organizational structure and a redefining of project goals and activities transpired between 1987 and 1989 in preparation for the anticipated Crescent Demonstration. The Crescent Demonstration, which began in 1991 and lasted through September, 1993, showcased and evaluated a multi-state, integrated heavy vehicle management system which utilized the previously tested technology. Sites selected along highways I-5, I-10, and I-20 through Washington, Oregon, California, Arizona, New Mexico, and Texas, and two sites in British Columbia, Canada, were equipped with WIM/AVC and AVI systems for the demonstration. A computerized communications system was developed to link the sites.¹⁶

Organizational Changes

The Crescent Implementation Group (CIG) was created within HELP to guide the planning and implementation efforts for the Crescent Demonstration. Its members comprised government and industry representatives from each state along the Crescent route. A Crescent Demonstration Project Manager who also served as Chairman of the CIG was appointed. The CIG was formally charged with setting the goals and objectives of the demonstration, defining the demonstration applications, selecting demonstration sites, and selecting and monitoring the designated Crescent Demonstration Operator. Additional organizational changes involved the transfer of some of ADOT's previous responsibilities to the California Department of Transportation, which had been selected as the lead state for the operational test.¹⁷

Another important organizational feature of the Crescent Demonstration was the decision to use a turnkey systems integration and operations contract. This would retain a single contractor responsible for the following:

- Design and provision of a computerized communication system;
- System integration of the communications network and the WIM/AVC and AVI equipment;
- Development and implementation of applications software;
- Maintenance, training and support of the integrated system; and
- Operation of the system through the Crescent Demonstration.

Lockheed Integrated Solutions Corporation was selected out of 12 respondents to an RFP issued to 125 vendors in May, 1989. After negotiations with HELP, Lockheed was awarded the contract in March, 1990.¹⁸

Goals and Objectives for Crescent

Crescent goals were recommended by the CIG and adopted by the Policy and Executive Committees in 1988. The goals, in order of priority, were to:

- Improve institutional arrangements,
- Assess the viability of the technology in the highway environment,
- Measure efficiency and productivity gains, and
- Identify additional applications for technology.

Objectives were established within each goal to provide developmental guidance.¹⁹

The CIG also defined appropriate technology applications for the Crescent demonstration. These included: state data collection; carrier data collection; weight enforcement programs; fixed-site weight screening; and automatic clearance for weights and lengths, registration and operating authority, safety inspections, and permits. “Enhanced applications” were also identified as possible future applications for HELP technology. Two of these applications, mainline vehicle screening and congestion monitoring, later became part of the Crescent Demonstration.²⁰

The goals and potential applications established for Crescent were far broader than the original data collection tool envisioned in 1983. Since that time, additional technology and new applications for the technology had been added to the HELP agenda. In addition, the Crescent Demonstration began a new focus on technology deployment issues. It examined institutional issues and barriers to program deployment, including organizational structure, incentives and risks for participants, and relationships between the participants.

As the objectives of the HELP program broadened in scope, participants’ expectations of the system grew. State participants cited increased efficiency, reduction of administrative burden, and better resource allocations as the primary benefits they hoped to gain from the HELP system. They believed the system would assist area law enforcement and aid in tax collection. Overall, they expected that the HELP system would increase safety and relieve congestion around weigh stations and points of entry.

The trucking industry saw HELP as a means of leveling the playing field between large and smaller carriers. They believed their efficiency and productivity would be increased by

having the ability to monitor truck location and speed. They also hoped to save time in-route with the automatic clearance capabilities.

Institutional Issues Identified Through the HELP/Crescent Evaluations

An evaluation process is vital to any experiment and was part of the original plan for Crescent. An Evaluation Committee (originally three separate committees, but later combined into one) was established which was responsible for developing an overall evaluation plan and monitoring evaluation activities. In 1992, the Evaluation committee appointed a Crescent Evaluation Team of consultants to plan and perform an independent evaluation of the demonstration project. The evaluation reports, produced in 1994, featured analysis of the system's technical elements and an overview of participants' experiences with the system. The latter were presented in state and motor carrier case study reports. Overall, the HELP system technologies and computer system were judged to be adequate and presented no significant barriers to the implementation of HELP applications, though recommendations were made for improvements.

Six states participated in Crescent, and, within each, a number of different departments and agencies were involved. For the state participants, it was found that institutional policies and turf issues were major barriers to successful application of HELP or any other IVHS system. Interjurisdictional cooperation between state agencies - especially planning agencies, permitting agencies and commercial driver's licensing agencies - was judged to be critical to HELP's success and often difficult to achieve. Also, certain state agencies - typically operating authority, taxation, and enforcement agencies - considered their data to be proprietary and were concerned about relinquishing control of it. Participation of state staff in HELP had greatly improved cooperation, but continued joint activities were considered necessary to maintain those gains. The need for technical standards to protect state investments and facilitate data sharing was recognized. Finally, it was concluded that state agencies would require more detailed analysis of benefits and costs before investing in HELP applications.

Trucking industry participation was crucial to the demonstration. Without the active participation of the 4700 commercial vehicles that received transponders, the demonstration would not have been possible. Motor carrier representatives were also involved in HELP program planning and evaluation. Though carrier views varied considerably based on the nature of their operations, most perceived that bypassing functions were the only HELP application that could provide significant benefits to them. They found little useful information in the Crescent data base and showed little interest in on-line access to it.²¹

Other studies also evaluated the Crescent Demonstration. Of note is the Volpe Center's 1994 *IVHS Institutional Issues and Case Studies* report on HELP/Crescent. Through interviews

with involved personnel, this study identified a number of institutional problems encountered and how they were handled. Following is a summary of the findings:

- **Lack of Trust – Relationships between the trucking industry and state regulatory agencies** have traditionally been tense. This led to early difficulties recruiting motor carriers into the HELP program. At one HELP annual meeting, truckers were vocal about their perception that they had no voice in the project. A “motor carrier charter” resulted which called for participation by motor carrier representatives on committees and subcommittees. Though some feel that problems remain between the states and truckers, final vehicle enrollment rates in HELP significantly improved over the course of the demonstration, pointing to an improved relationship between the trucking industry and the states.
- **Concerns about “Big Brother”- Some truckers were concerned that the AVI technology was just a way for the government to initiate weight/distance taxes.** Some drivers were also worried that the transponders would allow companies to track all their movements and could be used against them (for instance, to prove use of excessive speed). These issues impeded carrier recruitment.
- **Concerns about Data Confidentiality – Some state agencies and trucking firms feared that their confidential data would become public with the HELP system.** This issue was resolved with the selection of a third party contractor responsible for data collection, storage, and reporting requirements.
- **Lack of Member Continuity and Commitment – A number of states were censured for their lack of commitment to the HELP program.** Complaints included a lack of representation by industry champions, poor selection of members, and poor assignment of responsibilities. HELP’s goals required involvement of high-level decision-makers from states and industry. Frequently, this did not occur. In addition, HELP activities were often secondary because participation was voluntary, and those involved had other responsibilities.
- **Lack of Clarity in Roles and Goals – Throughout the course of the HELP program, different states and organizations assumed leadership for different parts of the project.** Though this had some positive aspects, it also created leadership voids at times and led to confusion about roles and responsibilities.
- **Poor Coordination – Lack of coordination within state agencies was judged as big of a problem as coordination between the states.** Internal coordination between disparate organizations, such as law enforcement, the department of motor vehicles, tax and revenue collection agencies, and other departments, was quite challenging.

- **Lack of Goal Clarity** – The evolution and articulation of goals was seen by some as a major problem. Originally, HELP/Crescent's goals were to demonstrate the feasibility of different technologies, but over time, they evolved to become more comprehensive in the creation of a *system*. Many participants blamed FHWA, due to its tendency to oversell program goals to justify the government's contributions. Some also claimed that the federal government never understood or embraced HELP's original plan to test technologies separately.
- **Lack of a Standard** – The need for a technology that could be compatible across all states and meet each state's unique regulatory requirements was seen as a major challenge for HELP. Participants believed that a nationwide IVHS architecture must address this issue.

The Volpe report also projected that motor carrier recruitment, intra-agency and interagency cooperation, market uncertainty, and cost sharing could be problem areas in future HELP program phases. It recommended that a full-time staff be hired to manage HELP and that a public relations campaign be launched.²²

Transition to HELP, Inc.

With the conclusion of the Crescent demonstration in September of 1993, the HELP program was officially complete. A new institutional arrangement would be necessary to fund and carry on the activities of the HELP program, which was desired by many partners. Help, Inc. emerged and became the official HELP program manager on October 1, 1993. HELP, Inc., a non-profit agency, provided a streamlined decision-making structure which would ease contracting authority, focus operational authority, and be able to receive federal, state, and private funds.²³

The decision to retain Lockheed as the sole-source franchisee was an important early resolution of the new organization. At a March 23, 1993, Board meeting, participants discussed the issue of system management and decided that management by a single contractor, provided through a franchise agreement, would be the best option for HELP, Inc. This would help standardize system operations throughout the various states. Because LMIMS had been awarded the Crescent Project contract through competitive procurement and had successfully completed the effort, the HELP, Inc. Board felt justified in negotiating a sole-source franchise agreement with LMIMS. The original franchise agreement between the two parties had a term of seven years and included a clause allowing either side to terminate the agreement. In 1997, the agreement was extended until 2020.²⁴

CURRENT INSTITUTIONAL ISSUES

Carrier Attraction and Retention

HELP, Inc.'s future rests on its ability to attract and retain motor carriers, since user fees from the carriers are required to support the system. Recent trends look positive, with the number of HELP transponder equipped vehicles at 64,000 and increasing rapidly.²⁵ PrePass marketing efforts appear to be paying off, and the response from the trucking industry has been positive, as evidenced by several recent articles and publications extolling the virtues of PrePass.

However, as alternative systems which do not require a user fee begin to gain strength, the HELP system may suffer. A case in point is the United Parcel Service's decision in 1995 to abandon HELP in favor of Advantage CVO (at that time Advantage I-75).²⁶ HELP, Inc. and LMIMS will have to maintain their marketing efforts in order to avoid future defections and continue the system's present growth.

Market Expansion

Expanding operations into new states and markets is essential to HELP, Inc.'s future interests. In order to produce a return on LMIMS's investment, the partnership needs to maintain a strong customer base and develop and provide additional services. The program has launched an active marketing campaign to augment its customer base. HELP's marketing agenda involves increased presence at national and regional meetings and conferences as well as frequent contact with prospective new partners – non-participating state agencies and motor carrier groups. However, many states are still undecided about whether to align themselves with HELP, Inc. or one of the other CVO programs. Some states, such as Oregon and Tennessee, have changed alliances over time. In addition, turnover in state administrations means that commitment levels to HELP change periodically, and there is a need for constant education of officials about the benefits of the HELP system. HELP, Inc. will not only have to continue its marketing efforts, but it will also have to maintain a customer service focus in order to retain its state members.

Interoperability with Other Systems

HELP, Inc. has recently received requests from Advantage CVO to establish systems' interoperability. This would allow a motor carrier to use the same transponder for bypass services in both systems. HELP, Inc. is cautious about discussing interoperability before certain criteria have been evaluated. The HELP partners have invested significant effort into establishing a high quality product and want to make sure that interoperability would not harm their service or their ability to recoup LMIMS's investment. Some HELP leaders are concerned that the push for interoperability is coming from outside state agencies looking to expand their customer bases and not from the motor carrier industry. HELP participants are also leery of the costs that would be

required to integrate the systems and some doubt whether the bypass service industry is at a stage of development where interoperability is necessary. Board members identified three main issues that need to be resolved for interoperability between systems: 1) technology, 2) bypass criteria, and 3) the working relationships between entities. HELP's President has generated a list of questions and conditions that would be required for systems integration and plans to discuss these with Advantage CVO management before agreeing to begin work toward systems' interoperability. Among the topics for discussions are issues of cost sharing, quality of service, safety issues, data privacy, carrier enrollment, payment for transponders, and bypass fees.²⁷

Data Collection and Use

While collection of data by a third party, LMIMS, has calmed many fears about the inappropriate use of data, privacy and control of data remain primary topics of discussion. The current fear is that states will use PrePass data to hold enrolled carriers to higher standards than those carriers inspected manually. HELP, Inc. has adopted a data retention and sharing policy to address these concerns. The policy says that HELP data is collected primarily for billing purposes and for general site activity reports, which are periodically provided to state agencies. It mandates that data be stored for a limited time and also specifies that state agencies may receive from the HELP system only that data which they collect during manual inspections of motor carriers.²⁸

Mounting Debt with LMIMS

Even though HELP, Inc. is a non-profit organization, Lockheed Martin is not. Currently, HELP, Inc. has a large debt with LMIMS, which HELP expects to repay as the system expands and become more heavily used. If this expectation begins to look unattainable, increasing membership or bypass fees would have to be considered or else the possibility of LMIMS pulling out of the agreement could be actualized.²⁹

Board Involvement

In a 1998 survey of HELP, Inc. Board members, failure to adequately involve the Board members in decisions pertaining to the operation of the HELP system was identified as one of the greatest threats to the success of HELP. This problem was identified in 55 percent of the states' responses and 11 percent of the motor carrier industry's. These results reflects a feeling among the Board that LMIMS and the HELP staff are taking a larger responsibility in driving the program than desired. The survey respondents suggested several possible corrective actions, including running the system more like a business, establishing more committees and meetings to involve the Board, pursuing Board- and user-driven strategies, and establishing a new governance structure.³⁰ HELP Inc.'s bylaws were amended in March, 1999 as a result of the survey.³¹

Organizational Structure

Concerns over board involvement and rapid growth due to the addition of new states has prompted a review of the structure of the Board of Directors. In addition to questions about the Board's effectiveness, there is concern that as HELP, Inc. grows, the board will become too expensive and unwieldy to operate. On the other hand, the Board has derived its strength from participation by each state and motor carrier representative. This review was launched in March, 1998, and no findings are yet available.³²

Another organizational question is that of appropriate annual dues for states. Many states feel that the previous membership fees of \$30,000 per year are too high. At a July 14, 1998, Executive Committee meeting, members voted to decrease fees for Active Members from \$30,000 to \$27,000 per year. In addition, it was thought that some states should be able to participate in PrePass without paying membership dues. Following approval by the Board in March, 1999, Associate Members are now allowed to enter into a Memorandum of Understanding with HELP, Inc. to deploy HELP technologies without paying dues but are not given rights to vote or hold office in the Executive Committee.³³

FUTURE OUTLOOK

HELP, Inc.'s dominance in the electronic clearance market is a definite asset. The organization's aggressive marketing strategies and current policy on interoperability worry its competitors. A representative from Advantage CVO was quoted when commenting on HELP's stance on interoperability, "You don't need to worry about interoperability if your goal is to be the only system."³⁴ HELP continues to focus its efforts on marketing its current system throughout the United States.

The company is also looking into providing additional ITS services, including Electronic Toll and Traffic Management, border crossing, fleet management and tracking, and electronic clearinghouse services. HELP, Inc. even extends its vision of possible services to automated roadside safety inspections, on-board safety monitoring, advance travel information systems, roadside warning systems, and intermodal tracking systems.³⁵

SUMMARY AND CONCLUSIONS

HELP's contributions to the CVO industry and to establishing precedence for public-private partnerships in ITS are unique. HELP's accomplishments include, but are not limited to, the following:

- First major multi-jurisdictional, public-private partnership for ITS/CVO applications,

- First successful deployment of integrated, multi-state ITS/CVO system,
- Currently operates the largest electronic clearance system in the most advanced stage of deployment in the United States,
- Leverages private funds for a program that benefits all parties involved,
- Improved relationships between previously adversarial parties.

Although a number of lessons can be learned from HELP's experiences, the most important reason for studying the partnership is its unique organizational structure as a non-profit, privately funded establishment. HELP, Inc.'s status as a non-profit organization has a significant advantage over less formal partnerships. Because it has independent operating authority, HELP, Inc.'s members can make decisions collectively, and each agreement or decision does not have to be separately approved by every state government involved. Therefore, decisions can be made and activated faster, and one or more states' failure to approve a measure does not hold up progress for the entire group. In addition, HELP, Inc. is not limited by government procedures for procurement, allowing for faster implementation of technology and greater flexibility.

Another unique organizational aspect of HELP, Inc. is its funding structure. HELP, Inc. allows states to implement electronic clearance technologies with minimal funds by taking advantage of private funding sources. The program utilizes two private funding sources: venture capital from the technology supplier and usage fees from the motor carriers who benefit from the program. Lockheed Martin, the technology supplier, finances the operation by installing equipment at inspection stations, maintaining a centralized computer data base, and operating the system free of charge to states. HELP, Inc. will reimburse Lockheed through the fees it generates when trucks use the system to bypass inspection stations. Motor carriers are assessed a \$0.99 fee every time they successfully bypass an inspection station. States pay only an annual membership fee of no more than \$27,000 per year, much less than the cost of outfitting a weigh station with technology. Because states do not have to dedicate significant amounts of funding for implementing technology, deployment can happen much more rapidly. Rapid deployment means more operational sites within the system, which leads to greater benefits for motor carriers.

HELP, Inc.'s competitors argue that forcing motor carriers to pay usage fees is a form of taxation. However, with 64,000 vehicles enrolled, HELP, Inc. has significant support from the motor carrier industry. This indicates that motor carriers do not view the fee as a tax and that the value of the benefits they derive from PrePass is greater than the amount of the fee.

HELP, Inc. has an unusual relationship with its technology supplier, LMIMS, from which both sides derive benefits. LMIMS does not simply provide a product and service to HELP, Inc.

under contract, it participates as an important partner to the organization. LMIMS is financially vested in HELP, Inc. The technology which it developed and supplies to the program without up-front payment represents a significant investment. Recouping this investment depends on HELP, Inc. continuing to expand and attract motor carriers. Therefore, LMIMS assists HELP, Inc. in its marketing efforts. On the other hand, HELP, Inc. depends upon LMIMS's initial and continued investment in the program. This provides incentive for HELP, Inc. to maintain a positive relationship with LMIMS by ensuring that their needs are met. Thus, the success of the partnership is important to both parties.

HELP's history and development also provide insight for public-private partnerships. The HELP program began with a clear and concrete vision, which helped to generate early support for the program and to assist partners later on in overcoming their differences as key points of contention arose. However, this vision was not static. It changed over time from focusing on data collection and dissemination to providing a service like electronic clearance. In other words, HELP began with a vision involving one technology application; it tested the necessary technology, and ended up finding new and more useful applications for the technology. Flexibility of the partners, thorough evaluations, and involvement of many parties were keys to enabling this transition of goals.

Another key feature of HELP's development is that it evolved over many years and through many phases, starting with feasibility studies and moving into technical research and demonstration phases before becoming a commercial entity. Each transition between phases allowed HELP to evaluate itself and refine its goals and organization. In addition, the long development period gave the partners many years to work together and establish trust, while still under the auspice of federal funding, before having to make difficult decisions regarding who would pay under a self supporting system.

HELP's founders realized from the start that organization and management of the HELP program was as important to its success as developing the technology. Therefore, much energy was expended in the early stages to determine the best organizational and management structure. Management studies were performed along with technical studies, and determining participant satisfaction levels and opinions were essential to evaluation processes. These elements were also key to the success of HELP and its ability to retain its members' interests.

HELP was the first partnership to pair motor carriers with state regulatory agencies, two traditionally opposing interests. HELP's ability to form a positive working relationship between these parties is a notable achievement. Its success is hinged on inclusion of both sides throughout the development process. Special efforts were made to ensure the motor carrier

industry had sufficient input, and its needs were taken seriously. Inclusion in the development of the program was important for gaining the motor carrier industry's trust and support.

HELP, Inc. and its predecessor HELP/Crescent set a precedent for other partnerships to follow. It was able to successfully merge several diverse and competing interests and provide an integrated ITS service across many jurisdictional boundaries. HELP, Inc. is a model that many other partnerships study due to its success at leveraging private sector funds. The partnership's status as a non-profit agency and its relationship with LMIMS are keys to its success. Today, HELP, Inc. is expanding rapidly due to the quality of its program and effective marketing and has a positive outlook for the future.

NOTES

¹ HELP, Inc., "About PrePass: PrePass Status," PrePass web site [cited February 28, 1999], available from: <http://www.cvo.com/status.htm>; INTERNET.

² HELP, Inc., "Strategic Business Plan" (draft), Phoenix, Arizona, July, 6 1998, p. 6.

³ Ibid., p. 4.

⁴ HELP, Inc., "About PrePass: PrePass Status," PrePass web site [cited February 28, 1998], available from: <http://www.cvo.com/status.htm>; INTERNET; and HELP, Inc., "PrePass Grows 600%: 1998 Bypasses Top 2.5 Million," Phoenix, Arizona, December 23, 1998 (press release).

⁵ HELP, Inc., "Strategic Business Plan" (draft), Phoenix, Arizona, July, 6 1998, pp. 9-12; and HELP, Inc., "Proposed Revised Bylaws of Heavy Vehicle Electronic License Plate, Inc.," Phoenix, Arizona, August, 1998; and Gail Peters, Administrator, HELP, Inc., Phoenix, Arizona, electronic mail correspondence, April 13, 1999.

⁶ HELP, Inc., "Strategic Business Plan" (draft), Phoenix, Arizona, July, 6 1998, pp. 7-8.

⁷ HELP, Inc., "Proposed Revised Bylaws of Heavy Vehicle Electronic License Plate, Inc.," Phoenix, Arizona, August, 1998; and Gail Peters, Administrator, HELP, Inc., Phoenix, Arizona, electronic mail correspondence, April 13, 1999.

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¹⁴ Ibid., pp. 11-12.

¹⁵ Ibid., pp. 13-23.

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CHAPTER 3. ADVANTAGE CVO

The partners of Advantage CVO have established a goal to create, "by the year 2000, a nation-wide electronic network which will allow commercial vehicles to travel from one state to another without stopping at state borders to check credentials."¹ Advantage CVO's predecessor, Advantage I-75, was formed in 1990 to provide a more efficient system for the movement of commercial vehicles through the I-75/Highway 401 corridor, running from Ontario to Florida. An operational test of Advantage I-75's Mainline Automated Clearance System (MACS) for weigh station bypass was performed between October, 1995, and September, 1997, after which the program changed its name to Advantage CVO. Today, the international partnership of state, provincial, and federal government agencies and trucking industry representatives has broadened its scope to seek members from outside the corridor.

With completion of the Advantage I-75 operational test in 1997, the program moved into deployment phase. No longer granted federal funds, Advantage CVO is searching for commercial viability. However, it is taking a different approach from HELP, Inc. by relying on state funding for implementation of its programs rather than private funding. Advantage CVO believes that the success of electronic clearance and other CVO services in the United States depends on developing interoperability between the different providers. Therefore, it has actively sought interoperability agreements and partnerships with other ITS programs, including CVO, electronic toll, and border crossing systems. On July 29, 1998, Advantage CVO and the Multi-jurisdictional Automated Preclearance System (MAPS), a CVO program in the Northwestern United States, signed a charter to merge their operations. Details for the merger had not been determined at the time of this paper's publication. However, the merger, is not expected to present significant technical or managerial problems, because the two groups have similar goals and operating characteristics and already have an interoperability agreement concerning technology. Interoperability with the HELP system, which has been a goal of Advantage CVO for some time, presents greater challenges due to differences in operating philosophies between the two programs. Advantage CVO, a publicly funded and operated program, provides interesting comparisons with HELP, Inc., a non-profit corporation, due to their different approaches to CVO provision. The ability of Advantage CVO and its partners to grow and resolve their differences with HELP, Inc. will be foretelling of the future of public verses private provision of ITS services.

This chapter describes Advantage CVO's Mainline Automated Clearance System (MACS) and current operating characteristics and then examines organizational features of the program, such as leadership structure, membership and funding. A history sections follows,

which discusses the program's formation, the Advantage I-75 Operational test, and early institutional issues and problems. Later sections address current institutional issues for the program and future projections, followed by a summary and conclusions.

SERVICES

Mainline Automated Clearance System (MACS)

MACS, designed by California-based JHK & Associates, incorporates hardware with existing weigh station facilities to provide commercial vehicle electronic clearance services. Three automatic vehicle identification (AVI) readers are installed on-site: an advance reader located approximately a quarter- to a half-mile upstream of the station, a compliance reader along the highway directly in front of the station, and an exit reader on the exit ramp from the station. Some sites install mainline weigh-in-motion and/or ramp-sorter readers. A host computer at each site controls the site-operations and collects data, which is then sent to a central computer at the University of Kentucky for processing of system-wide data. The hardware also includes transponders that are installed in each truck.

