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CENTER FOR TRANSPORTATION RESEARCH

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WORK PLAN FOR ESTABLISHING A PUBLIC-PRIVATE CONSORTIUM FOR TECHNOLOGY DEVELOPMENT

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TxDOT Project 0-6803: Technology Task Force

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1. Background

The Texas Technology Task Force (TTTF) proposes that Texas launch a public-private consortium that will bring together technology industry leaders and experts, public professionals and representatives, nonprofit organizations, and research institutions in order to encourage the adoption of emerging technologies that will contribute to a safer, more efficient, seamless, and enjoyable transportation system.

2. Public-Private Consortium (PPC)

The proposed consortium is to be a public-private partnership established with the intent of researching, developing, and implementing new technologies that will be exploitable by Texas industry. Partnerships will likely be an association of the State, the technology industry, nonprofit organizations, and research institutions. A PPC will allow Texas industry to participate in leading-edge research, development, and testing, while maintaining a reasonable cost structure. Texas recognizes the importance that these consortia may play in developing next-generation transportation technologies and services that are developed by industry and supported by government and academia. It is hoped that this change will significantly incentivize business-led innovation activities between industry, research institutions, and other innovative organizations. Consortia may be established to encourage and support the deployment of technologies, furthering the TTTF's goals.

3. Existing Transportation Technology Development Program

Research and development (R&D) programs led either by both government and industry are currently operational and pursuing emerging transportation technologies, particularly in the areas of connected vehicles and autonomous vehicles. The TTTF reviewed several R&D programs and initiatives as listed in Table 1. These programs rely on strong collaboration between the public and private sectors. Their functionalities usually include 1) identification of research needs, 2) development of strategic business or research plans, 3) research funding acquisition and management, and 4) moderating communication and collaborations (e.g., through annual conferences, newsletters, and publications).

Table 1. Major US and International Transportation Technology Development Programs and Initiatives

Name	Location	Year Started	Stakeholders	Technologies
USDOT ITS Program	USA	2010	USDOT, RITA, FHWA, FMCSA, FTA, FRA, NHTSA, MARAD, affiliated research institutes, manufacturers	Connected vehicles
TRIP Europe	Europe	2012	European Commission	Internet database of transportation research projects
Transportation Technology Transfer Initiative	USA	2003	AUVSI, NDIA, DOD, USDOT	Unmanned vehicles, ground robotics, ITS
Connected Vehicle Trade Association	USA	2010	Anyone involved in vehicle communication technologies	Connected vehicles
GSMA Connected Car Forum	UK	2012	Major players in automotive manufacturing and mobile communication	Connected vehicles
Car Connectivity Consortium	Worldwide	2011	Major players in automotive manufacturing and mobile communication	Connected vehicles
Mobile Autonomous Robotics Technology Initiative	Texas	2006	Southwest Research Institute	Autonomous vehicles
DARPA Grand Challenge	USA	2004	DOD, USDOT	Fully autonomous vehicles
USDOT: US Department of Transportation; **RITA**: Research and Innovative Technologies Administration; **FHWA**: Federal Highway Administration; **FMCSA**: Federal Motor Carrier Safety Administration; **FTA**: Federal Transit Administration; **FRA**: Federal Railroad Administration; **NHTSA**: National Highway Traffic Safety Administration; **MARAD**: US Maritime Administration; **AUVSI**: Association for Unmanned Vehicle Systems International; **NDIA**: National Defense Industrial Association; **DOD**: US Department of Defense; **ITS**: intelligent transportation systems				

3.1 USDOT Connected Vehicle Research Program

In 2010, the USDOT envisioned a "connected transportation environment" through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications and applications [1]. The connected vehicle research program is the result of cumulative research development of safety applications based on emerging short-range wireless communication in vehicular environment. The USDOT's Research and Innovative Technologies Administration (RITA) and National Highway Traffic Safety Association (NHTSA) each led research and legislation and policy-making efforts regarding connected vehicle technologies. The USDOT has also collaborated with

industry stakeholders while considering efforts toward eventual nationwide implementation. Through broad stakeholder discussions and rigorous internal studies, the strategic plan on connected vehicle research has been focused on the following targets:

- The technological gaps and challenges associated with moving from research prototypes to deployment-ready vehicle and infrastructure technologies;

- The institutional and policy challenges associated with cooperative public-private implementation, particularly the establishment of security features to enable trustworthy yet anonymous transmission of safety-critical messages; and

- The institutional complexities associated with scaling a research prototype to a nationwide system.

The program has pursued active and consistent engagement with a broad stakeholder community. Key highlights of the research programs include the following.

- **V2V/V2I safety pilots**: The safety pilot research, also called the model development studies, deploys connected vehicle-dedicated short range communication (CV-DSRC) technologies in a real-world road network with 2000–3000 vehicles with DSRC devices in Ann Arbor, Michigan. Volunteer vehicles equipped with V2V devices send and receive safety warning messages 10 times per second to provide foundations for cooperative, crash avoidance safety applications.

- **Driver safety clinics**: The driver clinics study evaluates driver response to the CV-DSRC technologies within a controlled environment. The studies are currently conducted at six different locations in Texas, Michigan, Minnesota, Florida, Virginia, and California, with at least 100 volunteer drivers and 24 DSRC-equipped cars at each clinic.

- **Affiliated testbeds**: Connected vehicle testbeds are currently established in six states, including Michigan, California, Florida, Minnesota, New York, and Virginia, for testing CV-DSRC applications, services, system components, management processes, and backend services.

The NHTSA is also progressing on a legislative and policy-making agenda. The NHTSA is expected to make several milestone decisions regarding DSRC enforcement on light vehicles (December 2013), heavy vehicles (2014), and implementation guidelines (2015) based on the corresponding research outcome from the RITA research programs [2].

3.2 Transportation Research and Innovation Portal (TRIP)

The Transport Research & Innovation Portal (TRIP), formerly the Transport Research Knowledge Centre (TRKC), is a European-based collaborative research portal focusing on providing project information, policy support, and communication and education in transportation research and innovations. The main objectives of TRIP are twofold. The first objective is to improve the access to knowledge in the European transportation research and beyond through the appropriate dissemination and promotion of research results. The second

objective is to connect transport research and