As a carrier reaches the first weigh station on its trip, the truck is weighed statically or in-motion. Some states allow trucks with good weight compliance histories to bypass this initial weighing. The vehicle's credentials have been checked through the advance reader and host computer prior to reaching the scales. The exit reader relays necessary trip data, including gross- and axle- weights, bridge formula, and axle spacing, to the individual transponder where it is stored. For the remainder of the trip, as the truck approaches subsequent weigh stations, all this information is monitored as each advance reader scans the transponders of oncoming vehicles. The reader determines whether the data is acceptable and then sends distinct audio and visual signals back to the in-cab transponder to indicate whether the truck can bypass the facility or must pull-in. The compliance reader in front of the weigh station monitors all bypasses and alerts station operators of unauthorized passes.²

CURRENT LEVEL OF DEPLOYMENT

While the Advantage CVO program is in a transition from testing to commercial implementation, the program is actively functioning. Weigh stations recorded over 170,000 green lights signaled to commercial vehicles from January to June, 1998. The number of carriers equipped with Advantage CVO transponders increased to over 5,000 trucks, representing 124 trucking companies, in July of the same year. Mark IV supplied 1,000 Fusion transponders, 400 already marked for immediate shipment to awaiting carriers, while 200 new Raytheon transponder-equipped trucks joined the system to bring the carrier participation to this level.³

ORGANIZATIONAL STRUCTURE

A Policy Committee comprising one or more official representatives from each member organization and chaired by Kentucky's Secretary of Transportation makes decisions, by consensus, for Advantage CVO. These decisions are aided by the findings and recommendations of ad-hoc task forces that research issues of perceived importance to the development of the program.

While the Policy Committee serves as the decision-making and planning body, the Kentucky Transportation Cabinet serves as the lead agency for Advantage CVO. This position is a clear result of the state's role as initiator of the program. The Cabinet's responsibilities as lead agency involve program administration and oversight. All projects for Advantage CVO are contracted through the Cabinet. Among these contracts is the contract with the Kentucky Transportation Center at the University of Kentucky to provide project staffing and run the operations center. The Cabinet also serves as the treasurer of the project. All participating states sign letters of agreement with Kentucky annually and provide the Cabinet with their portion of the funding as capital to run the system.

Several consultants were employed during the early phases of the program to perform system design and act as the system manager for the operational tests. Their contracts are now finished, and they are no longer in service with Advantage CVO. The Iowa Transportation Center served as an independent evaluator over the system for the operational test.⁴ Raytheon (formerly Hughes Transportation Management Systems) provides technical services through a maintenance contract and sells transponders to the program. Delco Electronics and Mark IV make the transponders.⁵

For the present, Advantage CVO continues to function under the same organizational structure as it did for the operational test. A drawback of this structure is that no one agency can speak for the entire partnership. Agreements and policies must be approved by each state individually, which can be a slow and sometimes difficult process. However, this may change in light of the recent merger with MAPS.

MEMBERSHIP

Advantage CVO's original membership comprised public and private players along the I-75 corridor. It included representatives from the trucking industry as well as the FHWA, Transport Canada, the Province of Ontario and the six states along the corridor: Michigan, Ohio, Kentucky, Tennessee, Georgia, and Florida.⁶ Today membership is open to other states, not along the corridor, and Tennessee has left the program to join HELP, Inc. At a July 29, 1998, Policy Committee meeting, official invitations for membership in Advantage CVO were given to 13 trucking as-

sociations and 7 states: Indiana, Louisiana, Maryland, Missouri, North Carolina, South Carolina, and Virginia.⁷

Each partner state or province has one official member on the Policy Committee, but representatives from other state agencies with jurisdictional interests can attend all meetings. Other members include three representatives from the Federal Highway Administration (Washington, D.C.; Region IV; and Region V) and one from each of the following: Canadian Ministry of Transport, Transport Canada, American Trucking Associations, National Private Truck Council, National Automobile Transporters Association, Ontario Trucking Association, United Parcel Service, Frito-Lay, and Roadway Express.⁸

State membership in Advantage CVO entails entering into a Memorandum of Agreement with the lead state agency, the Kentucky Transportation Cabinet, and allows the member representation on the Policy Committee. Member states pool funds for the management and maintenance of the MACS system according to the number of MACS equipped sites in each state. Each state is financially responsible for equipping its own weigh stations with electronic clearance technology compatible with the MACS system and for maintaining this equipment.⁹

FUNDING

Advantage I-75, at the time of its operational tests, was one of the FHWA's flagships in advancing ITS/CVO. Therefore, operational costs were funded by the U.S. government at about 70 percent of the \$12 million project total, with states chipping in 17 percent, Ontario 5 percent and a private source (Science Applications International Corporation) providing the remaining 8 percent. The carriers were not responsible for any participation cost during the operational test; transponders were provided to those drivers who volunteered for the service.¹⁰

Currently, as Advantage CVO has finished its operational test and moves toward commercial deployment, federal funding is no longer available and the cost-sharing has changed. The states have taken over the entire cost of the equipment, installation, maintenance, operations, marketing, and other program management costs. The carriers still pay no participation fees but are responsible for the costs of the transponders (\$45).¹¹

HISTORY AND DEVELOPMENT

Advantage CVO began as an FHWA-sponsored operational field test known as Advantage I-75. The program changed its name to Advantage CVO in 1997, at the end of the operational test as the program moved into wide-scale deployment.

Formation

The initial concept of Advantage I-75, to allow transponder-equipped and properly documented trucks to travel any segment along Interstate 75 at mainline speeds with no more than a single stop at weigh/enforcement stations, was proposed by the Kentucky Transportation Center in response to an FHWA request. Development of this concept into an operating project began with discussions between FHWA and Kentucky transportation officials, including Leon Larson (FHWA Region IV Administrator), Calvin Grayson (Director, Kentucky Transportation Center), and Don Kelly (Kentucky Transportation Cabinet). The concept was refined and a management plan and activities timetable developed between March, 1990, and May 10, 1990, the date of the first meeting involving government agency and motor carrier representatives from corridor states. This was followed by a conference sponsored by the FHWA in June of that year to generate support from potential partners and to discuss the management, technical, and financial aspects of the project. The Kentucky Transportation Center then used the proceedings from the conference in a project proposal, submitted to the FHWA at the end of 1990 and approved for federal IVHS operational test funding in 1991.¹²

Two early actions were important to the Advantage I-75 Partnership. First was endorsement by the governors of the states involved in the program. Six state governors and the lieutenant governor of Ontario signed a resolution supporting Advantage I-75, an action that gave confidence to some reluctant partners. Secondly, a committee was formed which researched possible institutional barriers to deployment of the MACS system. Once identified, actions were taken toward resolving many of the issues. Legal obstacles were the primary concern. Therefore, legal counsel was sought from each of the states' attorney generals who replied unanimously that the project would not violate any laws.¹³

Early Partners and Organizational Structure

The organizational structure and membership of Advantage CVO and its predecessor has changed little over its lifetime. Therefore, the organizational structure described previously for Advantage CVO also describes the early Advantage I-75 program. One notable change in membership is Tennessee, who was a founding member of Advantage I-75 but has since left the program. There have been a few changes in the industry participants.

Operational Field Test

Following the procurement of contractors for system design, system integration, and for the production of AVI transponders, the operational test formally began in the 1994 with a pilot test of the technology on four weigh stations in Kentucky. The second stage of the test involved technology application at 29 weigh stations, every one from Southern Florida to Detroit and the

first seven in Ontario. Ten of these were equipped with mainline WIM. This two-year test began in October, 1995.¹⁴

Goals and Objective for the Operational Test

The founders' original intention for Advantage I-75 was to make the project functional as quickly as possible so it could begin to demonstrate its potential. Therefore, they developed the following objectives for the program:

- Work within the existing institutional framework to the maximum extent feasible;
- Use off-the-shelf technology which meets the most appropriate "open" specifications available at time of procurement;
- Work towards immediate implementation;
- Require no changes in state statutes; and
- Share funding among the participants.¹⁵

Institutional Issues Identified During the Operational Test

The Volpe Center's IVHS Institutional Issues and Case Studies Report on the Advantage I-75 operational test uncovers a number of problems encountered in the early stages of the program's development. These are summarized below:

- Contractor Relationship Problems – An imprecise, fixed-price contract, coupled with an uncooperative systems integration contractor, led to delays, additional costs and increased liability for the states. The lack of clarity and specificity in the contract opened the door for debate concerning the contractor's scope of work and other functional points. The contractor was accused of not taking the project seriously, failing to meet the schedule for deliverables, dedicating insufficient staff and attention to the project, and, in general, lacking an attitude of trust, cooperation, and commitment. Problems eventually led to a stop work order, after which the contractor pledged a new commitment to the project and installed a new project team. However, before work could resume, lengthy contract negotiations pursued, and some participants never felt the issues were resolved.
- Conflicts with FHWA Headquarters – The FHWA Headquarters was not involved in the early planning stages of the program in which the scope of work was determined. After becoming involved in the operational test, the FHWA Headquarters wanted to change certain elements of the program, namely the technology to be used and the evaluation process. While the program founders intended to use existing technology to speed deployment, the FHWA felt that some of this technology was outdated and was not compatible with national priorities. A compromise was reached in which the contractor was required to provide a minimum accept-

able standard but would receive incentives for supplying a higher level of technology. The FHWA also felt that the program's original plan, to internally conduct a basic evaluation of the system, was insufficient. It wanted a more thorough evaluation conducted by an independent agency. The Iowa Transportation Center, an outside state university affiliate, was chosen, and the FHWA agreed to pay all additional evaluation costs.

- **Communications Problems** – A communications hierarchy, which required program staff to communicate information through the Kentucky Transportation Cabinet to the FHWA divisional offices which then reviewed the information before passing it on to the FHWA headquarters, led to complaints about the speed and accuracy with which information was disseminated. Many Policy Committee members were also dissatisfied with the communications procedures employed. As a result, the MACS FAX was developed as a tool to aid communication.
- **Size and Structure of the Policy Committee** – With 23 original members, the Policy Committee was large, and meetings often became unwieldy and unfocused since there were no limits placed on participation by outsiders. This led to the resolution that only Policy Committee members or their official designees would have permission to speak during meetings. There was also debate about whether some states whose motor carrier-related functions are divided between multiple agencies should be able to have more than one representative on the Policy Committee while other states had only one representative. It was decided to allow multiple representatives in order to encourage participation from all parties involved in trucking regulation. States with single representatives feared they would lose clout with this arrangement. However, this has not occurred, and most participants view the decision positively.
- **Inappropriate Policy Committee Representation** – Despite efforts to identify Policy Committee members with appropriate levels of interest, expertise, and political clout and who would be available for the duration of the project, some of the early representatives did not meet this description. Project delays were avoided due to extra efforts by the system design contractor who helped states designate and commit appropriate resources.
- **Regulatory and Enforcement Differences** – The partner states each had different statutes and procedures regarding regulation and enforcement. This became a problem with respect to two Advantage I-75 founding principles: that trucks would have to stop at a weight/enforcement station only once in the corridor, and that no state would have to change its laws in order to participate in the program. It was decided that for this project only, a truck meeting the criteria of the state in which it entered the corridor would be allowed to pass

through the other states. The earlier endorsement of Advantage I-75 by the state governors was credited as an important catalyst enabling this key compromise.

- **Motor Carrier Skepticism** – The motor carrier industry was leery of working with state regulatory agencies and was skeptical of the benefits they would derive from the program. These fears were compounded by the fact that the lead state, Kentucky, had a weight-distance tax. A large amount of campaigning and educational effort from program leaders, coupled with the trucking industry's realization that the states could institute the program regardless of the trucking industry's support, eventually won-over skeptics.
- **State Apprehension** – Not all states were eager participants in the Advantage I-75 project. Many states failed to understand the program's potential benefits and were reluctant to join. Support from the state governors and other high-level administrators was key in overcoming this reluctance. Another factor that won some state supporters was the fact that Advantage CVO had the ability to extend the useful life of weigh stations, which were expensive to replace.
- **Liability Concerns** – Liability concerns arose when the stop-work order was issued for the systems integration contractor. This was a particular concern for FHWA, who would be liable if the contractor decided to sue. However, litigation was avoided.¹⁶

CURRENT INSTITUTIONAL ISSUES

Commercial Viability

Advantage CVO is at a difficult stage of its existence, transitioning from a federally-supported operational test to an ITS service provider. The new organization must wrestle with issues of funding, marketing, working with new partners, setting up an organizational structure amenable to deployment rather than testing, and competing with other programs.

Advantage CVO operates under the philosophy that states should pay for the infrastructure elements of the program, while motor carriers should be responsible for transponders. Although this is consistent with traditional roles of government and private parties in transportation, some state governments are reluctant to put forth the funds required to implement the system. The 29 sites in operation as of April, 1998, were installed during the Advantage I-75 operational test using mostly federal funds. Few states have stepped forward to install sites using their own funds. Advantage CVO's future depends on states' willingness to fund the program from their own coffers. With increasingly tight state budgets, this could be a hard sell for Advantage CVO.

Based on HELP, Inc.'s experience, marketing is an important aspect of program expansion. Since the operational test involved only those states along the I-75 corridor, Advantage CVO must now introduce its service to outside states. An effective strategy and funding for mar-

keting to state agencies and motor carriers will be necessary to achieve this and attract new members.

The organizational structure of Advantage CVO has changed little since the operational test, despite the program's changes in focus and funding. Ideally, the structure of an organization will support the primary goals of the organization and encourage certain activities. For instance, many organizations correlate decision-making power with the level of funding that members provide. Advantage CVO is in the process of examining alternative organizational structures. Its merger with MAPS will invariably lead to changes within the organizational structure. However, it is not clear as to exactly what those changes will entail.

Advantage CVO sees itself as a viable alternative to HELP, Inc. for those states who wish to own and operate their own systems and do not believe in placing the burden of payment for the system on the trucking industry. It believes that the two programs, and possibly others, can co-exist without vying to place each other out of the market. However, the two programs are still competing for state and trucking company participation. Trucking companies are reluctant to buy multiple transponders or to pay for different systems. Therefore, they generally choose the program that offers them the greatest benefits in terms of location, cost, and expanse. Geographically larger systems give motor carriers greater range. At the same time, the number of motor carriers involved will influence states' decisions about which program to join because their systems will be utilized to a greater extent if more carriers are involved. Therefore, additional state membership is desirable for both programs. Despite competitive forces, Advantage CVO believes that both programs can exist in harmony if they make their technologies interoperable. This would allow trucks to use either system with the same transponder, in effect alleviating the competition between programs for motor carriers.

Interoperability with HELP, Inc. and Other Systems

Advantage CVO believes the success of bypass programs in the U.S. depends on making the various systems interoperable. This would allow a motor carrier registered with one system to use other systems without having to register with those systems or having to obtain separate transponders. For the states, it would mean more trucks would have access to their systems. Interoperability would require the different systems to use compatible hardware and software and to share information, such as transponder codes. Advantage CVO sees great benefits to both motor carriers and its member states of achieving interoperability between its system and others, and has therefore pushed for interoperability agreements with HELP, Inc. and other ITS service providers.

Advantage CVO and HELP, Inc. began talks about interoperability at a July 9, 1998, meeting in Nashville. The two systems use the same transponders and are technically compati-

ble, according to Advantage CVO personnel.¹⁷ However, HELP, Inc. remains skeptical of the idea as explained in Chapter 2. HELP, Inc. is concerned with control issues over data privacy, carrier enrollment, and system quality as well as the costs involved, and it questions the need and motivation for interoperability. HELP, Inc.'s position is that the individual systems should concentrate on building their own customer bases through marketing instead of sharing customers through interoperability.¹⁸ Advantage CVO has been frustrated by HELP, Inc.'s lack of enthusiasm for interoperability, but vows to keep pushing.

Advantage CVO also initiated discussions of interoperability with the Inter-Agency Group (IAG), a consortium of toll collection agencies in Delaware, Maryland, New Jersey, New York, and Pennsylvania. Both parties are eager to provide interoperability between their systems, allowing trucks to use the same transponders to participate in both programs. The IAG has already performed tests on Advantage CVO transponders in their system and is working to identify and address institutional issues related to interoperability. They have also agreed to help market the Advantage CVO program to motor carriers.¹⁹

Merger with MAPS

On July 29, 1998, representatives from Advantage CVO and MAPS agreed to merge their organizations into a new partnership for electronic screening in North America. Fourteen entities, including states, provinces, carrier organizations, and trucking companies, signed the original organizing charter. At least fifteen states and provinces are expected to join the new partnership. The mission of the partnership, according to the charter, is "to enhance highway safety by promoting the growth of voluntary, interoperable electronic screening systems for commercial vehicle operations throughout North America." A working group was formed at the July 29th meeting to develop the details of the partnership based on the goals and operating principles agreed to in the charter.²⁰ The merger will give the partners greater leverage to compete with HELP, Inc., which currently has 55,000 vehicles enrolled²¹ compared to Advantage CVO's 5,000.²²

The merger follows a January, 1998, agreement for interoperability between Advantage CVO and MAPS. The two organizations are technically compatible and have similar philosophies about operating electronic clearance services - that states should be responsible for infrastructure and motor carriers for transponders. The programs agreed to develop a common application form and single point of contact for carriers to enroll in both systems, to allow carriers to use transponders from either program, and to share transponder codes upon request by carriers. They also agreed to develop a single set of criteria for weigh station electronic clearance.²³ Having already established interoperability criteria eased the merger process.

Varying Member Participation Levels

One of the main barriers to the success of the Advantage CVO program is that there is a lack of consensus in members' future involvement in the system. Several states, such as Georgia and Kentucky, have fully committed to the program, citing benefits in enforcement for state-wide deployment and active carrier participation. Other states are not so dedicated to the program and participate with minimal deployment and a "wait and see" attitude. Though the trucking companies and organizations have been supportive of the program, additional participation is needed to make it truly successful.²⁴

Integrating New States into the System

Until recently, Advantage CVO has involved the only states along the I-75 corridor. Now, as the organization welcomes new state member, integration of these new members could potentially be problematic. As more states join the system, their individual requirements and regulations for granting clearance deviate from the other states'. Two alternative approaches have been identified to address the problem: 1) to allow flexibility within the system enforcement, hardware, and software or 2) to work toward a national standard for bypass operations that would allow for truly seamless borders. Both solutions present problems in reaching the desired result; the first would not alleviate the problems of different standards for trucks traveling through multiple states, and the second faces problems with negotiating such a standard.

Data Privacy

While Advantage CVO has not received any outside requests for data collected by the system, privacy of that information is still of utmost concern to carriers. Therefore, the system operator retains only the same information that was traditionally kept at weigh stations. Truckers' primary concern is that recording of their movements at every station allows enforcement to investigate trips more closely on issues such as time and length of travel per day. This is most important in states such as Kentucky where carriers are taxed according to weight-distance statistics. Tighter enforcement would perhaps lead to more taxation and citation, or disqualification of carriers from the system based on their service records. This apprehension appears to be lessening as truckers realize the benefits of automatic clearance. Advantage CVO did not have a formal data policy until it entered an interoperability agreement with MAPS.²⁵

Integrating New Services into the System

Integrating new services into the system may be a necessity to survive in markets outside the I-75 corridor where bypass operations may not be of top priority. Advanced traveler information systems and electronic tolling have become important aspects of intelligent transportation systems. Integrating these and other components into the system could provide future challenges for the program.

FUTURE OUTLOOK

As Advantage CVO works out the details of its merger with MAPS, some points about the new organization remain unclear. Both parties assert their dedication to a voluntary, state-funded electronic screening system that does not rely on pay-per-pass revenues. However, the organizational and funding structures of the partnership have not been determined. Transponder marketing and system expansion are first orders of business for the new partnership.²⁶ In addition, Advantage CVO representatives have expressed their interest in continuing to seek interoperability with other electronic clearance systems and electronic tolling authorities. The program does not intend to be the only electronic clearance provider in the U.S. but believes that states should be able to choose the system which best fits their needs, and that this can best be accomplished by making all available systems interoperable.

SUMMARY AND CONCLUSIONS

Advantage CVO, with its state financed system, provides an alternative to HELP, Inc.'s pay-per-pass electronic clearance system. The two organizations have fundamental differences in their philosophies about government and private roles in regard to electronic clearance. Advantage CVO takes the more traditional approach - that government, in this case state government, should be in charge of transportation infrastructure while the private sector is responsible for vehicle components. Therefore, its system is based on states footing the bill for installation, operation, and maintenance of all equipment necessary for electronic clearance, except for transponders, which motor carriers must purchase. Advantage CVO personnel believe that over time states will come to accept the costs for electronic clearance, just as they have for ramp-sorting and other technology upgrades. However, currently operational sites were all installed using federal funds during the operational test, and few states have been quick to install new sites with their own funds. The program's future depends on states' willingness to invest their own money in the system. On the other hand, HELP, Inc.'s program depends on securing private funds. The abilities of each program to maintain and capitalize on their different sources of income will provide insight into the future for private versus public provision of transportation services.

Another fundamental difference between Advantage CVO and HELP, Inc. is that the former does not believe that one system will or should dominate the market for electronic clearance. It believes that states should have a choice in what programs they deploy, and that carriers should be able to travel seamlessly, using the same transponder, through states with any system. This depends on interoperability between various systems, which has been a major focus for Advantage CVO. It has already formed interoperability agreements with two other systems, MAPS (prior to merging with the organization) and IAG, but has met resistance from HELP, Inc. HELP,

Inc.'s stance against interoperability in favor of competition for motor carriers was one factor behind the recent merger of Advantage CVO and MAPS. The organizations have similar operating philosophies and believe that together they will have better leverage to compete against HELP, Inc.

Advantage CVO shares many similarities with HELP, Inc. in its development. Like HELP, Inc., Advantage CVO began as an operational test instigated by state agencies and funded with a combination of state and federal resources. Support from senior officials was important for garnering state and motor carrier commitment to the program in its early stages. Motor carrier industry representatives were involved with the program from the beginning, but were initially distrustful of the states' motives. Reaching agreement and coordination of entities involved in trucking regulation within and between states posed difficulties. Data privacy remains a primary concern for both programs.

Advantage CVO is now at a transition point in its development. Its operational test was completed at the end of 1997, and, since that time, the organization has been contemplating alternative organizational structures and policies. In July, 1998, Advantage CVO agreed to merge with MAPS, an electronic clearance program in the Northwestern United States. The details of the new partnership have not been determined, but both programs are committed to providing a voluntary electronic screening program that is interoperable and does not require fees from truckers. They are seeking to expand into new states and market to new carriers. The success of the new partnership in competing with HELP, Inc. will determine the future of electronic clearance in North America, whether a privately-funded system will come to dominate the market or whether some states will continue to pick up the tab for infrastructure investments.

NOTES

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CHAPTER 4: I-95 CORRIDOR COALITION

"We can do things together that we can't do alone," is a quote that the I-95 Corridor Coalition (the Coalition) has adopted to describe its purpose.¹ The I-95 Corridor Coalition is a multi-modal partnership of over 40 government agencies and private organizations from 12 states along the highly congested and confined I-95 corridor in the Northeastern United States. The Coalition's mission and vision, written below, best characterize the partnership.

Mission. "We are working together to implement improved transportation efficiency and services in the Northeast Corridor and to create a seamless, multi-modal, state-of-the-art transportation system."

Vision. "We are a pioneering partnership of public agencies, toll authorities, and industry associations working together to coordinate Intelligent Transportation Systems (ITS) in the Northeast Corridor. Our goals are to improve mobility for people and goods, enhance safety for all travelers, and improve the economic vitality of the region. We strive to add value to the activities of member organizations by leveraging resources, sharing information, and coordinating programs. While helping shape the national ITS agenda, we focus on corridor needs and members' objectives in order to develop practical and implementable standards and interoperability criteria. We will increase the Coalition's diversity by becoming more multi-modal and intermodal in the movement of people and goods and by fostering public/private partnerships."²

Unlike HELP, Inc. and Advantage CVO, the I-95 Corridor Coalition is not focused on providing a specific CVO service, such as electronic clearance at weigh stations. Instead, the Coalition works to enhance and coordinate the existing ITS programs of its member institutions. Therefore, facilitating communication, providing training and serving as an information clearinghouse are important roles of the Coalition, as well as sponsoring technical studies. The I-95 Corridor Coalition also has a much broader scope than the other programs discussed because it covers many ITS applications, not just CVO programs.

The diversity of partners and programs within the I-95 Corridor Coalition mandates calculated organization and planning. The Coalition has met this challenge through its annually updated business plan, which is a strongpoint of the organization and a focus of this paper. The Coalition is also in the process of examining alternative organizational and financial arrange-

ments, and deciding what model (HELP, Inc or Advantage CVO) to follow for its CVO program. It's decisions on these issues will be important for the future of public-private partnerships in ITS.

SERVICES AND PROGRAMS

In the first five years of the Coalition's existence, from 1993 to 1997, the Coalition sponsored 25 separate projects and 14 operational tests. The projects ranged from such titles as "Incident Management – Detection, Response and Operations;" "Commercial Vehicle Operations;" and "Traveler Information Services" to "Training Program" and "Intermodal Forum." Operational tests included "Highway Advisory Radio," "CVO Electronic Clearance," and "Dedicated Short-Range Communications," among others.³

In late 1997, the Coalition adopted a new business plan that categorizes projects into 8 functional program tracks and aligns program tracks with specific strategies identified in the strategic plan. The eight program tracks are

1. Agency support,
2. Inter-regional multimodal travel information,
3. Coordinated incident management,
4. Commercial vehicle operations,
5. Intermodal transfer of people and goods,
6. Electronic payment of services,
7. Coalition support services, and
8. Emerging issues.

These program tracks support the following 4 strategies:

1. Provide organizational and technical support among member organizations' ITS programs;
2. Add value to members' ITS programs and increase customer benefits through coordination;
3. Secure funding to support Coalition programs and support services; and
4. Influence the national ITS program in support of corridor goals.

For each program track, the business plan identifies an objective statement and detailed five-year vision. It also lists activities (projects) currently underway and activities forecasted for the next five years.⁴ The Coalition's activities are numerous. While the services and operational

tests described in the next sections represent some of the more prominent activities, they are not a complete list of all the Coalition's functions.

Current Services

Although a number of the Coalition's projects remain in test phase, several services are currently available. These are described below.

Northeast Travelers Alert Map and Coalition Web Site. The most visible accomplishment of the Coalition is the Northeast Travelers Alert Map, a map entailing construction activities, upcoming events, and typical holiday traffic problems through the corridor from Maine to Virginia. Published biannually with spring/summer and fall/winter editions, the map is distributed to welcome centers, rest stops, and truck stops along the corridor. The map is available to download from the Coalition's website, www.i95coalition.com, which also provides bi-weekly construction advisories listed by state. The website contains information and reports on the Coalition itself, project progress, and corridor and Coalition news. It also has links to the member organizations that make up the partnership.⁵

Interagency Communications. To help communicate more effectively in times of transportation emergencies, the I-95 Coalition created an Information Exchange Network (IEN), linking all Coalition states through 52 information sites. Initially devised for relaying real-time incident tracking and road conditions to state agencies,⁶ the network has expanded to support the following functions:

- Construction tracking—agencies can input data on future construction projects and planned events (i.e. sports and concerts) for system notification;
- Site-to-site messaging—agencies are provided with interagency text messaging capabilities that include a built-in address book of agencies;
- IEN archives—agencies can remove old incident and construction data from the system and directly archive it into the system;
- IEN administrative services—agencies can set default data for their sites and workstations;
- Process Watchdog—system monitors communication lines and automatically reconnects communications if lines are interrupted;
- IEN map—agencies can view conditions of multiple areas simultaneously, manually plot incidents, and see agency locations; and
- IEN help services—agencies can utilize help services containing step-by-step procedures and examples.⁷

Highway Operations Groups. The four Regional Highway Operations Groups (HOGs) are aimed at improving incident management and highway operations through increased multi-jurisdictional communication. Over 120 representatives from law enforcement and highway operating agencies participate in periodic regional meetings and annual corridor-wide meetings where they receive updates on Coalition activities and discuss highway operations issues relevant to their regions and to the total corridor.⁸

CVO Program. The Coalition's CVO program was kicked-off in December 1996 with the initiation of a formal CVO Working Group of representatives from the trucking industry and motor carrier regulatory agencies. A series of operational tests (numbers 6 through 10 described later) were funded for CVO, and the Working Group meets regularly to discuss CVO issues. Today, the CVO Working Group has over 100 members, and the CVO program has become the Coalition's largest. While it has not endorsed a specific CVO program, the CVO Working Group has discussed the existing programs (HELP, Inc., Advantage CVO and MAPS) so that its members may make better informed choices regarding CVO.

Operational Tests

The Coalition sponsored 14 field operational tests in its first 5 years of existence. These are listed below along with the amount of funding dedicated to each:

1. Information Exchange Network (IEN) - \$6,000,000 for development, \$350,000 for ongoing support of the system
2. Highway Advisory Radio (HAR) - \$1,818,154
3. National Transportation Communication ITS Protocol (NTCIP) for VMS - \$500,000
4. Advanced Traveler Information Services (ATIS) - \$2,000,000 Coalition and Coalition member in-kind contributions; private funds also used
5. Open-Ended ITS - \$750,000 (canceled)
6. CVO Automated Traveler Information System (ATIS) (Fleet Forward) - \$7500,000 Coalition funds, \$250,000 private sector funds through cost sharing
7. CVO Roadside Safety - \$1,041,250
8. CVO Electronic Registration - \$1,806,750
9. CVO Electronic Clearance - \$300,000
10. CVO Safety Management - \$427,000
11. IEN Expansion to Intermodal Operators - \$250,000
12. Corridor-Wide Surveillance – To be determined
13. Dedicated Short-Range Communications (DSRC) - \$156,846
14. Internet-Based Traveler Information Services - \$200,000⁹

The operational tests associated with CVO are described below.

Field Operational Test 6 (FOT-6)—CVO Automated Traveler Information System (ATIS) (Fleet Forward). Through a program nicknamed Fleet Forward, FOT-6 is testing the feasibility of ATIS for commercial carriers and its effects on improving carrier routing and dispatching. Fleet Forward will provide congestion, incident, weather, and routing information to motor carriers in a repackaged form. The million-dollar, two-year test was started in September, 1997, and will progress through three phases of testing: experimental deployments in urban areas where traffic data already exists, a study of current technologies, and dissemination of information from a comprehensive library of travel information.¹⁰

Field Operational Test 7 (FOT-7)—CVO Roadside Safety. FOT-7 plans to help state inspection and enforcement officers focus roadside inspections on high-risk carriers. Begun in March, 1998, the project will train inspectors and officers on pen-based and laptop computers for use in the field. Specialized decision-support and data entry software developed by the Volpe National Transportation Systems Center and the FHWA will help these officers focus their attention on high-risk carriers and also efficiently speed the inspection and reporting procedures. As the test progresses, roadside links to the FHWA's Safety and Fitness Electronic Records (SAFER) system will be integrated into the system to provide real-time access to carrier performance records, inspection reports, and out-of-service citations.¹¹

Field Operational Test 8 (FOT-8)—CVO Electronic Credentialing. FOT-8 tests the technologies and procedures necessary to streamline credentials administration. Software being developed by the American Association of Motor Vehicle Administration (AAMVA), the FHWA, and third party service providers will allow carriers to electronically apply for credentials with their state motor carrier agencies. The element of FOT-8 with the greatest potential benefit is an interstate registration clearinghouse that would allow the state agencies to share credentials information with agencies in other states without the current paper trail or reentry requirements. This process will reduce the costs and red tape of the present system and could be viable after the two-year test is completed in March, 2000.¹²

Field Operational Test 9 (FOT-9)—CVO Electronic Screening. The I-95 Corridor Coalition is taking a different approach to electronic clearance of motor carriers than HELP, Inc. or Advantage CVO. The corridor has relatively few weigh stations and ports of entry and relies mainly on mobile units operating at temporary sites. Therefore, FOT-9 is a test of mobile enforcement units using laptops, AVI readers, and machine-vision camera systems. The project is not just testing of the equipment, but the set-up of system requirements and technology specifications, including the option of piggybacking off of electronic toll transponders. The project de-

scription calls for implementation and evaluation of the technology for widespread use throughout the corridor. While the two test states—Virginia and Delaware—are expected to test the technology at fixed weigh stations, project funds have been set aside for other states to utilize the technology with mobile units.¹³

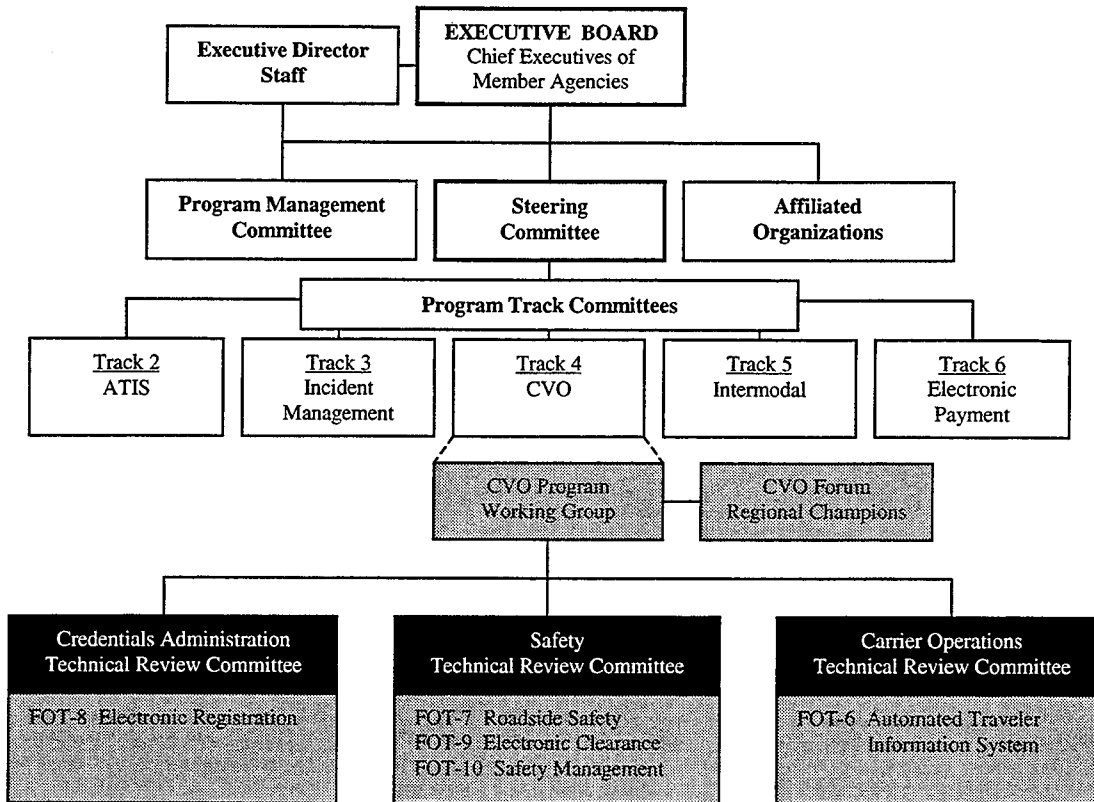
Field Operational Test 10 (FOT-10)—CVO Safety Management. FOT-10 outlines a move toward a comprehensive, performance-based motor carrier safety management program. The project is designed to complement FOT-7 and FOT-9 by creating a national model for motor carrier safety management. The I-95 Coalition hopes to incorporate performance assessments, high-risk carrier and driver inspections, analysis of truck travel patterns and accidents, accident countermeasure programs, safety compliance assurance monitoring and reviews, and industry education and outreach initiatives into this model. The goal of the test is to reduce all highway accidents and incidents within the corridor, not just those involving commercial carriers. The model hopes to utilize all the communication and data-gathering devices deployed in the other tests to help realize this goal.¹⁴

ORGANIZATIONAL STRUCTURE

The Coalition is governed by an Executive Board comprised of the Chief Executive Officer of each full-member organization and a Steering Committee that includes both policy and technical staff from each member agency. The Executive Board is the policy-making body that approves the Business and Strategic Plans and develops long-term missions and goals for the organization. It meets semiannually. The Steering Committee meets quarterly to manage all aspects of the Coalition's activities, including technical, institutional, organizational, program, funding, policy, and internal and external relations. Five program track committees guide specific programs along lines established in the Business Plan. Four staff members, consisting of an Executive Director, Contract Manager, Operations Program Coordinator, and Technical Program Coordinator are recruited from member organizations for one-year terms with the possibility of renewal. All other program participants are volunteers from member organizations and affiliates.¹⁵

The CVO Program Track is organized, as shown in Figure 3.1, into a CVO Working Group and three Technical Review Committees (Credentials Administration, Safety, and Carrier Operations). The CVO Working Group, established in 1996, oversees and directs the Coalition's CVO activities, recommends future CVO programs, designates Technical Review Committees, and recruits members into them. The Technical Review Committees are made up of members with particular interests and special skills from within the Coalition. The Committees, which are led by a chair and co-chair, oversee the operational tests within their focus areas.¹⁶

**FIGURE 4.1: I-95 CORRIDOR COALITION ORGANIZATIONAL
CHART WITH CVO PROGRAM TRACK**



SOURCE: I-95 Corridor Coalition, *Business Plan*, June 1996, p. 3; and I-95 Corridor Coalition, "CVO Program Trucking Along in the Corridor," *Corridor Clipboard*, March 1997, p. 1.

The Coalition can not execute contracts on its own. Therefore, a lead or host state agency is selected to provide procurement for each project. A partnership agreement with FHWA provides the financial means for a state Department of Transportation to arrange for procurement. The Coalition works closely with the procuring agency to prepare a request-for-proposal (RFP) package and in selection, contract negotiation, execution and oversight. The

Coalition's Contract Manager assists and directs the procurement agency with its contract management and oversight responsibilities.

Looking ahead, the Coalition recognizes that it may need to restructure its organization in order to leverage additional funds, overcome institutional barriers, and be more amenable to deployment. In 1995, it commissioned a white paper, discussed in the *Current Institutional Issues* section of this paper, to examine alternative organizational structures. However, no recent changes have been made.

MEMBERSHIP

Membership classifications in the Coalition are based on the size and function of the member organization, as opposed to a specific funding level, since there are no direct member fees for joining the Coalition. Full membership is available to any organization that operates a major regional transportation system or is an agency of the United States Department of Transportation and entitles members to representation on the Executive Board as well as all committees and task forces. Affiliate members are those organizations that operate major local systems or are transportation-related associations, such as MPOs. These members can have representation on all committees and task forces, but not on the Executive Committee. All other organizations who wish to join are classified as Friends of the I-95 Corridor Coalition and receive Coalition newsletters, notices of RFP, the Business Plan, the Strategic Plan and copies of Coalition deliverables (if requested), but do not have representation on the Executive Board or committees. The I-95 Corridor Coalition members are listed below:

- | | | | |
|---------------------|--------------------|----------------------|--------------------|
| • Connecticut DOT, | • New York City | • Delaware River | • MTA Bridges and |
| • Delaware DOT, | DOT, | Port Authority, | Tunnels, |
| • Dist. of Columbia | • New York State | • Maine Turnpike | • New Jersey High- |
| Dept. of Public | DOT, | Authority, | way Authority, |
| Works, | • Pennsylvania | • Maryland Trans- | • New Jersey Turn- |
| • Maine DOT, | DOT, | portation Authority, | pike Authority |
| • Maryland DOT, | • Rhode Island | • Massachusetts | • New York State |
| • Massachusetts | DOT, | Turnpike Authority, | Thruway Authority, |
| Highway Dept., | • Vermont Agency | • Metropolitan | • Pennsylvania |
| • New Hampshire | of Transportation, | Transportation | Turnpike Commis- |
| DOT, | • Virginia DOT, | Authority of New | sion, |
| • New Jersey DOT, | • Delaware River | York, | |
| | and Bay Authority, | | |

- Port Authority of New York & New Jersey,
- South Jersey Transportation Authority,
- AAA Foundation for Traffic Safety,
- Amtrak,
- ATA Foundation,
- American Bus Association,
- Coalition of Northeastern Governors,
- Federal Highway Administration,
- Federal Railroad Association,
- Federal Transit Administration,
- High-Speed Ground Transportation Association,
- Internat. Bridge, Tunnel & Turnpike Association
- ITS America,
- National Ind. Transportation League,
- National Private Truck Council
- TRANSCOM,
- US DOT Office of Intermodalism.¹⁷

A consultant is responsible for the dissemination of Coalition deliverables. All members of the I-95 Corridor Coalition receive one copy of Coalition deliverables through a designated contact. Non-member agencies and private organizations can also receive Coalition material by purchasing the material through ITS America or can read the summaries on the Coalition's World Wide Web site. Six reading rooms have been set up throughout the I-95 Corridor states to provide additional access to Coalition material.

FUNDING

Established with funds from the "ITS Priority Corridor Program" within the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the Coalition has depended on the federal government to finance its operations, which have cost between \$4.58 and \$9.64 million per year from 1993 to 1997. While member agencies match 20% of federal grants as required, this money, along with private sector funds, accounts for a relatively small fraction of the Coalition's income. The federal government continued its commitment to the Coalition in the Transportation Efficiency Act for the 21st Century (TEA-21) by earmarking \$5 million per year for six years starting in 1998. However, Coalition members recognize that federal funding may not always be available and, therefore, conducted a long-term financing study to explore alternative financing options, including support from other public and private sources.¹⁸ The results of this study are presented in the *Current Issues* section of this paper.

HISTORY AND DEVELOPMENT

The genesis for the I-95 Corridor Coalition was an informal group of transportation professionals working together to coordinate incident management in the region of the I-95 corridor. While limits on the region's capacity to expand transportation infrastructure made it an excellent candidate for ITS, implementation of compatible ITS systems across 28 operating agencies in 12

states along the corridor was almost impossible without a coordinating body. Recognizing this dilemma and the region's dense traffic, ozone levels, growth limits, and existing multimodal infrastructure, the U.S. Department of Transportation named the region a Priority Corridor in 1991, enabling it to receive special ISTEA funding. This led to the mandate for a partnership of agencies throughout the region to move it toward the ideal of having a seamless transportation system, which resulted in the formation of the I-95 Corridor Coalition in 1993.¹⁹ Strategic and business plans were established within the Coalition's first year of existence, and operational tests began the next.

CURRENT INSTITUTIONAL ISSUES

Future Funding

Since its inception in 1993, the I-95 Corridor Coalition has depended on federal ISTEA funds for about 80 percent of its funding. Realizing that federal funds may not always be available and the need to diversify its funding base, the Coalition commissioned a long-term financing study in 1995. The results of this study suggest that the Coalition should consider a five-tiered funding approach that involves the following aspects:

- Sell – Sell value-added services such as smart cards and CVO to customers;
- Invest – Encourage members to make a more direct financial investment in the Coalition;
- Maintain – Maintain federal funding;
- Partner – Enter into partnerships that result in additional public or private sector investments;
- Leverage – Use an infrastructure bank to leverage the funds that are available.²⁰

The plan envisions heavy reliance on federal and state funding during the first few years until the other financing options are able to develop and become feasible. Maintaining federal funding during this time period is considered possible if an effective campaign to educate federal policy-makers is launched. Collecting additional contributions from members will require working out an equitable and widely-accepted plan for members to share costs. These two funding options are considered more easily attainable and require less organizational changes than the other options.

According to the report, significant organizational barriers exist to the sale of Coalition services. The Coalition's current policy is to provide only services that add value to member organizations' current ITS programs without interfering in members' own plans and operations. Therefore, the Coalition can not control such assets as right-of-way. This leaves the Coalition with limited options for selling products. The report recommends that the Coalition redefine its customers and services to make them more amenable to product sales. This may require

changes in the strategic goals and objectives of the organization. Likewise, financing techniques that involve borrowing money or revenue-sharing agreements with partners will entail administrative and organizational changes to attract partners/investors. The report recommends that the Coalition begin addressing these issues immediately so that alternative funding sources may become viable within two years.²¹

Subsequent to the study, the federal transportation reauthorization bill, TEA-21, gave significantly more funding to ITS than previously expected. The Bill guarantees \$5 million per year through the year 2003 to the Coalition.

Organizational Structure

In conjunction with the issue of alternative financing mechanisms is the matter of organizational structure. The long term financing report recommends reexamining the Coalition's organizational structure in order to open new funding avenues with the private sector and other investors. In 1995, a white paper on organizational structure looked at a number of other programs, including HELP, Inc. and Advantage-CVO, in order to present viable alternatives for the Coalition. It came up with two basic options:

- Continue as a "virtual" organization, without legal charter, but with strong consensus from the member agencies to provide support, or
- Convert to some type of non-profit corporate organization with legal status and an increased opportunity to generate revenues from the sale of information and related services.²²

The Executive Committee met to discuss the issue of organizational structure in October of 1997 but made no significant changes.

Coordinating Programs

During its first five years of operation, the Coalition sponsored a number of disparate projects without a real focus on linking the projects into operational systems. As deployment becomes the Coalition's primary concern, it is examining ways in which programs can be grouped and coordinated for this purpose. The Coalition's policy has been to work within the existing structures and plans of its member agencies, to add value to their ITS programs without trying to alter the programs. Many of the Coalition's studies and tests have been conducted by agencies from different states, in which each applies its own state's values and structures to the project. Therefore, the project findings may be relevant for the specific state, but may not apply across the entire Corridor. To address this problem, the Coalition has undertaken a study of coordination and operational options. First of all, the study recommends concentration on the following four user service areas for deployment of Coalition programs: CVO, incident and traffic management, electronic payment, and intermodal passenger travel information. The study then identifies ac-

tions the Coalition could take to increase coordination among programs and member agencies. These are as follows:

- Increase management coordination and information exchange across projects within and across user service areas, recognizing that there is significant overlap among some areas, such as CVO, incident and traffic management, traveler information, and electronic payment;
- Increase coordination with national activities and standards development;
- Increase policy-level coordination with regional coordination programs and entities within the corridor, recognizing that coordination activities within the corridor are likely to continue to grow from regional groupings that have developed within and outside of corridor activities;
- Strengthen feedback and evaluation processes;
- Assist agencies to build better connections between management and operational staff at the member agencies;
- Reach out to include and educate new organizational participants at all levels of corridor coordination activities;
- Assist member agencies in developing and maintaining core training and technical support programs;
- Develop guidelines and protocols in support of corridor projects and seek to have them voluntarily adopted by all member agencies;
- Develop a communications system in which participating corridor organizations can exchange policy views, review documents, develop consensus, and maintain a historical record of corridor activities and decisions.

The findings of the report are to be applied in future work plans and business plans.²³

FUTURE OUTLOOK

The Coalition foresees a shift in its program activities within the next five years from field operational tests and studies to the facilitation and promotion of ITS deployment and implementation. This will engage a broader base of public and private partners including increased participation from law enforcement agencies and organizations involved in economic development, regional and local transportation, emergency services, and defense logistics. Like many organizations today, the Coalition is attempting to make its activities more outcome-based instead of output based. It will measure the future success of its programs by the Corridor's transportation system effectiveness. In addition, efforts will be refocused to address the Coalition's original and primary goal of "seamless" travel. To achieve these transitions, the Coalition realizes that it may

need to consider alternative organizational structures and funding mechanisms. It has taken steps to explore these areas. It has also recently restructured its business plan to be more strategically focused.²⁴

SUMMARY AND CONCLUSIONS

The I-95 Corridor Coalition represents a different approach to providing CVO services than the other programs studied. Instead of starting with a vision of a specific product and developing technologies and institutional structures to make that product a reality, the Coalition takes a more bottoms-up approach. It is concentrating on building the foundations for a comprehensive and coordinated ITS program. An emphasis is placed on training, facilitating coordination and planning among member agencies, and increasing interagency communication. The Coalition's program is much more holistic, examining multiple ITS functions at the same time, than the other programs, which are taking an incremental approach of starting with one basic service and later adding related services. This may help the Coalition mitigate some of the problems cited by the other programs. Building working relationships early on with other ITS programs could help states work through interagency and interstate coordination problems, making these problems more manageable when entering the CVO market. In addition, a holistic approach may facilitate the integration of different ITS programs.

On the other hand, the broad nature of the program means that the Coalition lacks a focused vision of its CVO program. A clear vision of the end product was essential to both HELP, Inc. and Advantage CVO in garnering high-level support and providing a reason for states to overcome their differences. To date, the Coalition's CVO program has consisted of a series of different projects. In addition, the Coalition has not endorsed a specific CVO program for the Corridor. Instead, it is concentrating on educating member states about the different programs and letting each decide its own course of action. These policies could hinder the rapid development of a coordinated CVO program in the Corridor.

A strength of the I-95 Corridor Coalition has been its dedication to strategic planning from very early stages. The Coalition's business plans, which were produced in the organization's inaugural year and updated annually, have played an essential role in coordinating its many partners and its multitude of programs. While the business plan started out as a list of unconnected projects, the plan has evolved over time to be better organized and in-line with overall strategic objectives.

Other characteristics of the Coalition include its reliance on federal funds for 80 percent of its program budget and its looseness of organizational structure. Although alternatives are being explored in both these areas, no significant changes have been made. While federal funding has been essential to the development of the Coalition, continued reliance on it could limit the Coalition's progress by not forcing the program to explore creative partnerships with the private

sector or between states. Not establishing these relationships or expectations early on could mean the death of the program, should federal funds ever be withdrawn.

Regardless of these factors, the I-95 Corridor Coalition has had some credible successes in its early years and has the potential to significantly impact many facets of the nation's ITS program. Many of the Corridor's programs are already setting precedents for the industry. The Corridor's density and confinement make it perfect for the application of ITS, and the testing, and development, and partnership-building that are taking place now are sure to lead to other standards of success in the future.

NOTES

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³ Ibid., Appendix B.

⁴ Ibid., pp. 9, 10, 12-30.

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¹⁰ Ibid., p. C.6.

¹¹ Ibid., p. C.7.

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CHAPTER 5. MULTI-JURISDICTIONAL AUTOMATED PRECLEARANCE SYSTEM

The Multi-Jurisdictional Automated Preclearance System (MAPS) is the newest partnership for providing integrated electronic clearance services to motor carriers that operate in the states of Idaho, Oregon, Utah, and Washington. MAPS was formed in 1996 to ensure the compatibility of electronic clearance programs in the member states and to allow trucks registered in one state access to the other states' electronic clearance systems. MAPS also provides a regional permitting program. The MAPS partnership is best characterized by the following terms of its Base State Agreement:

- MAPS jurisdictions agree to act cooperatively and provide mutual assistance toward the interoperable and efficient administration of weigh station preclearance and other related ITS/CVO activities.
- Jurisdictions will seek agreement on a uniform set of weigh station preclearance criteria.
- Jurisdictions will seek agreement on uniform standards for other ITS/CVO programs, such as those related to credentialing, carrier operations, and roadside safety processes.
- Jurisdictions agree to make information electronically collected available to other MAPS members to facilitate various ongoing regulatory enforcement activities.¹

Although the MAPS partnership is relatively new, the states involved, especially Oregon, have long histories of participation in electronic clearance and other ITS services for commercial vehicles. Oregon's Green Light Program operates the most extensive electronic clearance system within the four-state area, and serves as the backbone for MAPS. Idaho, Utah, and Oregon have a history of working together to streamline commercial vehicle operations through the IOU project. Therefore, MAPS is a natural extension of existing programs and relationships.

In the past, the MAPS states were involved with the HELP/Crescent project and HELP, Inc. to varying degrees. However, most MAPS states chose not to continue membership with HELP, Inc. for a number of reasons, which are discussed in this chapter. The MAPS electronic clearance program is similar to Advantage CVO's in that state agencies fund, own, and operate bypass technologies at weigh stations and ports of entry, and motor carriers pay an annual fee for the transponders only. Due to their similar operating philosophies, MAPS and Advantage CVO signed a charter in July, 1998, to merge their operations, following an earlier agreement for interoperability. This merger will expand the motor carrier base of both systems.

SERVICES

MAPS coordinates two primary services: electronic screening and regional permitting. Though each state is in charge of outfitting its own facilities with electronic clearance capabilities, most sites are being developed along the lines of Oregon's Mainline Preclearance System as described below.

Electronic Screening

The Mainline Preclearance System employs weight-in-motion (WIM) scales in the highway, loop detectors, and automatic vehicle identification (AVI) readers. Oncoming trucks are detected upstream of the station by induction loops, switching on a computer to store weight data from the mainline WIM scales, axle data from Dynax axle sensors, and height measurements from an over-head detector. As the truck approaches the AVI reader beyond these sensors, the carrier's transponder relays the truck's information to the reader and subsequently the weigh station where all data from the sensors and transponder are checked. Upon approval, the transponder shows a green light indicating bypass clearance and an AVI clearance reader located just upstream of the station records the bypass.² The system is fully compatible with those of both HELP, Inc. and Advantage CVO in its ability to read cab-mounted Hughes-Delco transponders, the current standard technology.³

Regional Permitting

Providing one-stop shopping for truck size and weight permits has been a priority of MAPS since its formation and is currently available in Oregon, Utah, and Idaho. It is not available in Washington because the service was formed primarily around the issuance of permits for triple-trailer operations, which are not allowed in Washington. A truck driver may obtain over-dimension permits for multiple states on his route (within Oregon, Utah, and Idaho) at the first checkpoint, avoiding the need to stop in every state to obtain permitting. States issue permits for other jurisdictions according to the requirements and costs set by the other jurisdictions. The issuance of permits is communicated between the jurisdictions via an electronic mail system. In the future, MAPS partners plan to upgrade their permitting system to meet the national architecture standards established for the Commercial Vehicle Information Systems and Networks (CVISN).⁴

CURRENT LEVEL OF DEPLOYMENT

As of November, 1998, twelve sites within the MAPS states were operating electronic clearance systems – two in Idaho, three in Utah, six in Oregon, and one in Washington. The states are continuing their efforts to bring new sites on line and plan to have the following numbers of operational sites by the end of 1999: six in Idaho, eight in Utah, 22 in Oregon, and 14 in

Washington. The MAPS states combined had issued approximately 2000 transponders to motor carriers as of November, 1998.⁵

ORGANIZATIONAL STRUCTURE

MAPS's organizational structure is considerably less complex than those of the other CVO programs in this study. This is because MAPS's sole purpose is to supply the necessary coordination between its member states' individual ITS programs in order to provide the two services described previously. MAPS is governed by an executive committee comprised of a president, vice president, secretary/treasurer and the chairperson of the industry advisory committee, a standing committee within the organization. The president and vice president serve one-year terms and the secretary/treasurer serves a three-year term. Each are elected at an annual meeting by representatives from the member jurisdictions. The executive committee meetings, which take place quarterly, have open attendance policies, and generally, representatives from each government jurisdiction and their associated motor carrier industry representatives attend all meetings. Standing and ad hoc committees may be formed at the discretion of the executive committee.⁶

Unlike Advantage CVO and HELP, MAPS does not have a central database for collecting and storing information. Under the MAPS program, each state implements and manages its own data collection system for its sites. The State of Oregon does employ a transponder administrator to market transponders and manage day-to-day business functions for its mainline preclearance system. The contractor with these responsibilities is a partnership between the Science Applications International Corporation and Northwest Transporter, the consulting and program services arm of the Oregon and Washington Trucking Associations.⁷

MEMBERSHIP

Membership in MAPS is open to any U.S. state or Canadian province and is granted with approval of at least two-thirds of the existing member jurisdictions. Member jurisdictions must sign the MAPS Base State Agreement indicating that they agree to its terms. Current members are the states of Washington, Oregon, Utah and Idaho. Representatives from British Columbia have attended several recent executive committee meetings and are expected to join MAPS in the near future.⁸

HISTORY AND DEVELOPMENT

The MAPS states have long histories of involvement in electronic screening and in working together to coordinate issues concerning commercial vehicle operations. Therefore, MAPS

was more of a natural extension and coordination of existing programs than a trailblazing new effort for the partners. All four partners had participated to varying degrees in the HELP/Crescent operational test and demonstration project and some have been involved with HELP, Inc. At the time of MAPS's formation in 1996, Oregon was committed to its Green Light Program, Washington and Oregon had been chosen as CVISN model deployment states, and Idaho, Oregon, and Utah were coordinating commercial vehicle operations through the IOU (Idaho Oregon Utah) Project. These existing programs influenced MAPS's formation and development.

All four states were involved in technical studies for the HELP/Crescent operational test and Oregon and Washington participated in the HELP/Crescent demonstration. Utah is still a member of HELP, Inc. today. Oregon played an instrumental role in founding HELP/Crescent and was a member of HELP, Inc. until the summer of 1996. Personnel from the Oregon Department of Transportation Motor Carrier Transportation Division give the following reasons for Oregon's separation from HELP, Inc. and its decision to form its own system for electronic screening:

- Price – Oregon did not agree with HELP, Inc.'s pay-per-pass pricing strategy fearing that it would discourage carriers from joining the system. Oregon preferred a pricing system which charged a flat fee based on the price of the transponder.
- Data Confidentiality – HELP, Inc. operates under the principle that transponder-generated data be used only for electronic clearance and not for any enforcement purposes. Under the HELP, Inc. program the data collected by the system is owned by motor carriers and stored by Lockheed Martin who sends periodic reports to member states. Oregon wanted the ability to use electronically generated data to enforce regulations related to safety, highways-use taxes, and truck size and weight. This was not allowed through the HELP system.
- Hardware Investment and Ownership – Contract talks between HELP, Inc. and Oregon got bogged down over exactly what hardware and equipment would be provided to Oregon, who would hold title to that investment, and how to ensure that the hardware systems would remain even if HELP, Inc. were to abandon its commitment. In addition, HELP, Inc. wanted to equip only high-volume traffic sites, whereas, Oregon, wanted additional weigh stations and ports of entry outfitted with electronic clearance technology.
- Maintenance – The two sides could not agree on how much HELP, Inc. should pay to maintain the system.
- Marketing – Oregon and HELP, Inc. could not agree on what goals HELP should meet in marketing transponders to the motor carrier industry.⁹

In 1993, Oregon was one of the first states to write a formal strategic plan for using intelligent transportation systems for commercial vehicle operations. The plan features several proposed applications, including Mainline Preclearance Systems, an Integrated Tactical Enforcement Network, and safety enhancements. For each application, the plan specifies requirements for hardware and software updates, new equipment testing, database upgrades, new equipment and database integration, electronic data interchanges, and independent evaluations. The plan led to the award of \$20 million in federal ISTEA funding, conditioned upon a \$5 million match from Oregon, to implement the elements of the plan in a six-year program known as Green Light. Under Green Light, 22 sites in Oregon were to be outfitted with electronic clearance capabilities by 1999. Other elements of the program included equipping two sites with Downhill Speed Information Systems, three sites with Road Weather Information Systems, and ten sites with Integrated Tactical Enforcement Network technology.¹⁰ The funding obtained through the Green Light Program has been invaluable for the rapid development of MAPS sites within Oregon. These sites serve as the backbone for MAPS. In addition, Oregon has assisted Idaho and Utah to develop their electronic clearance capabilities through the loan of hardware and distribution of transponders to those states.¹¹

Washington and Oregon were selected as CVISN model deployment states in September, 1996, as a result of a jointly submitted proposal. The CVISN pilot project objectives for Oregon and Washington include demonstration of the following capabilities at one or more sites:

- Electronic application and issuance of credentials for motor carriers;
- Interfacing of state systems to the International Registration Plan (IRP) Clearinghouse;
- Interfacing of state systems to the International Fuel Tax Agreement (IFTA) Clearinghouse;
- Electronic clearance at fixed and/or mobile sites based on predetermined criteria;
- Distribution of safety information to computers at the roadside to target high-risk carriers;
- Electronic collection of inspection and other data from the roadside and uploading to SAFETYNET;
- Use of license plate reader(s) at roadside to electronically identify commercial vehicles and carriers to check safety information; and
- Electronic application and issuance of state and regional oversize/overweight permits.¹²

Many of these objectives are concurrent with the goals of MAPS. The funding Oregon and Washington receive as a result of their status as CVISN pilot states has enhanced MAPS regional permitting capabilities and will lead to future technology upgrades in this area. Idaho and

Utah plan to apply to become CVISN pilot states when FHWA begins recruitment of new states in round two of the program.¹³

MAPS emerged out of the IOU Project, which was a cooperative effort between Idaho, Oregon, and Utah to streamline commercial vehicle operations along Interstate 84. The IOU Project was initiated in 1994 when the three states pooled funding received from the FHWA for reducing institutional barriers to commercial vehicle operations. Under the IOU Project, the three states began discussing and installing compatible technologies for electronic clearance at weigh stations and one-stop shopping for regional permitting, with the goal of enabling motor carriers to operate uninterrupted between Portland and Salt Lake City. The IOU Project became MAPS in 1996 when Washington State joined the partnership in its electronic clearance efforts. Changing the name of the partnership to MAPS signified a transition toward more global thinking as opposed to IOU, which was a regional project. MAPS was intended to serve as an alternative to HELP, Inc.'s PrePass system. The MAPS partnership gave participating states leverage in recruiting carriers, while allowing states relative freedom to develop their own electronic clearance and data collection systems.¹⁴

PAST AND CURRENT INSTITUTIONAL ISSUES

Technology Investment

Prior to 1996, Oregon, Idaho, and Utah had begun installing automatic vehicle identification technology at weigh stations using in-ground antennae that read transponders mounted on vehicles' bumpers. In early 1996, it was becoming obvious that most other ITS programs around the nation, including HELP, Inc., Advantage I-75, and several automatic tolling programs, favored above ground antennae and in-cab transponders. By this time, HELP, Inc. had pledged to invest only in the above-ground antennae, a reversal in policy from several years previous when the organization had favored the in-ground technology. The IOU states faced a dilemma about whether to abandon their existing investment (Oregon had already installed in-ground antenna in approximately 50 lanes) or continue investing in technology that would be incompatible with most of the nation's other ITS systems. At significant costs to themselves and delay to operations, the IOU states chose to convert their stations to above-ground technology. Recognition of the need for national compatibility of ITS systems and truck drivers' insistence upon having to install only one transponder within their vehicles were significant factors in the states' decision. Upgrading to the different technology cost Oregon approximately \$4.5 million and Idaho and Utah approximately \$420,000.¹⁵

Data Privacy and Weight Distance Taxation

Oregon officials feel strongly that motor carrier data collected through electronic systems should be treated the same as data collected manually at weigh stations. The state feels justified in using electronically collected data for regulatory enforcement purposes, including enforcement of the state's highway-use tax. This potential use of the technology has been one of the driving factors in Oregon's significant investment in electronic clearance capabilities. Oregon personnel contend that the concept of electronic clearance was originally promoted as a way to enhance safety and regulatory compliance and that HELP, Inc. unnecessarily limited its use to verification of carrier weight and credentials at inspection facilities.¹⁶ It is true that the original vision for the Crescent project was for an electronic data collection process that would provide information for multiple uses. Electronic clearance was a secondary function which emerged from the test.

Oregon's stance is different from that taken by HELP, Inc., which prohibits the use of its technology for any purpose other than electronic clearance. HELP's policy was implemented to encourage motor carrier participation in the program and calm industry fears of more strict state regulatory enforcement with the improved tracking capabilities afforded by the technology. However, if Oregon is successful in enrolling carriers even with its data policy, there could be implications for HELP, Inc. Restricting the HELP system to electronic clearance purposes only is not a full use of the technologies' capabilities. Should Oregon's system be successful, other government agencies may follow suit and begin to object to the data restrictions currently imposed by HELP, Inc. At present, MAPS's carrier enrollment is far less than HELP's (approximately 2000¹⁷ vehicles compared to 55,000¹⁸), but MAPS is also relatively new.

Relationship with HELP, Inc. and Advantage CVO

Due to the proximity of the two systems and the fact that the heavily traveled I-5 corridor runs through both, MAPS has always been closely connected to HELP, Inc. The leaders of MAPS feel strongly that the two systems should work together to optimize commercial vehicle operations in the Western United States. However, MAPS is at a disadvantage in dealing with policy differences between itself and HELP, Inc., because HELP is so much larger and more established. MAPS partners are resentful of HELP's reluctance to cooperate on the issue of interoperability. Not having access to HELP's captured motor carrier base could jeopardize the MAPS system. MAPS partners feel that HELP is acting in its own best interest without consideration of what is best for national ITS priorities.

In terms of operating philosophies, MAPS is more closely aligned with Advantage CVO. Because of the two programs' similarities and their common discord with HELP, MAPS and Advantage CVO agreed in July, 1998, to merge their operations to form a new national ITS/CVO organization. All the MAPS and Advantage CVO members and four additional jurisdictions

agreed to join the new partnership. Additional details about the merger are provided in Chapter 4. The combination of the two programs will give each greater leverage to attract carriers and compete with HELP, Inc.¹⁹

SUMMARY AND CONCLUSIONS

The MAPS program is a relative newcomer to the electronic clearance scene. While MAPS is relatively new, its partners, especially Oregon, have long and distinguished histories in ITS/CVO programs. All of the states participated in the HELP/Crescent operational test. Oregon and Washington are CVISN model deployment sites, and Oregon's Green Light CVO Project is recognized as a national model. Therefore, MAPS was not a trailblazing endeavor in its four member states (Oregon, Washington, Idaho, and Utah) but a continuation of existing programs and efforts in order to create a compatible and interoperable electronic clearance system and one-stop regional permitting capability among its membership.

MAPS was formed as an alternative to HELP, Inc. The MAPS member states left the HELP program for a number of reasons, most importantly, differences in opinions about pricing and data policy. The MAPS states believed that HELP's pay-per-pass pricing scheme was overly burdensome to carriers and would inhibit enrollment. Secondly, MAPS states, especially Oregon, wanted the ability to use data collected electronically by the system for regulatory enforcement purposes which was not possible under the HELP system. Data ownership and usage policy is a primary difference between the two programs.

The MAPS states are each responsible for installing and operating electronic clearance technologies at their own weigh stations, and have relative freedom in the configuration and use of the systems, as long as they meet compatibility standards. As of November, 1998, 12 sites in the MAPS states had operational electronic clearance systems out of a plan for 50 operational sites by the end of 1999. Approximately 2000 transponders have been distributed by MAPS to carriers.

MAPS partners believe that all the major ITS/CVO systems in the nation must be interoperable in order to provide the greatest benefits to both motor carriers and government jurisdictions. The MAPS partners have been discouraged by HELP, Inc.'s failure to share this vision. MAPS believes that interoperability between HELP and MAPS is especially critical due to the two systems' proximity. Advantage CVO shares MAPS stance on interoperability and also has similar operating characteristics to MAPS. The two systems decided to merge into a new organization in July 1998 in order to give both better leverage in working with HELP, Inc. in and attracting motor carriers. The systems were already interoperable following a previous agreement. MAPS future

success rests on its ability to attract motor carrier participation under the new organization and continued state and federal investment in electronic clearance technology at weight station.

NOTES

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⁵ Randal Thomas, ITS Program Manager, ODOT Motor Carrier Transportation Division, Salem, Oregon, telephone interview by Valerie Briggs, November 10, 1998.

⁶ Multi-Jurisdictional Automated Preclearance System (MAPS) Base State Agreement; and Randal Thomas, ITS Program Manager, ODOT Motor Carrier Transportation Division, telephone interview by Valerie Briggs, November 10, 1998.

⁷ Randal Thomas, ITS Program Manager, ODOT Motor Carrier Transportation Division, telephone interview by Valerie Briggs, November 10, 1998; and MAPS, "Multi-Jurisdictional Automated Preclearance System: A Briefing Paper," prepared by ODOT, Salem, Oregon, August, 1997, p. 5.

⁸ MAPS, Multi-Jurisdictional Automated Preclearance System (MAPS) Base State Agreement; and MAPS, "MAPS April 1998 Update," p. 1.

⁹ James H. Brock, Program Technician, ODOT, Motor Carrier Transportation Division, Salem, Oregon, electronic mail correspondence, September 17, 1998; and Randall Thomas, ITS Program Manager, ODOT Motor Carrier Transportation Division, Salem, Oregon, telephone interview by Valerie Briggs, November 10, 1998.

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¹² State of Oregon, *Oregon CVISN Project Plan*, Salem, Oregon, May, 1997, p. 1.7.

¹³ MAPS, "Multi-Jurisdictional Automated Preclearance System: A Briefing Paper," prepared by ODOT, Salem, Oregon, August, 1997, pp. 3, 7.

¹⁴ MAPS, "Multi-Jurisdictional Automated Preclearance System: A Briefing Paper," prepared by ODOT, Salem, Oregon, August, 1997, pp. 3, 7; and James H. Brock, Program Technician, ODOT, Motor Carrier Transportation Division, Salem, Oregon, electronic mail correspondence, September 17, 1998.

¹⁵ MAPS, "Multi-Jurisdictional Automated Preclearance System: A Briefing Paper," prepared by ODOT, Salem, Oregon, August, 1997, pp. 3, 7; and Memorandum from Loyd Henion, ODOT to Motor Carrier Transportation Division personnel, April 15, 1996.

¹⁶ James H. Brock, Program Technician, ODOT, Motor Carrier Transportation Division, Salem, Oregon, electronic mail correspondence, September 17, 1998.

¹⁷ Randal Thomas, ITS Program Manager, ODOT Motor Carrier Transportation Division, Salem, Oregon, telephone interview by Valerie Briggs, November 10, 1998.

¹⁸ HELP, Inc., "About PrePass: PrePass Status," PrePass web site [cited December 9, 1998], available from: <http://www.cvo.com/status.htm>; INTERNET.

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CHAPTER 6. MICROELECTRONICS AND COMPUTER TECHNOLOGY CORPORATION (MCC)

The Microelectronics and Computer Technology Corporation (MCC) was the first major research and development consortium in the United States. Motivated by the threat of Japan's increasing strength in the computer and electronics industry, 10 companies in these fields banded together in 1983 to cooperatively perform precompetitive research. MCC was supposed to develop breakthroughs in advanced technology and transfer these advances to its member companies, who then were responsible for commercializing the technologies. As the first cooperative venture of its kind, MCC faced many challenges. Its opponents saw it as a threat to U.S. capitalism and thought it would stifle competition. Antitrust violation was a serious concern for the consortium until the passage of the National Cooperative Research Act of 1984. MCC was a major player in the passage of this act, which paved the way for many future consortia. MCC deserves much credit for its pioneering efforts and for opening the door for future joint ventures.

However, having no role models hurt MCC. MCC's original research mission and vision were too broad and far-reaching. They required the involvement of too many diverse interests, making coordination of these interests difficult. In addition, members were unwilling to wait for long-term results from research, making the original mission unsustainable. MCC's research focus and organization changed many times during its 15 year existence, leading to disillusionment by many members. In general, the consortium had a difficult time sustaining support and receiving adequate commitment from its members. Much can be learned from MCC's struggles and failures as well as its successes.

PROGRAM FORMATION

Motivation and Initiation

Because MCC was the first private research and development consortium of its kind in the United States, the program's founders had to tackle a number of challenges with relatively little guidance. Among the most important of these was overcoming sentiments that the MCC concept violated U.S. anti-trust laws and that cooperation between competing firms was contrary to the US's valued notion of capitalism. Key to overcoming these obstacles were strong motivating factors and a determined program instigator.

William Norris, founder, CEO, and chairman of Control Data Corporation, had previous experience with several small-scale R&D consortia, and, for many years previous to MCC's formation, had advocated a broad-based R&D consortium for the computer industry. It was not

until the Japanese emerged as a serious competitive threat to the U.S. computer and electronics industry that these companies began to take Norris' idea seriously. By the early 1980s, Japanese companies already dominated the market for consumer electronics including microwave ovens, videocassette recorders, and color televisions, all of which were invented in the United States. They were rapidly gaining world market share within the computer and semiconductor industries as well. The catalyst for MCC's formation was Japan's announcement in 1981 of the formation of a consortium to develop the Fifth Generation Computer – a more human-like computer with greater intelligence capabilities. This followed on the heels of a successful R&D consortium involving Japanese electronics companies and two government organizations which had helped Japan corner the market for dynamic random access memory semiconductors, a key technology in the computer industry.¹ Around the same time, Bob Price, Norris' right-hand man and president of Control Data, stirred up fears among computer executives with his "three computer companies" speech at a trade association conference. Price predicted that if the computer industry continued along its current path, there would be only three survivors: IBM, AT&T, and Japan, Inc.²

These events generated enough fear among U.S. computer and electronics companies that Norris was able to organize a meeting on February 19, 1982, to discuss the threat. Meeting participants included executives from 16 companies and two trade associations, the Director of MIT's Laboratory for Computer Science, the U.S. Undersecretary of Defense for Research and Engineering, the U.S. Undersecretary for International Trade, and the Pentagon's Chief of Research and Engineering. Primary topics of discussion at this meeting included whether cooperation was the correct response and would be feasible, and whether discussion of key research would constitute antitrust violation. The meeting resulted in a decision to proceed with planning for MCC.³

A steering committee, consisting of two representatives - usually the second, third or fourth highest ranking official from each of 17 companies - was formed to prepare for MCC's opening in January 1983, less than a year after the initial meeting. The committee's responsibilities included developing a business plan and research agenda for MCC, selecting a site location and acquiring facilities, recruiting a president, and numerous legal, regulatory, and financial activities. MCC began operations in 1983 with 10 founding member companies and Admiral Bobby Ray Inman as its president and CEO.⁴

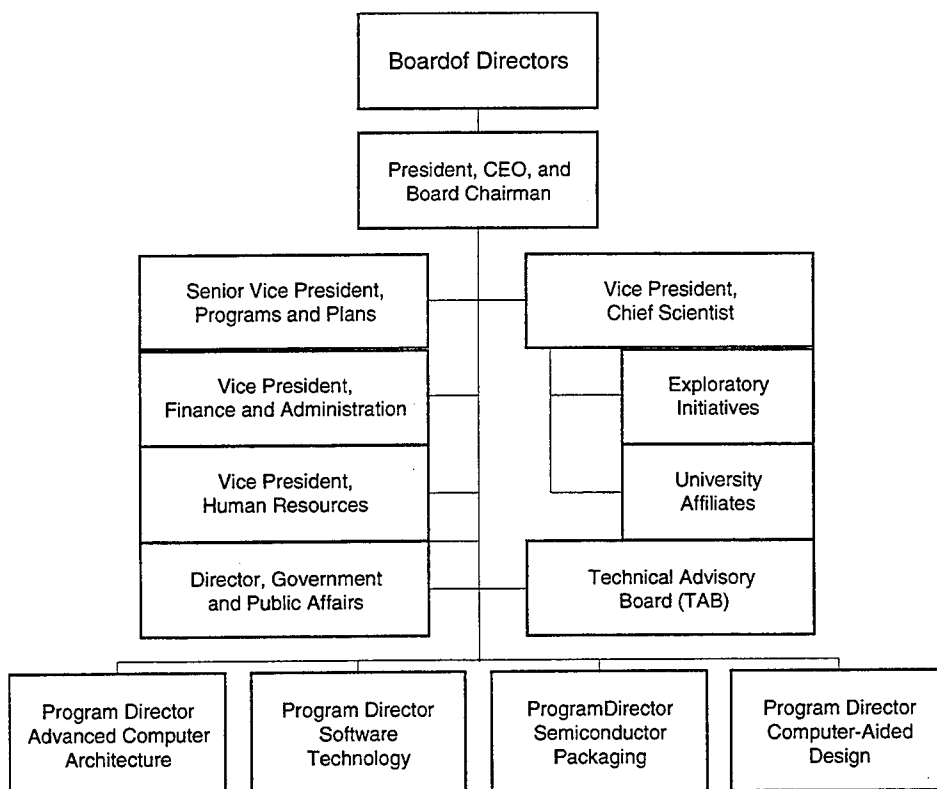
Initial Organization

Early vision. The founders' vision for MCC was as a premier scientific research facility that would bring together the nation's most talented scientists and engineers, and provide them with state-of-the-art equipment to conduct complex, multidisciplinary research. The research

focus was to be on long-range (five to ten years), pre-competitive technologies and processes in areas essential to future computing systems and to the competitiveness of MCC's funding companies. MCC was to develop breakthroughs in advanced technology and transfer these advances to its member companies, who were responsible for commercializing the developed technologies. It was hoped that this approach would shorten the product development cycle timeline and would most effectively utilize scarce research talent, thereby improving U.S. computer companies' competitiveness.⁵

Organizational Structure. A Board of Directors, made up of one representative from each shareholding company and MCC's CEO, governed MCC. The President and CEO (same), assisted by five Vice Presidents and four Program Directors, was in charge of operations. A Technical Advisory Board, made up of senior officials from the member companies, reviewed

FIGURE 6.1: MCC'S ORIGINAL ORGANIZATIONAL STRUCTURE



SOURCE: Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial: The Microelectronics and Computer Technology Corporation* (Boston: Harvard Business School Press, 1994), p. 201.

MCC's research plans and budgets semiannually and advised the CEO, Board of Directors, and Program Directors about technical matters.⁶

MCC's research activities were organized into four separate research programs: semiconductor packaging, computer-aided design, software technology, and advanced computer architecture. Member companies could individually select which research programs to participate in and fund. This entitled member companies to receive the technologies developed only by the specific research programs in which they participated. Therefore, research programs operated as separate entities, and communication between the programs was restricted. Each research program was headed by a Program Director who reported to the President (see figure 6.1).⁷

Membership and Funding. MCC first attracted main-frame computer manufacturers and semiconductor manufacturers. As MCC's focus began to broaden, aerospace manufacturers and conglomerates involved in related areas also joined MCC. Founding members of MCC were Control Data Corporation, Digital Equipment Corporation, Honeywell, NCR, Sperry Corporation, Harris Corporation, Advanced Micro Devices, Motorola, National Semiconductor and RCA. Over the next three years, large firms including Lockheed, Boeing, Martin Marietta, Rockwell, Allied-Signal, Kodak, 3M, Westinghouse, General Electric, and Hewlett-Packard also joined MCC.

Early members of MCC were all company shareholders. For a price of \$500,000 per share in 1983, shareholding members were entitled to representation on MCC's Board of Directors. The price per share was raised to \$1,000,000 in 1984, before being lowered to \$250,000 in 1986. Member companies paid separately for the research programs in which they took part.⁸

Another membership option, which was not advertised in the early years but became popular later, was associate membership. This allowed companies to join MCC research programs without paying the initial shareholder price. Associate members were not entitled to representation on the board and received research findings later than shareholders.⁹

Early Issues

Concern about Anti-Trust Violation. One of the major stumbling blocks to MCC early on was convincing company leaders and the federal government that the program would not be a violation of U.S. anti-trust laws. At the time of MCC's formation, anti-trust laws outlawed the discussion of markets, trade-practices or formation of contracts or trusts between competing companies and they carried stiff penalties of treble damages. Therefore, company leaders were reluctant to participate in any action that could even resemble anti-trust violations.

The founders dealt with this problem early on by informing the Federal Trade Commission in advance of all meetings and providing a summary of meeting proceedings. Lawyers were also present at all meetings, and participants were kept mindful of topics that may

or may not be discussed. However, many companies remained reluctant to become involved until the Department of Justice issued a decision on December 28, 1992, that it would not object to the formation of MCC but would review each research program as required. This decision was key to MCC's start of operations the following month and to convincing Admiral Inman to accept the company's presidency.¹⁰

It was two years later that MCC's operations were officially legalized with the passage of the National Cooperative Research Act of 1984. MCC was considered a key factor in the passage of this law which opened the door to hundreds of new research consortia throughout the United States.¹¹

Overcoming Negative Perceptions. MCC represented a departure from the previous hundred years of U.S. business policy. Critics labeled the organization a threat to American capitalism and open competition. The organization's champions had a difficult task convincing these individuals that MCC's purpose was to foster competition by helping companies to compete with Japan and IBM. Some computer companies did not become involved in MCC because they believed that the red tape inherent in large, diverse institutions would only slow and complicate technical development. They also feared that MCC would facilitate government involvement in the industry, which many opposed.¹²

Difficulty Cooperating. As members of Norris' team pointed out, it was not the nature of U.S. computer executives to cooperate. Those that did participate in MCC were protective of their own interests and concerned that no company gain greater benefits from MCC than others. Great pains had to be taken to assure that no company had undue influence in MCC's formation.¹³ Companies also refused to dedicate their best researchers and personnel to the program, requiring MCC to recruit researchers from academia and outside. This made technology transfer more difficult and weakened MCC.¹⁴ These turf-protecting attitudes also led to an organizational research structure that was non-conducive to cooperation and coordination and did not support MCC's original mission and goals.¹⁵

Establishing a Research Agenda. Structuring MCC's research program was a critical element for attracting shareholders and determining the ultimate success of the program in meeting its mission. Program planners met extensively with technical staff from the participating companies to identify appropriate research projects – ones that had a wide base of support, but were difficult for a company to fund on an individual basis. These were grouped into the four research programs mentioned previously.¹⁶

It soon became clear that most companies were not interested in all four research programs and would not join MCC if that meant funding all the research programs. This led to the "cafeteria style" membership plan in which companies chose which research programs to

participate in and fund. Members were equally adamant that only those companies who were funding the programs receive the research results from those programs. Therefore, security measures were enforced to block information sharing between the programs. This partitioning was later seen as counter-active to MCC's vision of cooperative research, but was deemed necessary at the time to gain member support. Additionally, dividing the research into four independently operating programs required each program to establish a critical mass of company support. Since there were not enough computer companies involved to provide this, additional members were recruited from other industries, such as aerospace and defense, leading to a broadening of MCC's scope.¹⁷

PROGRAM DEVELOPMENT AND EVOLUTION

MCC's operating life from 1983 to the present (1998) is characterized by substantial change in purpose and focus. After an initial honeymoon period, lasting throughout most of Admiral Inman's presidency, problems and environmental changes began to arise, both internal and external to MCC, which required alterations in MCC's policies and goals. Major shifts in focus and policies can be linked to each of MCC's CEOs as each attempted to address conditions of the time. MCC's first CEO, former Deputy CIA Director, Admiral Bobby Ray Inman (1983-1986), had the challenges of helping organize MCC and leading it through its formative years. However, these years were characterized by great zeal for MCC's mission and relatively high member support. It was not until the end of Inman's term as president that many of the problems which have plagued MCC ever since began to appear. Therefore, Gibson refers to the Inman presidency as the "honeymoon era."¹⁸ This section focuses on problems that occurred primarily after Inman's presidency and the policy responses by later MCC presidents Grant Dove, Craig Fields, and John McRary. Grant Dove, the Texas Instruments veteran who succeeded Inman and continued as CEO until 1990, made moderate changes to MCC's research program structure and focus. This was followed by more radical changes implemented by Craig Fields, a former Defense Advanced Research Projects Agency (DARPA) executive. John McRary, who became MCC's CEO in 1994, had the task of repairing damage caused by some of Fields' unpopular policies and moving MCC back toward its original focus. This section first outlines the problems and changing conditions underlying the policy shifts during MCC's life. Then the major changes in organizational structure and focus during each president's term are identified. The next subsection discusses the effects of these changes, and a final subsection explains other factors which influenced MCC's development.

Problems and Changing Conditions

Impatience for Technical Results. Although MCC had been established with the understanding that it would focus on long-term research, members quickly became impatient for results. Within the first year, board members began asking for deliverables. By 1986, MCC was receiving frequent and heavy criticism from the media as well as the public and private sectors for not producing technological breakthroughs.¹⁹

Changing Authority within Member Companies. Part of the push for faster deliverables resulted from a changing power structure within member companies during the 1980s. Originally, decisions concerning MCC, including funding, were made by top-level officials of the member companies. Over the years, as the initial enthusiasm for MCC began to wane and many companies followed a trend to decentralize authority, decision-making authority for MCC was shifted to member companies' research and development (R&D) departments. MCC began competing for funding with companies' internal research programs. R&D managers were expected to produce deliverables within limited time-periods; therefore, they passed this expectation on to MCC research projects. MCC found itself catering to a different audience than previously, leading to the need to change its research focus and marketing strategy.²⁰

Loss of Membership. Maintaining adequate membership to support research programs has driven many of the changes in MCC's organization and focus. After an initial growth period, six shareholding companies left MCC between 1986 and 1988 as a result of mergers and acquisitions as well as dissatisfaction with the consortium. Others went on inactive status, keeping their membership, but not funding any research programs.²¹ These losses received considerable media attention and initiated a series of revisions in MCC's structure and research focus aimed at attracting membership. Policy changes during the Dove, Fields and McRary eras all altered membership patterns, especially of associate members.

Need for Additional Funding. Funding provided by member companies began to drop after a peak of \$73 million in 1987. This was a result of previously mentioned factors, a perceived lessening of the Japanese threat, and financial troubles within the member companies. Besides attempting to attract additional membership, MCC's leaders also looked for outside funding sources, such as the federal government and revenue generated from spin-out companies. Despite these attempts, MCC's funding consistently declined after 1987 to only \$25 million in 1995.²²

Reactions to Problems and Changing Conditions

MCC's original purpose was to conduct long-term, high-risk research on pre-competitive technology with industry-wide application. This research focus evolved over the years toward shorter time horizons, more narrow applications, and increasing commercialization. As the

organization modified to support commercial research, for-contract research, spin-out ventures, and, eventually, consulting services, MCC moved away from its original goals.

CEO Grant Dove was the first to alter MCC's research focus. Upon assuming the presidency in 1987, Dove "unbundled" the four research programs into 19 projects which were grouped into 5 program areas. Labeled the "core/satellite" membership plan, members could join a program and receive results from all the projects in that program or could join individual projects. Dove advocated a medium time horizon for MCC's research projects. The research focus was spelled out in the 1989 business plan as "commercial research" with a goal of producing results within three years.

Faced with increasing financial difficulties and member dissatisfaction when he became MCC's CEO in 1990, Craig Fields made radical changes to MCC's research program. He initiated "for-contract" research for single clients or small groups of companies. "For-contract" research sometimes entailed passing funds through to member companies for research at their home laboratories. For the first time, a research program, computer-aided design, was discontinued. The remaining four programs were classified as either High Value Electronics or Information Services, but the "unbundled" core-satellite structure was retained.

Field's tenure marked a substantial departure from MCC's original focus on long-term, pre-competitive, basic research. Field's priority was to create wealth for the member companies by delivering products and services. Research was to be short-term and commercially focused. This priority was the driving element of Field's new emphasis on supporting spin-out companies to commercialize and market MCC's technologies. A 20 percent overhead charge was levied on MCC's research resources to establish a venture capital fund, MCC Ventures, for assisting the start-up of new companies. MCC Ventures would also provide management advice to the spin-out companies and help create strategic alliances with MCC member companies. The idea was for the spin-out companies to then provide a return on MCC's investment through a share of their profits once successful. However, MCC Ventures was not popular with MCC members, as discussed in the next section, and was discontinued after Fields left MCC.²³

By 1996, under the leadership of John McRary, MCC's strategic plan described the organization as "a consortial services company" with a twofold mission: "(a) to leverage members' R&D to maximum effects, and; (b) to reduce time-to-market for MCC participants."²⁴ New avenues for obtaining these goals were advocated, such as partnering with university and national labs, outsourcing R&D, pursuing government funding, and creating products that members could use.

In addition, two new business strategies were instituted – research studies requiring participation by all members and the provision of consulting services. Pre-project research

studies had previously been conducted with only the participation of companies interested in the research. Under McRary, the research studies process was formalized and required all MCC member companies to participate. Four to six research studies are conducted per year to establish technical feasibility and member commitment. No intellectual property is generated from these studies. In June, 1998, MCC opened its laboratory for consulting services for non-member companies. This continues the trend toward greater commercialization of MCC's services.

Effects of Changes and Reactions

Dove's core/satellite membership plan was popular among associate member, but had little effect on the number of shareholders or overall funding from members. The "unbundled" structure drove down the cost for those companies who wanted only to participate in one or a few research projects, giving these companies little incentive to invest in MCC as a whole through shareholder membership. The result was that the number of associate members increased from 15 to 34 between 1989 and 1991, but shareholding members remained steady at 21 despite a decrease in share-price from \$500,000 to \$250,000 (officially the share-price was \$1,000,000 prior to the reduction, but no company actually paid this price).²⁵

Fields' early years continued the trend toward increasing associate membership while maintaining steady shareholder membership. However, the end of Fields' presidency marked a sharp decline in overall membership, due in part to the unpopularity of the venture capital program. Similar to Dove's policies, the "for- contract" research policy attracted members to specific projects but not to supporting MCC as a whole. Therefore, by 1992, the number of associate members exceeded 50. However, these membership gains quickly eroded as members became discontent with MCC's venture capital fund program. MCC Ventures had a fundamental flaw in that companies who financially supported the research were not satisfied with research results and money going to new companies instead of back into their own organizations. By siphoning off MCC's resources, the program was seen as damaging to the consortium's research mission. The result of MCC Ventures was the downfall of Fields, who many members perceived as having used MCC as an instrument to gain wealth, and a downturn in MCC membership from a peak of 77 in 1992 to just 42 in 1994.²⁶

Other Factors Influencing MCC's Development

Failure of Oversight Bodies. One of the many problems associated with partitioning off the different research programs was that it rendered useless research oversight and coordinating bodies. This, in turn, contributed to the lack of cohesion and changing focus of the research mission. MCC's original organizational structure included a Technical Advisory Board (TAB), comprised of one official from each member company, which was to review and steer MCC's

research efforts. TAB representatives were senior people in their companies who could both communicate their companies' research needs to MCC and influence their companies' top executives on the Board of Directors. By separating the research programs, care had to be taken to allow TAB representatives to review and discuss only those research programs in which their companies were involved. This severely limited discussion and left nobody to look out for the big picture. Therefore, the TAB became more of a forum for micromanaging projects than for providing the oversight functions for which it was designed. The ineffectiveness of the TAB led to a deterioration of the quality of people assigned to serve on it, which further reduced its abilities to provide guidance and influence. The failure of this oversight body meant that no group was serving as a watchdog to keep research efforts on track and to plan a coordinated research program. It also impeded technology transfer to member companies.²⁷

Fields replaced the TAB with a Requirements Advisory Board (RAB) whose purpose was to determine the shared strategic technology needs of its member companies and formulate long-term requirements through which MCC programs could most effectively address these needs. Besides recommending technology areas for MCC to develop, the RAB was also to establish measures of success for research programs and benchmark MCC's progress. McRary revised the RAB to include not only senior-level engineering and research directors from member companies but also outside expertise from universities to advise MCC on which projects to pursue.²⁸

Initiatives for Federal Government Funding. MCC originally did not seek federal government funding because it did not want to be seen as looking to government to solve the computer industry's problems. However, as funding from member companies began to drop in the late 1980s, MCC saw the federal government as a valuable source of research dollars. Efforts to win federal research grants, which began under Dove, were escalated under Fields who was the former head of DARPA, a primary source of federal research dollars for MCC. Under Fields, MCC hired a full-time lobbyist based in Washington and held a fundraiser in 1993 for the chairman of the Senate Armed Services Subcommittee on Defense Industry and Technology. Notable successes of MCC's lobbying efforts include a \$10.3 million award from the Advanced Technology Program for researching Holostore technology and a \$7.1 million award from DARPA to develop a roadmap for environmentally conscious manufacturing technologies. However, many of MCC's other government funding initiatives did not pan out, as a result in part to drastic cuts in their target government research programs by the Republican Congress in fiscal year 1995. Although the federal government's share of MCC's total funding increased from 3 percent in 1988 to 16 percent by 1991, this still amounted to only about \$10 million per year. Reasons suggested for MCC's lack of success in obtaining government funding include its failure to

establish federal government presence in the organization from the beginning, and later, banking on civilian technology programs which were prone to cutbacks. Despite disappointments in this avenue, MCC still pledges to continue its quest for government research dollars, although it is unclear what government programs will be targeted for these funds.²⁹ One effect of MCC's government funding initiatives has been the widening of the consortium's research focus to include environmental issues. MCC's environmental program, which developed out of its environmental roadmap project for DARPA, has become one of the consortium's three primary research areas and is an industry leader in design-for-environment matters and electronics recycling.³⁰

CURRENT SITUATION

Today, MCC operates with 18 shareholders and 11 associate members. These members represent a wide variety of high tech industries including computer, electronics, telecommunications, and aerospace, as well as NASA and the U.S. National Security Agency. Besides conducting traditional consortial R&D projects and studies, MCC also provides single-client consulting services, pursues federal funding for research, and organizes global technology scanning tours. Consortial R&D projects and studies fall under one of three divisions: electronic systems, information technology, and environmental programs. Consulting services are offered for both software and hardware applications and are focused on either evaluating technology alternatives against client requirements or deploying MCC and other emerging technologies into the business applications of member companies. Hardware consulting services have recently been opened to non-member companies. Global Technology Services are open only to shareholder members and are intended to increase members' awareness of emerging technologies and markets in foreign countries.³¹

SUMMARY AND CONCLUSIONS

MCC's importance lies in the precedent it set for future cooperative ventures more than in its own business accomplishments. MCC was the first major U.S. consortium. It struggled with issues of legality concerning anti-trust, legitimacy in a competitive economic system, and cooperation between fierce competitors. Although, in hindsight, some of its early decisions may not have been the best options for the long-term success of the consortium, MCC's founders had no U.S. models to guide them. MCC was a primary factor in the passage of the National Cooperative Research Act of 1984, after which hundreds of consortia formed. MCC revolutionized American thinking about business cooperation in non-competitive areas. Many companies chose to follow its lead. Despite the national implications of MCC, many critics have

called the organization a major disappointment. Although it has experienced some success in semiconductor packaging, software development tools, and environmental roadmapping and has spawned several successful spin-out companies, MCC has failed to hit the technical homerun originally expected of it. It has had difficulty producing research that a wide range of its members use. Critics argue that research funds would have been better invested in member companies' own R&D departments than in MCC. MCC's steep decline in membership during the 1990's supports this theory. A number of factors can be blamed for these failures.

MCC was motivated by the threat of the Japanese 5th generation computer project. Yet, its original organizational structure was not organized around countering this threat. The original research program featured an assortment of technical projects partitioned off into separate divisions. This did not allow for integration of the technologies and immediately made the development of a 5th generation computer impossible. Therefore, MCC lost sight of its vision even before it started. The partitioning of the research programs also set a dangerous precedent for catering to individual or small groups of members as opposed to the consortium as a whole. As organizational changes were made to support commercial research, for-contract research, spin-out ventures and outside consulting services, the trend toward greater focus on individual members continued. Over time, MCC lost sight of the original intention of companies working together toward a common goal, and, instead, focused on providing services to individual or small groups of customers. Therefore, the organization lost the ability to produce large and revolutionary results.

Several factors contributed to this divergence from the original mission. First of all, the Japanese 5th generation computer threat never materialized as expected. Japan's computer and electronics industry went into decline during the late 1980s, and the Japanese VLSI consortium did not prove to be as effective as originally feared. With the original objective no longer pertinent, MCC had a difficult time establishing a new overarching goal, and was never able to find a similar impetus for cooperation. Secondly, MCC did not establish specific and measurable goals to accomplish. Instead, the organization was trying to attack a vague threat without clear targets. It had no measures of success for which to strive or around which to organize its activities.

From the beginning, MCC had a difficult time garnering the member support necessary to achieve its mission. The partitioning of the research program is the first example of members' unwillingness to fully commit to the consortium. Members were only willing to pay for activities from which they would benefit directly. They also resisted committing valuable personnel to the consortium or investing time and resources to ensure effective technology transfer. This lack of commitment indicates that companies did not value MCC's activities as an integral part of their

businesses. MCC's broad scope of research activities and the diversity of its membership meant that most of its research was not vital to the core business functions of its members. Therefore, members were unwilling to invest their top people or large amounts of resources to MCC projects. Comparisons with other consortia suggest that MCC may have been more successful had it narrowed its research base to a few technologies that represented the core business components of a smaller group of companies.

Additional lessons can also be learned from MCC about the nature of activities appropriate for cooperative partnerships. Even though MCC was founded with the idea of conducting long term research, its members were unwilling to wait for these results. Time-frames for returning research results became progressively shorter over MCC's life time. MCC's inability to produce measurable results or demonstrate progress early on lead to skepticism by supporters. Although MCC may have been on course during its early years for its long-term research activities, the consortium had nothing to show for its efforts or point to as a success. Studies of consortia have shown that early successes are critical for maintaining member support. This makes long-term focuses difficult without interim milestones. Secondly, activities which do not lend themselves to quantifiable targets are difficult for consortia. MCC experienced much greater success with its hardware applications than its software programs. This is partially because it is easier to set targets and define end-criteria for hardware than software products.

MCC is an experiment in cooperation. Although it has not been successful in all its endeavors, it has provided valuable lessons for later cooperative ventures. MCC suffered both from unfortunate circumstances and management decisions that, in hindsight, probably hurt the consortium. However, it was blazing a new trail and had no models to guide its decisions. The consortium has weathered significant changes within and outside its organization. Despite its struggles it remains functional today.

NOTES

¹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial: The Microelectronics and Computer Technology Corporation* (Boston: Harvard Business School Press, 1994), pp. 7-10.

² Ibid., pp. 33, 48.

³ Ibid., pp. 54-59.

⁴ Ibid., pp. 59-81.

⁵ Ibid., pp. 5, 65, 69-70.

⁶ Ibid., p. 200.

⁷ John B. Horrigan, "Cooperating Competitors: A Comparison of MCC and SEMATECH," Working Paper, Board on Science, Technology, and Economic Policy, National Research Council, forthcoming, p. 4.

⁸ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 80-82.

⁹ Ibid., p. 89.

¹⁰ Ibid., pp. 55, 78-80.

¹¹ Ibid., p. 21.

¹² Ibid., pp. 3, 4.

¹³ Ibid., pp. 59-60.

¹⁴ Ibid., pp. 198-199; and John B. Horrigan, "Cooperating Competitors," p. 14.

¹⁵ John B. Horrigan, "Cooperating Competitors," p. 4.

¹⁶ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 63-65.

¹⁷ John B. Horrigan, "Cooperating Competitors," p. 4.

¹⁸ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 191.

¹⁹ Ibid., pp. 201-203; and John B. Horrigan, "Cooperating Competitors," p. 6.

²⁰ John B. Horrigan, "Cooperating Competitors," p. 6.

²¹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 81-83.

²² John B. Horrigan, "Cooperating Competitors," pp. 3, 37.

²³ Ibid., pp. 5-7, 14-15.

²⁴ Ibid., p. 7.

²⁵ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 82.

²⁶ John B. Horrigan, "Cooperating Competitors," pp. 5-7, 14-15.

²⁷ Ibid., pp. 12-13.

²⁸ Ibid., pp. 7-8.

²⁹ Ibid., pp. 21-23, 27, 29.

³⁰ Ibid., p. 22.

³¹ Microelectronics and Computer Technology Corporation (MCC), "Microelectronics and Computer Technology Corporation," MCC web site [cited September 15, 1998], available from: <http://www.mcc.com.html>; INTERNET.

CHAPTER 7. SEMICONDUCTOR MANUFACTURING TECHNOLOGY INITIATIVE (SEMATECH)

The Semiconductor Manufacturing Technology Initiative (SEMATECH) has been widely acclaimed as a model of industry-government cooperation. Like MCC, SEMATECH is a research consortium composed of a number of competing member companies, but, unlike MCC, the U.S. government has also been an important partner, supplying half the organization's funding for its first 10 years of operation. SEMATECH was formed in 1987 in order to combat Japanese growing dominance in the semiconductor manufacturing industry. It brought together both semiconductor manufacturers and semiconductor manufacturing supply companies in a vertical consortium. This combination proved to be a formula for success.

SEMATECH learned from many of MCC's early mistakes. SEMATECH had a narrow research focus with clearly defined and measurable goals. Its ability to meet on time the goals it set gave credibility to the organization and helped it sustain member support. A focus on customer service, member-driven program planning, and effective technology transfer practices were also important elements in keeping members involved. SEMATECH has been able to grow and adapt to changing conditions over time due to the strength of the organization established in its early years. Government funding for SEMATECH ended in 1996. Since that time, the consortium has continued its operations with increased funding from its private partners. In 1998, SEMATECH added an international component to its operations. SEMATECH succeeded in many areas in which MCC failed. It serves as a valuable case study for comparison purposes.

PROGRAM FORMATION

Motivation and Initiative

Similar to MCC, the primary motivating factor for SEMATECH was U.S. semiconductor manufacturing companies' startling loss of market share to the Japanese. Just one example of this was dynamic random access memory (DRAM) semiconductors in which the U.S. share of the worldwide market had plummeted from nearly 100 percent in the mid-1970's to around 20 percent in 1986.¹ The DRAM loss contributed to U.S. companies' dramatic decline in total worldwide semiconductor market share during the same period.² Semiconductor manufacturing equipment suppliers were also losing their industry predominance, though they still held a slight edge over Japanese companies until 1989.³

While the semiconductor industry was reeling, the U.S. government was also becoming concerned, thanks in part to efforts by the Semiconductor Industry Association (SIA), a lobbying group formed in 1975. Early political efforts to impede Japanese advances in the industry included the U.S.-Japanese Semiconductor Trade Agreement of 1986 which placed a floor on

Japanese chip prices in an effort to stop the dumping of Japanese chips on the U.S. market at prices below production costs. The idea for a cooperative government-industry semiconductor manufacturing institute gained political momentum following the release of a February 1987 report by the Defense Science Board of the Department of Defense. It recommended government funding for such an institute based on the defense industry's reliance upon a strong U.S. semiconductor sector. At the same time, the SIA issued a report advocating the formation of an industry-government research consortium.⁴ Subsequently, SEMATECH was officially created at the May 1987 SIA board meeting by 13 companies (NRC joined later) who represented 85 percent (including NRC) of the semiconductor component manufacturing capacity in the U.S.⁵ A five-year funding plan was established calling for matching industry and government support. Congress' approval in December 1987 of \$100 million to be allocated to SEMATECH for its first year enabled operations to begin in 1988. Government funds for SEMATECH were to come from the Defense Advanced Research Projects Agency (DARPA, renamed ARPA in 1992) and were subject to annual review by Congress along with SEMATECH's annual plans. SEMATECH was to have an operating lifetime of 5 years, though this was later extended.⁶

Initial Organization

Early Vision. SEMATECH's original mission statement was "to provide the U.S. semiconductor industry with the domestic capability for world leadership in manufacturing."⁷ The consortium was to develop the tools and equipment necessary to manufacture semiconductors. However, there was a lack of consensus as to what this entailed. SEMATECH's early champion, Charlie Sporck of National Semiconductor, envisioned SEMATECH as a technology proving ground and manufacturing facility. This idea was adapted to an early focus on developing semiconductor manufacturing technology, equipment, and materials and integrating them into a prototype manufacturing line at the SEMATECH facility. As discussed later, this proved to be impractical and was soon amended again. However, learning from MCC's mistake, it was established early on that SEMATECH would have a single research program in which all members participated and received equal access to results.⁸

Organizational Structure. The organizational structure of SEMATECH has changed little since its formation. The Board of Directors is composed of SEMATECH's CEO, a CEO or high-level executive from each member company, a representative from SEMI/SEMATECH (the Semiconductor Equipment and Materials Institute), and a representative from ARPA (prior to 1997) – each with one vote. An Executive Technical Advisory Board (ETAB) determines SEMATECH's technical thrust by distributing the budget, which is determined by the Board of Directors, among various technical programs. The ETAB representatives are very senior technologists within their companies who are closely connected with the SEMATECH Board of Directors members. The ETAB also charts and assigns personnel to Focus Technical Advisory Boards (FTABs) which govern specific areas of technical concentration. These personnel are

typically hands-on technologists within the member companies. Finally, Project Technical Advisory Boards (PTABs) monitor specific projects. While these boards serve a governing and oversight function, a permanent staff manages daily operations. These include the research staff, project managers, program directors, a chief executive officer, chief operating officer, and chief administrative officer. Many of these researchers and managers are assignees from member companies.⁹

Membership and Funding. SEMATECH's founding members were both "merchant" manufacturers of semiconductors for outside sale and "captive" producers who made chips to put in their own products. They were Advanced Micro Devices, Inc. (AMD); American Telephone and Telegraph (AT&T); Digital Equipment Corporation (DEC); Harris Corporation; Hewlett-Packard Company; Intel Corporation; International Business Machines Corporation (IBM); LSI Logic; Micron Technologies, Inc.; Motorola, Inc.; National Semiconductor Corporation; NCR Corporation (joined in 1988); Rockwell International Corporation; and Texas Instruments Corporation. Membership in SEMATECH was limited to firms headquartered in the United States and substantially controlled by U.S. citizens. While the founding firms represented 85 percent of U.S. semiconductor manufacturing capacity, about 200 smaller semiconductor companies existed in the United States who did not join or support SEMATECH; the \$1 million dues was prohibitive for many. In 1992, LSI Logic and Micron Technologies, two of the smallest members left SEMATECH, citing fundamental disagreements over the research focus. Harris, AT&T, and NCR have also since left and Lucent Technologies joined.¹⁰

For its first six years of operation, SEMATECH received \$100 million per year from DARPA, which was equally matched by industry contributions. Member companies paid dues of 1 percent of their semiconductor sales, with a minimum of \$1 million and a maximum of \$15 million to reach the industry total contribution. SEMATECH reduced its 1994 budget to \$180 million, still divided equally between federal government and industry sources. This level continued until fiscal year 1997 when SEMATECH decided to forgo government funding thereafter and rely solely on industry funds. The budget for FY 1997 was \$120, all of which came from industry contributions.¹¹

Early Issues

Building Support within Congress. Much of SEMATECH's success has been a result of its political astuteness in dealing with Congress. This was especially true during SEMATECH's formative years. The SIA's organized lobbying efforts, led by Charles Sporck, the CEO of National Semiconductor Company, were key to bringing the semiconductor industry's troubles to the attention of Congress. The next step was building bipartisan support from a Democratic legislature and Republican administration for funding SEMATECH. This was achieved by marrying SEMATECH's commercial and defense implications. Democrats tended to prefer a purely commercial SEMATECH funded through the Department of Commerce. However, the

Administration opposed any government support of industry except for national security purposes. Therefore, lobbying efforts were focused on Defense Secretary Casper Weinberger, and SEMATECH was eventually placed within the Defense Department, administered by DARPA.¹²

Additional evidence of the SEMATECH founders' shrewd political judgement was the site selection of Austin, TX. Although Austin's \$68 million offering package was far less than Phoenix's offer worth \$201 million or Massachusetts' inflated offer of \$441 million, Austin's offer was worth much more in political dollars. At the time, Texas yielded such political heavyweights as Speaker of the House Jim Wright, chairman of the Senate Finance Committee Lloyd Bensten, chair of the Ways and Means Oversight Committee J.J. (Jake) Pickle, chair of the Government Operations Committee Jack Brooks, newcomer Senator Phil Gramm, and Vice President George Bush. Pickle in particular was considered a champion for SEMATECH legislation. It is no coincidence that Austin was announced as the winning site just 14 days after approval for SEMATECH's first year of funding was pushed through Congress.¹³

Lack of Leadership. An element which endangered SEMATECH early on was its failure to appoint a CEO for nearly 17 months. Congress saw this as an ominous sign for the consortium's future and threatened to withhold funding for the program's second year if SEMATECH's members could not agree on this one point. In addition, the fledgling organization desperately needed strong leadership to help coordinate its interests (discussed below). Robert Noyce, co-inventor of the integrated circuit and founder of Intel Corporation, rose to the challenge. From 1988 to 1990, Noyce provided strong leadership and served as the figurehead that SEMATECH needed to instill confidence in its members and Congress. Unfortunately, Noyce died suddenly of a heart attack in June of 1990 near the time that Chairman of the Board Charles Sporck retired, sending SEMATECH into another turbulent period until William Spencer was appointed CEO in October 1990.¹⁴

Coordinating Diverse Interests. While requiring members to support a single research package avoided the problems MCC had with the partitioned research program structure, it necessitated the convergence of all members' interests. The merchant semiconductor makers wanted SEMATECH to increase chip capacity, while the captive suppliers desired incremental cost savings in their manufacturing processes. DARPA and the producers of semiconductors for defense were most concerned with chip reliability. Arguments among the parties produced an initial research mission that was vague and unsustainable. This in turn led to a business plan and research proposals that were poorly coordinated and inappropriate for a consortium, reflecting firms' individual research interests. DARPA rejected SEMATECH's first operational plan due to its seeming lack of communication between member firms. These problems were significantly reduced when Noyce was appointed CEO and launched a refocusing effort.¹⁵

PROGRAM DEVELOPMENT AND EVOLUTION

While not without problems, SEMATECH's course of development is most noted for its success stories. The consortium was able to bridge its differences to develop a research mission that was attainable, provided benefits to its members, and helped the U.S. semiconductor industry rebound against the Japanese. Good management practices built a culture of success and kept the support of both government and industry partners for ten years. SEMATECH adapted to changing political and economic environments without losing its core focus or values. This section attempts to define the basis for these achievements while describing SEMATECH's development and distinctive features between 1988 and 1997. The first two sections describe the formation and changes of SEMATECH's research program, which is central to the organization. Several sections follow describing business practices that have helped shape the organization. These include partnerships and methods of maintaining government and industry support. The final sections describe recent changes including the end of government funding and increasing global interaction.

The Equipment Focused Research Agenda

During SEMATECH's first year, research focused on improving manufacturing processes, in accordance with the original operational mission. However, the fear that this focus would result in companies having to share of too much proprietary information dampened the cooperative environment and hindered progress. When Noyce became CEO of SEMATECH, he led a full-scale reassessment of the consortium and its place in the semiconductor industry from which emerged a realization of the dire problems within the U.S. semiconductor manufacturing equipment (SME) industry. SEMATECH's research focus was shifted to the SME industry as an area much less subject to competitive advantage for members, but still urgently needing improvement. The new research mission was to conduct "pre-competitive research in generic manufacturing technology."¹⁶ In addition, clear targets concerning the ability to manufacture chips with smaller line-widths were established in connection with the mission. These targets, all of which were met, were to develop technology that could demonstrate the production of 0.8 micron chips by 1989, 0.5 micron chips by 1990, and 0.35 micron chips by 1992, using all American-made equipment.¹⁷

The new focus on equipment led to a much more decentralized research structure. The share of SEMATECH's budget committed to external projects increased from 20 percent in 1988 to 53 percent in 1990.¹⁸ These took the form of Joint Development Projects (JDP), External Improvement Projects (EIP) and contracts to member companies, and federal and university labs. JDP and EIP contracts assist equipment suppliers in developing (JDP) or improving (EIP) products. While these typically took place at the suppliers' facilities, they were managed by SEMATECH employees, SEMATECH engineers were assigned to the projects, and frequent meetings took place between the supplier's and SEMATECH's staff. Therefore, SEMATECH

retained a large degree of control over these outside contracts. SEMATECH's central facility in Austin was used primarily for bringing together the results of outside projects in a single production line for demonstration and testing.

The new research focus and structure was argued to have a number of advantages for its members. Outsourcing allowed for faster development cycles and more focused operating capabilities at SEMATECH's central facility. Coordinating the allocation of research funding reduced duplication among semiconductor manufacturers in the development of new tools and lessened fragmentation. The "qualification" (testing and demonstration) of new technology at the central facility, reduced the need for expensive testing by individual firms, aided purchasing decisions for members, and provided feedback to suppliers. In addition, member company assignees who were involved in these projects increased their knowledge of equipment maintenance, software, and operations, thereby facilitating the adoption of these technologies at their member companies. While member companies were not required to purchase equipment developed through SEMATECH's SME contractors, most did, based on their familiarity with the equipment and the business relationships established through dealing with these companies. Since SEMATECH's goal was to use all American-made equipment and supplies, this translated into increased sales for U.S. SME manufacturers at SEMATECH's member companies, thus strengthening the U.S. SME industry.

A change in SEMATECH's technology sharing rules accompanied the shift in focus. Originally, the sales of equipment developed using SEMATECH funds was restricted to SEMATECH member companies for the first year. Faced with criticism from outside semiconductor manufacturers that SEMATECH was exploiting tax revenue to benefit its member companies at the expense of non-member firms, SEMATECH changed this policy in 1991. The new rules specify that SEMATECH members have priority in purchasing such equipment and, once their demand is met, suppliers may sell to outside firms. This benefits SME firms by broadening their markets but is a detriment to SEMATECH members. However, members still retain some lead time and had the advantage of greater familiarity with the equipment from being involved in its development.¹⁹

SEMATECH as Executor of the National Technology Roadmap for Semiconductors

In 1993, SEMATECH had attained its goal of demonstrating 0.35 micron technology, the U.S. semiconductor industry's market share was rising above that of the Japanese, and SEMATECH's original 5-year government funding commitment was over. SEMATECH renewed its request for matching government funds for another five years based on a new mission: "[To] solve the technical challenges required to keep the United States number one in the global semiconductor industry." To accomplish this, SEMATECH attempted to establish itself as the chief developer and executor of national policy involving semiconductors. This idea was manifested through the National Technology Roadmap, a comprehensive plan for the U.S.

semiconductor industry, which SEMATECH helped develop through the SIA in cooperation with industry, government and university participants. The first roadmap was developed in 1992 and continues to be updated. SEMATECH was appointed manager of the roadmap and, beginning in 1994, aligned its research agenda with the roadmap plans. New technical thrusts for SEMATECH following this transition included packaging, test, design, materials, and interconnect technologies. Thus, the new research focus was broader and longer-term than previously.²⁰

Partnerships

SEMI/SEMATECH. With SEMATECH's adoption of an equipment focus, it was clear that suppliers of manufacturing equipment and vendors of raw materials for semiconductor production would play an important role. The existing trade organization for this industry was called SEMI, Semiconductor Equipment Manufacturers Institute, and had over 900 members, including 200 Japanese companies.²¹ U.S. members of SEMI formed SEMI/SEMATECH soon after the creation of SEMATECH to facilitate linkages between U.S. SME suppliers and SEMATECH. SEMI/SEMATECH promotes communication between SEMATECH and its members and works to assure that U.S. companies receive SEMATECH contracts. SEMI/SEMATECH's members, which currently number more than 130, have always represented the vast majority of U.S. SME production capabilities. SEMI/SEMATECH is located within SEMATECH's Austin facility and has representation on SEMATECH's board of directors. SEMATECH's CEO also serves on SEMI/SEMATECH's governing board. This partnership, bringing together equipment suppliers and users into a vertical consortium, has been credited as one of the keys to SEMATECH's success.²²

Educational Partnerships. From the beginning SEMATECH believed it had a duty to ensure a quality workforce for the semiconductor industry. At first, it targeted the university community through its Centers of Excellence program. The Semiconductor Research Consortium (SRC), a consortium predating SEMATECH, funds university-based semiconductor research and administers the program for SEMATECH. Prior to 1997, SEMATECH provided \$10 million per year, which funded research in 12 universities across the country. While SEMATECH's budget reductions in 1997 prevents the consortium from funding the program at past levels, it vows to continue sponsoring university research through other means. SEMATECH recently became involved with the joint government-industry sponsored Focus Center Research Program which will provide multi-million dollar contracts to up to six university systems for semiconductor research.

1997 also brought about a shift in SEMATECH's educational program focus, directing more attention to community colleges and technical schools due to estimations of a critical shortage of skilled operators and technicians for the industry. The Partnership for Workforce Development (PWFD) program was instituted with the goal of increasing graduation rates and numbers of two-year colleges offering semiconductor manufacturing technician training. In its

first year, the program helped increase the number of schools offering this degree program by 50 percent to 52 colleges, and increased enrollment by 100 percent to 4,000 student.²³

Federal Laboratories. In keeping with its initial status as a government-industry partnership, SEMATECH has funded a great deal of external R&D activities at federal labs. Most notably was its partnership with the Department of Energy's (DOE) Sandia National Laboratories to perform cooperative research over five years beginning in 1993. The partnership, in which SEMATECH contributed \$100 million, was the largest cooperative research project ever between the DOE and a private-sector partner (Gibson and Rogers, 1994).²⁴ Today, SEMATECH has a major research contract with the Oak Ridge National Laboratory.²⁵

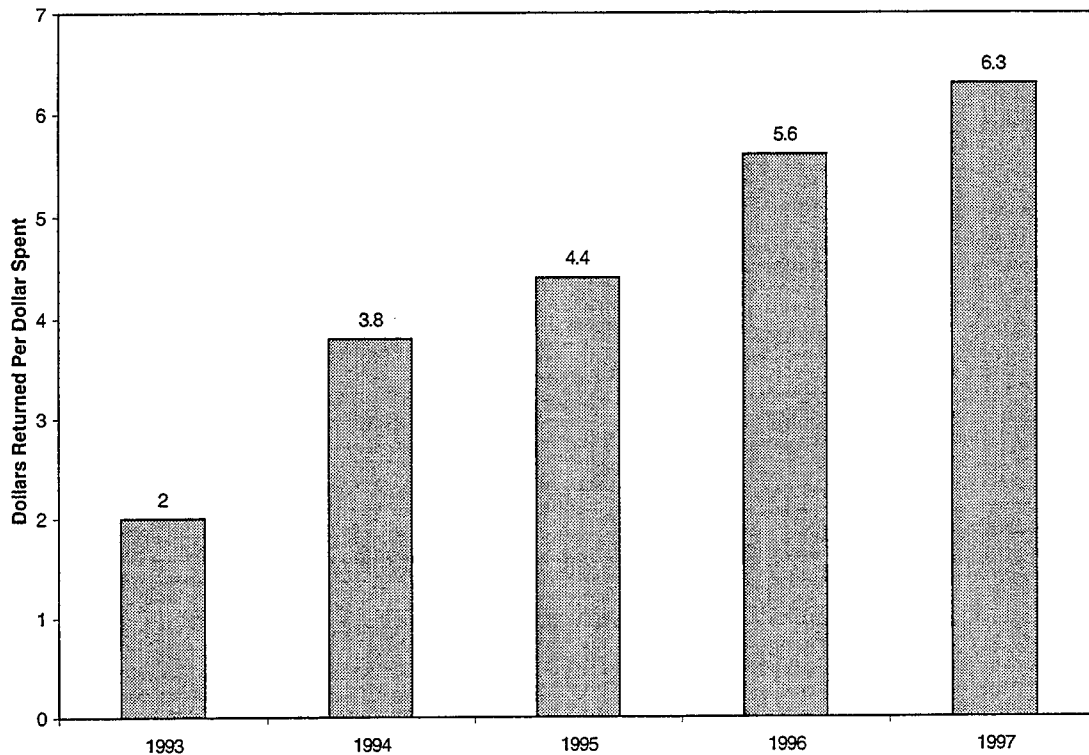
Maintaining Industry Support

SEMATECH has maintained the support of its member firms for so long largely because it views its members as customers to whom it must deliver products and services of value. For SEMATECH, pleasing its customers depends upon a high level of member input at all stages of a research program, beginning with the decision to support a project, and good technology transfer techniques to move developed technologies into member companies in usable form. The consortium has cultivated a number of methods to achieve these ends. First of all, the Technology Advisory Board (TAB) system - including ETABs, FTABs and PTABs - provides a communications hierarchy to effectively transmit information from company representatives supervising the details of projects to the decision-makers on the Board of Directors. This assures company input at all levels and aids the high-ups in making informed and consistent policy decisions for the consortium. However, this system depends heavily upon good communication between personnel at each level (for example between FTABs and ETABs), and can be subject to internal manipulation in the allocation of funds. Therefore, the Return-on-Investment (ROI) methodology was established to work with the TAB system.²⁶

The ROI methodology allows member firms to gauge the benefits they receive from involvement in the consortium and evaluate the relative importance of SEMATECH projects to their operations. It consists of a simple spreadsheet application that calculates a numerical value of a company's return-on-investment for a SEMATECH project based on company determined values for cost avoidance, strategic benefits, and soft value benefits. The ROI provides valuable feedback to SEMATECH about member satisfaction and is a means for comparing and selecting alternative projects. In addition, the ROI development process, in which SEMATECH employees work with members over a three month period, fosters greater awareness between both parties of the others needs and expectations. Creating a numerical value system was not in and of itself sufficient to increase customer satisfaction. SEMATECH also had to establish within its daily operations and TAB meetings a culture that respected and responded to ROIs. Many SEMATECH officials contend that the ROI methodology was a defining achievement of William

Spencer's presidency and has contributed to SEMATECH's stability and success.²⁷ ROI values have consistently increased since they were first implemented in 1993 (see figure 1).

FIGURE 7.1: AVERAGE SEMATECH MEMBER COMPANY RETURN ON INVESTMENT (ROI)



SOURCE: adapted from SEMATECH, "1997 Annual Report," SEMATECH web site [cited September 1998], available from: <http://www.sematech.org/public/annrpt.htm>; INTERNET.

Bi-annual project assessment surveys provide another means of evaluating program value to members. FTAB representatives, member company advisors for specific technical areas, complete surveys twice per year to indicate their companies' satisfaction with the performance of each project and the importance of the project to their company. Representatives give each project numerical ratings based on a 100-point scale for both project importance and project performance. Ratings for each project are then compiled across all member responses. Projects receiving less than a 50 percent rating for either performance or importance are targeted for corrective action.²⁸

In 1997, customer service was taken to an even higher level with the individual customer satisfaction (ICS) program. SEMATECH realized that each of its customers has unique needs and expectations and tried to tailor itself to better meet these individual concerns. For the first

time, member companies were asked to name which out of all SEMATECH's projects were most important to their company and to specify "key value deliverables" as well as timetables for those deliverables. The responses went straight to SEMATECH's top executives to receive appropriate attention. A second aspect of the ICS program involves SEMATECH account executives working directly with each member company to establish a clear statement of that company's requirements for the consortium. The account executives meet with SEMATECH's CEO monthly to determine how well requirements are being met and to plan for corrective action if necessary. On a quarterly basis, the account executive and CEO meet with each company's Executive Technical Advisory Board member to review requirements and evaluate progress. Annually, SEMATECH issues a customized executive review to high-level company management explaining what SEMATECH is doing for their company. Board members have responded positively to the increased individual attention, and the ICS program may be a key factor in the record breaking ROI values for 1997.²⁹

While customer service initiatives are important for establishing expectations, it is SEMATECH's ability to provide useful products to member companies that has really kept companies involved. SEMATECH considers assignees from member companies a key component to producing deliverables that members can use. Assignees both give input during the product development cycle that helps tailor products to their companies' needs and take knowledge about the products back to their member companies, making technology transfer more successful. Currently, approximately 50 percent of SEMATECH's technical employees are assignees, thanks to concerted efforts by SEMATECH's management.³⁰ In its early years, SEMATECH encountered problems receiving the best quality assignees and often these assignees had difficulty maintaining their positions within their member companies while on assignment. SEMATECH was able to overcome these problems by increasing awareness of assignee issues through surveys and task forces. In 1992, a task force was established to deal with such issues as assignee selection, integration into SEMATECH, smoothness of return to member companies, and tracking the careers of assignees after they returned to their home companies. Primary topics of discussion for the task force were how to evaluate assignees' performance while on assignment and how to encourage return to their original companies at the end of the assignment period. It is generally agreed that the quality of assignees has improved over time and many companies now say that they endeavor to send only first-rate employees to SEMATECH.³¹

These programs are all aimed at keeping SEMATECH members closely involved in the consortium's activities. This close association has assured that research is focused in the direction that most benefits members and helps tailor results to best serve them. Thus SEMATECH produces results that members can use, which, in turn, keeps members involved.

Maintaining Government Support

SEMATECH received \$90 to \$100 million in government funding annually for nine years. While the first five years of government funding were dedicated to safeguard U.S. defense capabilities and economic competitiveness with Japan, funding continued for several years after these were no longer issues. Perhaps the primary reason for this was that the consortium was able to showcase its early successes as the benefits of government-industry cooperation and as arguments for continued government support. Secondly, the consortium established itself at the center of government policy regarding semiconductors. When the National Advisory Committee on Semiconductors (NACS) was authorized in 1988 to develop a comprehensive semiconductor strategy for the United States, representatives from SEMATECH's member companies took key positions on the committee. Not surprisingly, NACS spoke glowingly about SEMATECH in its reports and recommended increased funding for the consortium. When NACS disbanded in 1992, SEMATECH helped ensure that its functions were continued in the private sector by the Semiconductor Industry Association. The National Technology Roadmap for Semiconductors (NTRS) developed out of this initiative. SEMATECH has been closely associated with the Roadmap since its inception, serving as manager and executor as well as having representatives on nearly all working groups which contribute to the NTRS. Most recently, SEMATECH has been involved with the Semiconductor Technology Council (STC) established in the FY 1994 Defense Authorization Bill to improve coordination among industry, the federal government, and universities concerning semiconductor research and development. SEMATECH members play a prominent role on the STC, and SEMATECH staff help coordinate the STC's activities. By establishing a central position for itself within the semiconductor policy arena, SEMATECH was able to promote its image as a successful model of government-industry collaboration and create a basis for continued government funding.³²

Continuing without Government Support

In 1994, the SEMATECH Board of Directors voted unanimously to forgo federal government financial support after 1996 on the grounds that the U.S. semiconductor industry had succeeded in reviving itself and was now strong enough to tackle its problems without government assistance. By 1995, SEMATECH began decreasing its expenditures to prepare for the loss of government funding, and, in 1996, the board decided to increase member dues by 30 percent starting the following year to help offset the loss. Despite the decrease in expenditures, (\$124 million in 1997 down from \$160 million in 1996) and increase in dues, the ROI values reported by member companies were the highest ever for 1997. SEMATECH credits its attempts to coordinate productivity improvements, streamline business processes, and require equipment suppliers to assume more of the cost on joint development projects for its success at maintaining customer satisfaction despite a smaller budget.³³

International Initiatives

SEMATECH has become increasingly global throughout its lifetime. From an early stage, SEMATECH's goal to limit its beneficial influences to American companies was difficult to achieve. At the time of SEMATECH's formation, some of its member companies already had ties and alliances with international firms and joint ventures have continued to form since. Thus, inherently, foreign firms have gained some benefits from SEMATECH through their American partners. There have also been several cases of Japanese or other foreign firms buying out SEMATECH participants. For example, NCR Corporation was first bought out by AT&T and then sold to an American subsidiary of Hyundai Electronics Industries of Korea. Another case, in which a SME supplier involved in SEMATECH, Semi-Gas, Inc., was sold to a Japanese firm, received a great deal of government attention including a Justice Department block on the sale on antitrust grounds, which was later rejected; the sale continued. A similar case was that of the Silicon Valley Group Lithography Systems, Inc. (SVGL) in which SEMATECH and ARPA invested \$60 million to develop new stepper technology. When SVGL announced plans to partner with Japanese-owned Canon, SEMATECH reacted favorably. This was because the consortium had learned from a previous experience that technological superiority alone was not enough to ensure the success of new firms. Business strength was also essential, and SEMATECH believed the Japanese firm could provide for the fledgling SVGL to help it be successful.³⁴ The SVGL experience marked the beginning of a new business philosophy for SEMATECH in which it attempted to "help U.S. companies gain sufficient technical muscle to join international partnerships and pursue global competition from a position of strength."³⁵

While SEMATECH's members and partners were forming global ties, so was the consortium itself. In 1991, SEMATECH and its European counterpart, JESSI agreed to share information as an attempt to make members of both consortia more competitive against the Japanese.³⁶ At SEMICON Japan in 1993, SEMATECH CEO William Spencer urged global industry cooperation in three areas: standards; the next-generation wafer size; and environment, safety, and health research. Spencer's arguments were well received, and, a year later, representatives from semiconductor industry companies and consortia worldwide met to discuss standards and details of the next generation 300 mm wafer. Following this, in 1995, SEMATECH formed a subsidiary, the International 300 mm Initiative (I300I) to speed the introduction of 300 mm wafers into high-volume manufacturing through joint research. The I300I currently has 13 member companies from the United States, France, Italy, Germany, Netherlands, Taiwan, and Korea. It has also works closely with its Japanese counterpart J300 to develop standards and guidelines.³⁷ The April 1998 launching of International SEMATECH, a wholly owned subsidiary of SEMATECH, represented a distinct departure from the consortium's original pro-American sentiments. International SEMATECH operates under its own advisory boards and includes all U.S. SEMATECH members plus five international members. SEMATECH transferred some of its

projects to International SEMATECH while retaining others for its U.S. members.³⁸ Thus, over the years, SEMATECH has come to expect and embrace the international environment of the semiconductor industry. Its mission gradually changed from bolstering the U.S. semiconductor industry to increasing productivity throughout the industry via worldwide cooperative ventures. Today, the consortium's mission reads "SEMATECH and International SEMATECH members will create shared competitive advantage by working together to achieve and strengthen manufacturing technology leadership."³⁹

CURRENT SITUATION

Today's SEMATECH has a history of success to build upon but it is also adjusting to increasing globalization and surviving without government funds. Its 10 U.S. and 5 international members provide its entire operating budget which was \$124 million in 1997. The consortium continues to help update and manage the National Technology Roadmap for Semiconductors, upon which its research mission is based. Member companies also play a crucial role in determining SEMATECH's research mission through the individual customer satisfaction program begun in 1997 and other means. In 1998, the consortium's research programs include interconnect; front end processing; assembly and packaging; design systems; and manufacturing methods within SEMATECH and Lithography infrastructure; 300 mm wafer development; standards; environment, safety, and health; and manufacturing methods within International SEMATECH. Despite financial cutbacks, SEMATECH maintains its commitment to education and even started the Partnership for Workforce Development program to promote semiconductor manufacturing technology degrees at community colleges. The consortium carries out its activities with 600 employees, about 50 percent of which are assignees from member companies.⁴⁰

SUMMARY AND CONCLUSION

SEMATECH has received extensive praise within policy and management circles, and has often been cited as an impetus and model for additional government-industry partnerships. These accolades are based on a number of factors. First of all, SEMATECH's formation coincided with turnarounds in the U.S. semiconductor and SME industries. U.S. companies' share of the global semiconductor market, which trailed Japan's by more than 12 points in the late 1980s, surpassed Japan's by 1993.⁴¹ Meanwhile, the U.S. SME industry reversed a twenty-year decline in its global market share in 1990 and reestablished its lead over the Japanese the same year.⁴² While these results were partially due to a weakening of the Japanese industries and partially to actions taken by U.S. companies internally, SEMATECH also received credit. Secondly, SEMATECH met most of its internal objectives concerning the development of process technology, supply of manufacturing equipment and collaboration between manufacturers,

suppliers, and research centers. Most notable, it set and achieved specific technical goals to demonstrate the technology to produce smaller line widths and larger wafers. Additional testament to SEMATECH's success is its high member satisfaction level as indicated by members' return-on-investment factors and good member retention rates. Moreover, members have been willing to increase their investments in SEMATECH over time through assignees and higher membership dues. These signs point to SEMATECH as a success and an organization for future government-industry partnerships to emulate.

SEMATECH's successes are attributable both to fortunate circumstances and good management decisions. The consortium had a number of advantages that helped it during its early years. First of all, the semiconductor industry had experience working together prior to SEMATECH through the SIA and SRC. The SIA, established in 1975, acted as a lobbying body for the industry, and the SRC, which was instituted in 1982, channeled resources into university research on semiconductors. Secondly, SEMATECH could learn from the previous experiences of MCC, which preceded it. SEMATECH benefited from having a more specific objective, increasing U.S. market share of semiconductor sales, than MCC, which was working on the more vague and technologically diverse problem of developing 5th generation computer capabilities. This translated into a more homogeneous membership for SEMATECH, making it easier for members to work together. The nature of SEMATECH's research also enabled the consortium to set measurable goals for which to strive. Finally, financial support from the federal government guaranteed a steady source of revenue for at least five years and gave the program credibility in the eyes of those industry members who might have been doubtful.

While these factors enabled SEMATECH's success, they did not guarantee its success. Good management and decision making throughout the consortia's life built it into a strong and sustainable organization. Examples of good management foresight began with the founders. The SIA's lobbying efforts and framing of the industry's problems as threats to national security and the U.S. trade balance were precursors to receiving government funding. Political astuteness in later actions was essential for maintaining government support. Rules for sharing results were made simple: all members shared results equally. This avoided some of the problems MCC faced with division into factions and lack of member commitment to the entire program. While SEMATECH's initial research focus caused problems because it required members to share proprietary information, this focus was altered after the first year to one that was sustainable throughout SEMATECH's life. The new focus on the semiconductor manufacturing equipment industry was agreeable to most members (although two member left the consortium because they did not agree with it) and enabled SEMATECH to meet the technology goals it established for itself. Mechanisms such as the Technical Advisory Board (TAB) system, Return-On-Investment (ROI) methodology, and Individual Customer Service (ICS) program were instituted as means to ensure that decisions about the research program were

guided by members and that SEMATECH was meeting its members' expectations. Research projects were assigned timetables and were tightly managed so that they produced deliverables when expected. This attention to members' needs and pattern of generating usable results kept members actively involved in SEMATECH. CEO's and senior managers continued to serve on SEMATECH's boards and send quality assignees at all levels, which further strengthened the program. Wise choices made early on benefited SEMATECH throughout its lifetime. They established a framework within which SEMATECH could meet its goals and set up a stable organization that did not require radical overhauls. SEMATECH's management was then able to build upon their early successes and further strengthen the organization.

SEMATECH was also good at adapting to changing economic and political conditions. From the beginning, SEMATECH established itself in the center of semiconductor policymaking by ensuring it was well represented on government boards and committees. This helped the organization receive favorable reviews and remain in the public eye. It also took on the responsibility of developing and managing the National Semiconductor Technology Roadmap. The Roadmap brought together representatives from industry, government and academia to chart a course for semiconductor research and development. By aligning its goals with the Roadmap, SEMATECH became somewhat of an authority on the Roadmap's execution, giving the organization an important role and reason to continue receiving government funding even after the U.S. semiconductor industry had regained parity with the Japanese. SEMATECH was also able to point to specific accomplishments to further its arguments for continued government-industry cooperation beyond the initial five years. However, by 1997 the semiconductor and SME industries had gained sufficient strength to support SEMATECH without government help. The transition to no government funding was phased in between 1995 and 1997. It was made easier by the fact that SEMATECH's members were willing to make up part of the loss through higher dues. SEMATECH also adjusted well to globalization. In its early years, the consortium was strongly averse to participation by foreign firms. Its rules regarding international cooperation slowly evolved over time. International cooperative ventures and programs were established one at a time until, in 1998, SEMATECH transferred a number of its activities to a new subsidiary International SEMATECH. Because the change happened gradually, the transition was not difficult. SEMATECH was able to survive significant transition periods. It did so by building a base of support among its members and government and adjusting its mission and stance to meet the needs of that base over time. Transitions occurred gradually, and serving its members remained central to SEMATECH.

In their comparison of SEMATECH to other consortia world-wide, Grindley, Mowery, and Silverman suggest additional features which aided SEMATECH's success. The fact that SEMATECH was initiated by industry and not government was important, and the consortium's close association with its member companies throughout its life was a source of strength. Equally

essential was the fact that industry members were able and willing to make significant contributions to SEMATECH. This was possible because the industry was basically strong. SEMATECH was not trying to rebuild the industry, but only to fix a few weak areas. This fact also helped the consortium to narrow its focus. Unlike many European consortia, SEMATECH had the flexibility to revise its research agenda, making it easier to address its constituents changing needs and problems that arose. SEMATECH's focus on improvement and adoption of technology rather than basic research also helped it to survive because it was able to deliver faster results. A centralized management structure and careful management of internal and external projects served SEMATECH well compared to other consortia that act more as contracting organizations. These consortia often have trouble integrating the results of research performed externally. Likewise, the vertical structure that SEMATECH employed, including equipment makers and suppliers in the research process as well as a narrowly defined target industry, has proven to be more successful for consortia than horizontal structures involving a more widely defined industry without suppliers. Finally, setting up good practices for transferring technology results back to member companies through assignees and other formal processes was key to SEMATECH's success.

SEMATECH has been widely studied and has helped scholars better understand the necessary conditions and inter-workings of public-private partnerships. It is regarded as model for public-private partnerships due to its achievements. Over its ten-year existence, it has evolved with conditions of the time without losing its primary focus or base of support. It has benefited both from fortuitous circumstances and good management decisions. Early successes set the tone for the rest of SEMATECH's life. Also essential for its survival has been its close association with its member companies. Recent years have brought significant changes to SEMATECH's operations with the end of government funding and the internationalization of some of its functions. However, the consortium appears to be adjusting well and has a promising future outlook, thanks in part to the strong foundation it lay for itself in earlier years.

NOTES

¹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial: The Microelectronics and Computer Technology Corporation* (Boston: Harvard Business School Press, 1994), p. 8.

² Ibid., p. 474.

³ Grindley, Peter, David C. Mowery and Brian Silverman, "SEMATECH and Collaborative Research: Lessons in the Design of High-Technology Consortia," *Journal of Policy Analysis and Management*, Vol. 13, No. 4, 1994, p. 739.

⁴ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 475; and John B. Horrigan, "Cooperating Competitors: A Comparison of MCC and SEMATECH," Working Paper, Board on Science, Technology, and Economic Policy, National Research Council, forthcoming, p. 3.

⁵ John B. Horrigan, "Cooperating Competitors," p. 4; and Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 477.

⁶ John B. Horrigan, "Cooperating Competitors," p. 4; and Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 477-482.

⁷ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 473.

⁸ John B. Horrigan, "Cooperating Competitors," pp. 5, 10.

⁹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 503; John B. Horrigan, "Cooperating Competitors," pp. 16-17.

¹⁰ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 500-502; John B. Horrigan, "Cooperating Competitors," pp. 3-4.

¹¹ John B. Horrigan, "Cooperating Competitors," p. 4.

¹² Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 475-477; and John B. Horrigan, "Cooperating Competitors," pp. 23-24.

¹³ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 469, 483-497.

¹⁴ *Ibid.*, pp. 508-510.

¹⁵ John B. Horrigan, "Cooperating Competitors," pp. 5, 8-9; and Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 503-504.

¹⁶ John B. Horrigan, "Cooperating Competitors," p. 9.

¹⁷ *Ibid.*, p. 9.

¹⁸ Grindley, Peter, David C. Mowery and Brian Silverman, "SEMATECH and Collaborative Research," p. 732.

¹⁹ *Ibid.*, pp. 730-734.

²⁰ John B. Horrigan, "Cooperating Competitors," p. 10, 25-26; and SEMATECH, "Timeline of Events," SEMATECH web site [cited September 1998], available from: http://www.semtech.org/public/general/chrono/time_toc.htm; INTERNET.

²¹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 510.

²² SEMATECH, "Semiconductor Industry Suppliers Association of America, SEMI/SEMATECH" SEMATECH web site [cited September 1998], available from: <http://www.semtech.org/semi-sematech/home.htm>; INTERNET.; and Grindley, Peter, David C. Mowery and Brian Silverman, "SEMATECH and Collaborative Research," pp. 729-730.

²³ SEMATECH, "1997 Annual Report," SEMATECH web site [cited September 1998], available from: <http://www.semtech.org/public/annrpt.htm>; INTERNET.

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- ²⁴ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 506.
- ²⁵ SEMATECH, "1997 Annual Report," SEMATECH web site [cited September 1998], available from: <http://www.sematech.org/public/annrpt.htm>; INTERNET.
- ²⁶ John B. Horrigan, "Cooperating Competitors," pp. 16-17.
- ²⁷ Ibid., 17-18.
- ²⁸ SEMATECH, *1997 Annual Report*.
- ²⁹ Ibid.
- ³⁰ Ibid.
- ³¹ John B. Horrigan, "Cooperating Competitors," pp. 18-19; and Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 523-527.
- ³² John B. Horrigan, "Cooperating Competitors," pp. 23-26.
- ³³ SEMATECH, *1997 Annual Report*.
- ³⁴ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 502, 512-520; and SEMATECH, "Timeline of Events," SEMATECH web site [cited September 1998], available from: http://www.sematech.org/public/general/chrono/time_toc.htm; INTERNET.
- ³⁵ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, p. 520.
- ³⁶ Ibid., pp. 519-520.
- ³⁷ SEMATECH, *1997 Annual Report*.
- ³⁸ SEMATECH, "Facts about SEMATECH and International SEMATECH," SEMATECH web site [cited September 1998], available from: <http://www.sematech.org/public/general/about.htm>; INTERNET.
- ³⁹ SEMATECH, "SEMATECH and International SEMATECH Mission, Vision, and Values," SEMATECH web site [cited September 1998], available from: <http://www.sematech.org/public/general/mission.htm>; INTERNET.
- ⁴⁰ SEMATECH, "SEmiconductor MANufacturing TECHnology," SEMATECH web site [cited September 1998], available from: <http://www.sematech.org/public/home.htm>; INTERNET.
- ⁴¹ Gibson, David V. and Everett M. Rogers, *R&D Collaboration on Trial*, pp. 8-9, 528-530.
- ⁴² Grindley, Peter, David C. Mowery and Brian Silverman, "SEMATECH and Collaborative Research," pp. 739-740.

CHAPTER 8. PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

The Partnership for a New Generation of Vehicles (PNGV) is a cooperative research and development program between the U.S. government and the United States Council for Automotive Research (USCAR) which is comprised of Chrysler Corporation, Ford Motor Company, and General Motors Corporation. President Clinton initiated the PNGV in 1993 with the primary goal of developing a vehicle capable of achieving three times the fuel efficiency of current family sedans while maintaining or improving levels of performance, size, utility and total cost of ownership while also meeting federal safety and emissions requirements. This ambitious goal prompted immediate action by industry and government partners and has become the basis for a positive working relationship. At this time, the partnership has successfully fulfilled its first milestone, technology selection, and continues toward creating concept vehicles and then prototype vehicles by 2004.

Unlike SEMATECH, the PNGV's government support comes largely from existing projects within seven different government agencies. No new government funds have been allocated for the program. While this has posed unique management challenges, it has been a testament to government's ability to leverage all sources of support to their fullest extent. In addition, the partnership is enabling faster commercialization of government research with the help of its industry partners. While the final analysis of PNGV remains to be made, it is already serving as a valuable model for future public-private partnerships.

PROGRAM FORMATION

Motivation and Initiative

During the latter part of the 20th century, the U.S. automobile industry has been a major element of the U.S. economy, capturing 4.5 percent of the U.S. Gross Domestic Product in 1991 and accounting for 10 percent of consumer spending. However, the U.S. share of world automobile sales declined steadily from 76 percent in 1950 to only 19 percent in 1991, although U.S. companies fared better domestically, retaining 79 percent of the market in 1991. In 1992, imported cars and parts accounted for \$39 billion of the US's \$84 billion trade deficit while imported petroleum, used largely to fuel automobiles, accounted for another \$45 billion. Highway miles driven in the U.S. nearly quadrupled between 1950 and 1990 and were expected to continue to increase, causing significant environmental impacts.¹ This prompted the U.S. and state governments to pass increasingly stringent regulations on automobile emissions during the same time period. Particularly startling to the auto industry was California's 1990 mandate that two percent of new cars sold in the state must be "zero emission vehicles" by 1998. These

factors prompted the U.S. government and auto industry to work together to solve their mutual problems.

The PNGV arose out of President Clinton's initiative announced on February 22, 1993, called, "Technology for America's Economic Growth, a New Direction to Build Economic Strength." The initiative intended to move America toward a stronger economy, cleaner environment, more competitive business, more effective government, and technological leadership in critical fields. Part of Clinton's plan was to link research efforts between government agencies and the U.S. automobile industry in the development of prototype vehicles which would substantially increase fuel efficiency while reducing emission levels and conforming to current standards of performance, size, utility, safety and affordability. The results would reduce the US's dependence on foreign oil while increasing the competitiveness of the U.S. automobile industry and reducing the environmental impacts of driving.²

The U.S. Big Three auto makers had been working together on specific research efforts since 1988. In 1992, they formed the United States Council for Automotive Research (USCAR) to coordinate the various consortia which had formed to explore various automotive technical issues.³ USCAR and its constituent companies - Chrysler, Ford and General Motors - agreed to the Clinton initiative, and together they developed a shared vision and published a Declaration of Intent for the PNGV, which President Clinton announced on September 29, 1993. A program plan produced ten months later provided additional details about the new partnership. The agreement to cooperate through the PNGV marked a distinct departure from the adversarial relationship that had been traditional between government and the automobile industry.⁴

Initial Organization

Purpose and Goals. The PNGV was intended to help the automobile industry make a quantum leap in technology, focusing on largely untested alternative technologies to develop a new generation of vehicles that could achieve fuel economies up to three times those of current vehicles. This was to be accomplished by bringing together the research and development resources of the federal establishment, including national laboratories and university-based research institutions, with the vehicle design, manufacturing, and marketing capabilities of the automotive industry. The July, 1994, PNGV Program Plan laid out three specific goals for the partnership:

- Goal 1 – Significantly improve national competitiveness in manufacturing;
- Goal 2 – Implement commercially viable innovation from ongoing research on conventional vehicles; and
- Goal 3 – Develop a vehicle which achieves up to three times the fuel efficiency of today's comparable vehicles.⁵

While goals 1 and 2 were important components of goal 3 and yielded shorter term results, goal 3 was the ultimate objective of the partnership and where most attention was focused. The new

vehicle was to be comparable to the 1994 models of Chrysler Concorde, Ford Taurus, and Chevrolet Lumina in terms of passenger- and load-carrying capabilities, performance, handling, customer features, safety, useful life, servicing requirements, and total cost of ownership while achieving fuel efficiencies of approximately 80 miles per gallon (or equivalent BTUs for alternative fuels). Goals 1 and 2 were to be primarily within the domain of the industry partners while government was to concentrate its efforts on goal 3 and especially high-risk features of the program. An aggressive timeline was established for the program with target dates of 1997 for selecting the most promising technologies, 2000 for constructing concept vehicles, and 2004 for developing production prototype vehicles.⁶

Participation. The PNGV is a partnership between seven government agencies – the Department of Commerce (DOC), the Department of Defense (DOD), the Department of Energy (DOE), the Department of Transportation (DOT), the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency (EPA), and the National Science Foundation – and USCAR, which comprises Chrysler, Ford, and General Motors.⁷ The partnership is maintained through various contracts, understandings, cooperative research and development agreements, grants and other shared research arrangements among private partners and individual government agencies. Through these mechanisms, universities, suppliers and other parties capable of making relevant contributions can also participate in PNGV. Specific programs and agencies of particular importance to the PNGV are the DOE, the Advanced Technology Program of the National Institute of Standards (NIST) within the DOC, the Technology Reinvestment Program (TRP) within the Advanced Research Projects Agency in the DOD, and National Laboratory Cooperative Research and Development Agreements (CRADA).⁸ As specified by the Clinton administration, the PNGV does not involve new government funds, but instead earmarks existing research projects within government agencies relevant to PNGV. Therefore, PNGV has no specific budget and it is difficult to assess exactly how much federal money is allocated to the program, but the program was initiated with the idea of spending approximately \$300 million per year in government funds on PNGV-related projects. Funding cuts in 1996 reduced government PNGV expenditures to about \$225 million. About half of these estimated annual expenditures are for research projects in federal labs that are not strictly dedicated to PNGV but have potential for PNGV application.⁹

Management Structure. The PNGV management structure involves separate industry and government management bodies in a parallel form. Operational Steering Groups and Technical Teams are the primary governing bodies. The Operational Steering Groups are in charge of strategic planning, reviewing and prioritizing programs, assuring the availability of resources and funding, coordinating legal and public affairs functions, and providing direction to the Technical Teams. On the government side, the Operational Steering Group is chaired by the Under Secretary for Technology from the DOC and includes senior officials from each of the

seven participating agencies plus the Office of the Vice President (OVP), Office of Science and Technology Policy (OSTP), Office of Management and Budget (OMB), National Economic Council (NEC), and the Office of Environmental Policy (OEP). Industry's Operational Steering Group is composed of Vice Presidents from Chrysler, Ford, and General Motors who rotate chair responsibilities and are supported by each company's PNGV director. The Technical Teams report to the Operational Steering Groups and are responsible for plan development and implementation, project management, coordination of technical expertise among government and industry, and communication of progress to the Operational Steering Groups. Government and industry structured their technical teams differently with government's divided into panels based on specific technical areas and industry's built around pre-existing consortia within USCAR. Government's Technical Team is made up of technology managers from the seven operating agencies and OVP, OSTP, and OMB, while industry's comprises senior executives from the three auto companies. Legal and public affairs groups for both sides report to the Operational Steering Groups. A Government PNGV Secretariat and the USCAR Secretariat provided administrative functions such as storing and disseminating data, maintaining facilities and responding to public requests. The National Research Council, which is associated with the National Academy of Science and the National Academy of Engineering, is also involved as the independent evaluator of the PNGV program.¹⁰

PROGRAM DEVELOPMENT AND EVOLUTION

The technical challenge of the PNGV has been likened to the United States Apollo Space project of the 1960's, yet PNGV operates under far more constrained conditions. Its research projects are spread over multiple government laboratories within 7 separate federal agencies, three major automobile manufacturing companies, other research consortium, universities, supply companies and additional outside contractors. PNGV's management has limited abilities to control projects or direct resources within the government sector. Public and political support for the PNGV are far less than for the Apollo space program, and the requirement that government funds must come from within existing programs poses additional management challenges. The PNGV partners come from radically different cultures with traditionally adversarial relationships. In addition to these management challenges, the PNGV product must be marketable to the U.S. public, making the technical challenge even greater. Despite the multitude of challenges facing PNGV, the program has been successful in developing a number of new technologies and meeting its first major milestone.

With PNGV's limited resources and management constraints, meeting its goals depends on maintaining its focus and leveraging resources in the best possible manner. PNGV's management has been aided by the periodic peer review conducted by the NCR's Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles

(Review Committee). The Review Committee is a team of distinguished scientists and engineers who are charged with assessing the progress of PNGV over time and the relevance of research projects and management characteristics to the PNGV goals and schedule. Besides serving as a management tool, the Review Committee's four reports provide insight into the issues and challenges facing the PNGV throughout its life. This section outlines a number of these issues, the Review Committee's recommendations, and PNGV's response, when available. The first report, published in 1994, concentrates on management issues while later reports become increasingly technically oriented. Therefore, the majority of issues discussed in this paper come from the first two reports. The fourth report, published in 1998, also provides valuable insight into PNGV's recent achievement in meeting its 1997 milestone and suggests future directions for the program. Management issues addressed by the Review Committee revolve around national commitment to PNGV, management and organizational structure, government funding and support, and external influences and impacts.

As consistent with the nature of evaluation reports, most of the comments concern problems or areas for improvement. However, the Review Committee also cites a number of positive elements and frequently commends the PNGV for improvements made. Especially noteworthy is the first report's recognition of the high level of cooperation and positive working relationship established between the government and industry partners.

National Commitment

The PNGV was initiated by the Clinton administration and remained largely a partnership between the administration and USCAR at the time of the first report. The Review Committee believed that accomplishing the ambitious objectives of the program would require the sustained commitment by Congress and the public, as well as the administration. Establishing wide-based support for the program was especially crucial and difficult because the benefits from PNGV were expected to take many years to develop and would be widely diffuse. Therefore, support from one or a few core groups was relatively unlikely, but PNGV's survival was dependent upon making its goals a national priority.

In its first report, the Review Committee recommended that the public affairs groups be provided adequate resources to launch a public affairs campaign and suggested specific actions which could be taken. The second report commended the partnership's progress on this matter over the ensuing year, especially through its media education efforts and the creation of a world wide web page. However, the report identified additional problem areas and opportunities as well. Widespread publicity through advertisements; newsletter, magazine, and video promotions; showcasing of the PNGV vehicle at public venues; and increased participation at relevant trade shows, meetings, and conferences was touted as critical for gaining public support for PNGV. Keeping Congress members and their staffs fully informed about the PNGV's goals and activities was also recommended. Both government and industry partners were to have roles in these

efforts. The second report also suggested that the disunity among the government agencies concerning PNGV initiatives and the lack of commitment from some (the DOT and NASA in particular) hurt the program in terms of gaining Congressional support. A need for coordinated public affairs efforts between the agencies and unified presentation of the program in front of Congress was stressed. The PNGV management was generally supportive of the Review Committee's comments regarding building public and political support and worked to strengthen its public relations efforts.¹¹

Program Management

Program management, both on the government and industry sides, was a serious concern to the Review Committee in the early years. While the Review Committee conceded that the original PNGV management structure, composed of dual Operational Steering Groups and Technical Teams, was adequate for governing the PNGV, the committee doubted its abilities to manage the functional details of the program. The Review Committee believed a centralized government program manager and staff would be necessary for this purpose. It cited the inability to redeploy funds and direct projects within separate agencies as weaknesses of the existing management system. Despite these urgings, PNGV leaders did not feel that instituting a central manager was possible, and no action was taken.

An Integrated Platform Development Team and Technical Director were recommended in the first report to unify industry's efforts toward goal 3 of the program. Industry's later decision to develop separate concept vehicles within each company decreased the need for an Integrated Platform Development Team. However, the Review Committee viewed this decision as evidence of poor integration between the industry partners and continued to advocate a single technical director for USCAR and the establishment of integrated working groups. The Review Committee argued that a single technical director could coordinate and manage projects and address problems that had arisen concerning project delays and USCAR staff giving inadequate time to PNGV. This suggestion also failed to be implemented.

Another concern to the Review Committee in the first report was the lack of planning documents with detailed objectives, responsibilities, schedules, milestones, budgets, and resource allocations. Most of these issues were addressed in the PNGV Technical Roadmap developed in 1995. However, two years after the project began, the Roadmap still did not adequately identify resource requirements or present critical milestones and quantitative performance measures for all issues. The Review Committee also pointed out that the PNGV lacked a coherent strategy for determining which technologies to support, and it stressed the urgency of developing such a strategy. According to the Review Committee, the strategy should address making trade-offs between technologies that were most likely to meet the technical requirements verses technologies that had the greatest likelihood of being developed within the PNGV timeframe. One tool for aiding technology selection and determining performance targets

and tradeoff parameters is systems analysis. Systems analysis is an analytical process through which evaluators can assess competing technologies and vehicle concepts in relation to the vehicle performance requirements of goal 3. The Review Committee considered systems analysis essential for successful management of PNGV and noted that while efforts to implement systems analysis had begun prior to the second report, it was not yet being fully utilized due to lack of adequate resources. This delay was expected to hinder the technology selection process and possibly compromise the PNGV's ability to meet its 1997 target date for narrowing the technology focus. Despite these lapses in the planning processes, PNGV was able to meet the 1997 milestone. The Review Committee acknowledged in later reports that the systems analysis and other planning functions improved greatly over time.¹²

Government Funding and Support

One of the major selling points when the PNGV was formed was that it would not require any new government funding. Support for PNGV was to come from existing funds and programs within participating federal agencies. Therefore, PNGV-related projects were, to a large degree, components within other research projects or required the redirection of funds within the agencies to specific PNGV purposes. Left to their own discretion, some agencies, such as the Department of Defense and NASA, failed to support specific PNGV-related projects to the degree expected. Redirection of funds was complicated by the different authorization and appropriation language governing PNGV targeted projects. These factors made it difficult for PNGV management to control projects, define a specific budget for PNGV, or redirect resources according to PNGV's priorities. In order to give PNGV management greater control over relevant projects, the Review Committee strongly recommended that the PNGV seek funding through a central line-item in the federal budget for its major elements. However, PNGV management did not believe that this idea would be politically feasible and decided to continue with the original funding plan.¹³

Outside Influences

A program as large and revolutionary as PNGV is subject to a number of influences beyond its direct scope. While PNGV's technical program presented ample challenges to occupy the full attention of those involved, it was important that the program participants not operate in a vacuum, but account for external activities and conditions. Two external influences that the Review Committee brought to light were international advanced car developments and infrastructure implications. The Review Committee suggested that these two factors be considered in future research decisions and technology selection processes. PNGV's formation in 1993 was quickly followed by the formations of similar partnerships in Europe and Japan to develop advanced automotive technologies. This raised the stakes for PNGV, making intense international competition for the sale of high-tech vehicles likely. A preliminary survey in 1995 suggested that the U.S. was behind its foreign competitors in certain key technologies associated

with PNGV. The committee considered this both a rallying cry for PNGV support and incentive for developing international technology review and benchmarking processes.¹⁴

PNGV was conceived with the vision of increasing national competitiveness, reducing dependency on foreign sources of energy, and lowering energy consumption and environmental pollution. However the radical changes proposed by PNGV could have revolutionary impacts on existing infrastructure systems, the results of which are largely unknown. These results have the potential to jeopardize gains made by PNGV in terms of national objectives. Impacts are likely to materials and parts supply bases; maintenance, repair, recycling, and insurance industries; energy sources; highway infrastructure; public safety; and environmental systems. Shifts in capital and labor needs are anticipated due to these changes. A couple of studies on infrastructure and capital impacts and needs were conducted prior to the second report. However, due to the potentially far-reaching effects of PNGV, the Review Committee suggested continued and in-depth studying of this issue. It also felt that minimization of the negative impacts on infrastructure systems should influence technology decisions.¹⁵

CURRENT SITUATION

PNGV recently completed on time its first major milestone, selection of the technology to be used in the year 2000 concept vehicles. This major accomplishment for industry and government partners involved the study and development of many competing technologies to determine which have potential to meet the requirements and time schedule for goal 3. Throughout PNGV's life, debate has ensued over whether to support technologies with the greatest potential to meet or exceed PNGV goal 3 requirements or those technologies which have the greatest potential for commercial development by the 2004 target date. The selected technologies favor lower-risk and shorter development times. Currently, no plan exists for supporting the development of non-selected technologies, although many of these technologies demonstrate potential for application in advanced vehicles beyond the PNGV timeframe. In light of remaining uncertainties in the selected technology, PNGV loosened final vehicle requirements concerning performance, utility, and cost-potential to be within 30 percent of the original targets; however, requirements for fuel economy, emissions, and safety were not relaxed. PNGV estimates that the 2000 concept vehicles may not meet all of the goal 3 requirements but remains confident that the 2004 prototype vehicles will. With the achievement of the first milestone, the primary burden for future activities shifts to industry to develop concept and prototype vehicles. However, the government is still expected to play an important role in supporting technology development.¹⁶

SUMMARY AND CONCLUSIONS

While the ultimate outcome of PNGV remains to be seen, the partnership has demonstrated enough early success to be considered a model for future government-industry partnerships. Perhaps most significantly, the PNGV transformed a previously adversarial relationship between the automobile industry and the U.S. government into a mutually beneficial working relationship. PNGV represents a new way for government to approach environmental protection and other national priorities. Instead of fighting with the automobile industry over regulations that it insists are infeasible, the PNGV uses existing government resources to help the industry achieve higher standards. The partnership takes advantage of both sides' strengths: the government's in long-term, high-risk research, and the auto industry's in applying and marketing research results. PNGV also provides a means of increasing the commercial applicability of existing government research. At the same time, it has not led to any new government expenditures.

The PNGV has faced a number of management obstacles and less than ideal conditions. These include the scattering of its research projects across multiple federal agencies, lack of a central budget, varying levels of government support, low national recognition, and limited management flexibility. Yet, PNGV has achieved its first milestone despite these obstacles. This is partially due to the strong vision driving the partnership. A vehicle comparable to today's family sedans with fuel economies of up to 80 miles per gallon is a clear and exciting goal for all those involved and the public at large. There is also unarguable value to both partners in achieving the vision. For the auto industry, this value is increased competitiveness, and for the government it is reduced environmental pollution and decreased reliance on foreign energy. The vision is strengthened by specific technical parameters that provide a clear focus for the program. Preliminary milestones break down the long-term research goal into shorter-term parts, making it easier to gauge progress along the way and giving the program opportunities to celebrate early successes. A tight time line increases the urgency of the program, discouraging project delays and requiring careful decision making. PNGV's objectives are extremely ambitious and represent stretch goals more than realistic expectations. However, they create excitement and serve as good motivating factors for those involved as well as for the general public.

Critics of PNGV argue that the program is corporate welfare and should be the full responsibility of industry. However, without government prodding or mandate, industry has little incentive to invest in developing a PNGV-type vehicle. The development risks are high and have limited payoff for the auto industry. The benefits of the PNGV vehicle - decreased air pollution and lessened reliance on foreign energy sources - are widely diffuse, accruing to the population as a whole. Therefore, it would be difficult for such a program to generate industry support. However, the high potential payoffs warrant government support. PNGV's reliance on government has created some difficulties. The program is subject to political whims, as

demonstrated in the 1996 funding reductions. In order to make the program politically feasible, the founders decided not to ask for any new government funds for PNGV. This placed PNGV at the mercy of federal agencies to redistribute their funds in support of PNGV projects. Some agencies resisted. These issues created extra management challenges for PNGV leaders.

The Review Committee and PNGV's leaders had differing views regarding management and organizational structure. The review committee argued that PNGV's management had limited abilities to direct resources or control projects to the degree required to meet the program's objectives. This was partially due to the fact that PNGV did not have a specific line-item budget allocation. The committee urged PNGV to push for greater central control and line-item budget allocation. PNGV's management did not feel that these options were politically feasible and continued to operate under the original management structure. It remains unclear whether a different management structure would have benefited the project. A management tool that proved to be valuable for PNGV was peer reviews. These reviews helped the program maintain focus and identified weaknesses.

PNGV represents the power of combining government and industry strengths with an ambitious vision. Despite challenging conditions, the program is well on its way to achieving its vision, as demonstrated by completion of the first milestone. Without the motivation and backing from government, PNGV would probably never have been initiated. Likewise, industry provides the necessary link between advanced technologies and marketable products. Together, the industry and government partners have formed new working relationships and an enthusiasm to succeed. Even if PNGV falls short of its 2004 goals, it has already set in motion revolutionary thinking about automobile production. These ideas are likely to continue well beyond the life of PNGV.

NOTES

¹ "Auto Facts" (material presented to the Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, Dearborn, Michigan, August 22-25, 1994).

² Partnership for a New Generation of Vehicles (PNGV), "Declaration of Intent," Washington, DC, 1993.

³ United States Council for Automotive Research, "USCAR as Umbrella for Big Three Research," Dearborn, Michigan, June 29, 1994 (press release).

⁴ Partnership for a New Generation of Vehicles (PNGV), "Declaration of Intent," Washington, DC, 1993.

⁵ PNGV, *Program Plan* (Washington, DC, November 29, 1995), p. 1-1.

⁶ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 6-8.

⁷ PNGV, *Program Plan* (Washington, DC, November 29, 1995), p. 2-1.

⁸ *Ibid.*, pp. 9-1, 10-2 – 10-2.

⁹ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Fourth Report* (Washington, DC: National Academy Press, 1998), p. 87.

¹⁰ PNGV, *Program Plan* (Washington, DC, November 29, 1995), pp. 2-1 – 2-1, 8-1.

¹¹ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles* (Washington, DC: National Academy Press, 1994), pp. 2, 23-25; and Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 24, 81-83.

¹² Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles* (Washington, DC: National Academy Press, 1994), pp. 2-4, 19-22, 25-26, 31-33; and Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 20-22, 67-70, 71-79, 101-104.

¹³ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles* (Washington, DC: National Academy Press, 1994), pp. 3, 22-23, 32; and Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 25, 75-76.

¹⁴ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 19-20, 77-79; and Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Fourth Report* (Washington, DC: National Academy Press, 1998), pp. 83-84.

¹⁵ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Second Report* (Washington, DC: National Academy Press, 1996), pp. 22-23, 62-66.

¹⁶ Standing Committee to Review the Research Program of the Partnership for a New Generation of Vehicles, *Review of the Research Program of the Partnership for a New Generation of Vehicles Fourth Report* (Washington, DC: National Academy Press, 1998), pp. 62-69, 75-79, 85-88.

CHAPTER 9. CONCLUSIONS

This paper has explored a number of unique and creative partnership. Many were revolutionary concepts for their times and all required that partners adjust to new ways of doing business. The case studies represent different organizational approaches and business philosophies regarding partnerships. Each has unique characteristics, but there are also many similarities among the cases examined. This chapter discusses lessons learned and common-points among the case studies.

VISION, OBJECTIVES, AND GOALS

Each of the partnerships studied were driven by strong motivating factors which initially drew the partners together. The most successful partnerships were able to translate these motivating factors into a compelling vision and clearly defined objectives. The vision is a primary factor in bringing partners together and helping sustain partnerships over long-terms. Based on the experiences of the partnerships studied, narrow visions which seek to achieve one primary goal obtain the best results. More widely defined visions build in undesirable complexity to organizations. They often require additional partners, making coordination of interests more difficult. Wide visions and objectives spread resources more thinly and require multiple foci, making it harder to achieve any one objective. At the same time, wide visions increase the expectations placed on a partnership and can lead to discontentment if any of these expectations are not met. Narrow visions create a clearer purpose for the organization and are easier to sell to potential partners. Comparisons between MCC and SEMATECH support these conclusions. MCC's wide reaching vision led to the problems described here. On the other hand, SEMATECH established a narrow vision, enabling it to focus efforts and resources on accomplishing its primary goal.

Secondly, partnerships benefit most from visions and objectives that are results-oriented with measurable standards of achievement. In other word, goals should be set to accomplish specific tasks within a given time period. These goals should have standards which allow clear determination of whether the goal has been reached. It is best if one or more of these goals can be accomplished within a short time period. This gives the partnership an opportunity to achieve some level of success early in its lifetime. Early successes are important for sustaining momentum and bolstering commitment to the partnership. The PNGV used these tactics. Even though its ultimate objective required long-term development, it established interim milestones. These gave the partnership occasions to celebrate its success and assess its progress along the way. The PNGV also clearly defined standards of success in its description of the new generation vehicle.

It is unrealistic to expect visions and objectives to remain static over long time periods. Many of the partnerships studies experienced changes in their goals over time. After its operational test, HELP discovered that its technology was more valuable for electronic clearance purposes than for data collection and dissemination, its originally intended function. SEMATECH's objectives gradually expanded in scope and became more globally focused to adjust to changes in the industry. However, it is important to point out that SEMATECH started with a narrow vision and expanded this vision only after it had established a history of success and a strong commitment from its members. SEMATECH also phased in its changes gradually. This marks a distinction from MCC, which performed several radical overhauls of its objectives in an effort to halt declining member support. MCC's changes usually did not have the intended effect.

PARTICIPATION

Establishing and maintaining commitment from the correct parties is crucial to the success of public-private partnerships. Of utmost importance is ensuring that all relevant parties are actively involved. Inclusion of trucking industry interests as well as multiple state agencies from the early stages of development is what enabled the successes of Advantage CVO and HELP, Inc. SEMATECH found its vertical structure, which included both manufacturers and suppliers, beneficial. However, all partners involved should have a specific stake in the partnership's primary goal. Involving partners with different primary objectives leads to diversity of interests and can complicate operations or side-track the program. MCC had this problem. It was formed by a number of parties with inherently different primary interests. These diverse interests pushed the consortium in many different directions, making it difficult to achieve any of its objectives.

In many cases, potential members are reluctant to join partnerships at first. MCC, PNGV and Advantage CVO all faced this problem. Endorsement by high-ranking officials often helps this situation. Advantage CVO (Advantage I-75 at the time) gained acceptance after six governors signed a petition in support of the program. President Clinton's leadership in the formation of PNGV was critical. MCC gained greater support after Congress passed the National Cooperative Research Act.

One common characteristic among the cases studied is that they all involve cooperation between traditionally adversarial parties. Building trust among parties is a critical element in most partnerships. In doing so, it is important that each party has adequate input into decision-making processes and that each believes its concerns are taken seriously. In addition, a strong vision for the partnership, promising mutually beneficial results, often acts as the glue that binds partners together and helps them to overcome differences. The ITS case studies report that improved relationships between the motor carrier industry and state governments has had positive effects that transcend the partnerships.

Perhaps the most important factor in gaining and sustaining commitment to partnerships is ensuring that each partner benefits substantially from the success of the partnerships. HELP, Inc., has done an excellent job of tying together the interests of its partners. SEMATECH has also maintained good member commitment by focusing on customer satisfaction. It prides itself on delivering results that its members can use. The consortium also has a number of mechanisms to ensure that its objectives remain aligned with member interests.

ORGANIZATION

There are some common points in the organization of all of the partnerships studied. All are led by policy-making boards comprised of representatives of the partners. Often, these boards are aided by full-time staff and committees. Case study evaluations have noted the importance of finding the right representatives to serve on the board and committees. The representatives to the policy board must have the authority and interest to commit resources to the program. Partnerships whose boards are comprised of the top management echelon of their member organizations tend to be the most successful, because these personnel can commit the most resources. At the same time, it is important to have representatives with subject matter expertise involved. For this reason, some of the partnerships studied have both a policy board and a committee of representatives for making technical decisions. This tends to work well in situations where the policy body representative and technical representative communicate well; otherwise, decisions can be disjointed. MCC had this problem because representatives responsible for technical decisions were at much lower levels in their member companies than the policy board representatives. Establishing formal lines of communication between representatives, as SEMATECH did, can help this situation. Another important point about policy boards and decision making bodies is that size creates complexities and encumbers the decision-making process. Tradeoffs must be made between including all relevant parties and limiting decision-making bodies to manageable sizes.

A full-time staff is considered to be beneficial for several reasons. First of all, turnover on boards and committees is often high. A full-time staff can provide consistency and long-term memory for partnerships. Secondly, in the absence of a full-time staff, various partners must take leadership responsibilities. This can cause confusion about roles and responsibilities and, at times, can lead to lapses in leadership. HELP, Inc. experienced this problem during its operational test and subsequently appointed a full-time staff.

Another important aspect of the cases studied is that most call for partners to make changes to their own organizations in order to support the goals of the partnership. State partners in Advantage CVO and HELP, Inc. changed some of their internal processes and standards for regulating motor carriers in order to create compatible systems. SEMATECH and MCC needed their member companies to donate the best and brightest employees to the consortia in order to make technology transfer successful. PNGV requires government agencies

to divert resources from other research programs. A notable exception is the I-95 Corridor Coalition, which does not attempt to change its member organizations.

FUNDING

Funding is a critical aspect of any partnership and deserves some attention. With the exception of the I-95 Corridor Coalition, all of the partnerships under study require some type of financial contribution from participants. In many cases (SEMATECH, MCC, Advantage CVO, MAPS) member contributions are the primary funding source for the partnership. Consequently, customer satisfaction is imperative. Of these partnerships, SEMATECH is the only one that has clearly demonstrated its ability to survive purely upon member contributions. While Advantage CVO and MAPS have experienced excellent success with some states in committing financial resources toward its objectives, many states have been slow to take action. However, less than a year has passed since Advantage CVO became an independent organization without reliance on federal funds. Therefore, its ability to sustain itself through state funding remains to be determined. MCC's revenues have declined dramatically over the years and today are about one third of their peak values.

HELP, Inc. has the most unique funding structure, leveraging two sources of private funding: usage fees from motor carriers and venture capital from its technology supplier. These mechanisms have allowed deployment of its service at a rapid rate with minimal state investment requirements. While the partnership has received criticism that its usage fees constitute a tax on motor carriers, the high enrollment of motor carriers in the program counteracts this argument. The funding arrangement depends upon an up-front investment from a large private company, Lockheed Martin. In order to sustain the arrangement, HELP, Inc.'s PrePass system must generate adequate revenues to repay Lockheed Martin. Its ability to do so, will indicate the viability of this type of funding alternative for future partnerships.

Several partnerships have instituted graded cost requirements, where some members can join for a lesser fee and not receive the same benefits as full members. Generally, associate membership, as it is often called, does not allow the party to have representation on the decision-making boards. This membership option is generally designed to encourage new organizations to join the partnership, in the hopes that they will eventually graduate to full membership. However, this idea can backfire, as MCC discovered. If the distinctions between full and associate membership are too small, existing full members may revert to associate membership. On the other hand, creating different benefit schedules for different levels of members complicates the partnership. MCC's members got so caught up in separating the benefits received by partners for different levels of financial commitment that they lost the ability to interact freely and work together. One of the keys to SEMATECH's success was its requirement that all members pay equal rates and receive the same benefits. This ensures that partners are equally committed to the partnership's success as well.

The federal government has participated to varying degrees in almost all the partnerships studied. Federal funding in the early years of a partnership can be valuable to help it get established. This gives the partnership time to build member support, work out initial differences, and achieve some early successes before the partnership must be self-sustaining. However, there is also danger of partnerships becoming reliant on federal funds. Federal funding for the partnerships studied was usually dedicated to research purposes and was intended to be discontinued when the research was complete. If partnerships become reliant on these funds and do not have plans for self-sufficiency, they are subject to failure at the end of the federal funding period. Partnerships that plan from the early stages for eventual self-sufficiency are the most successful at weathering this transition. SEMATECH and HELP, Inc. both managed to continue their operations at the end of federal funding. A common element to both partnerships is that they received substantial funding from their members even during federal funding periods. This set a precedent and ensured that only committed members were involved in the partnership, making the transition smoother.

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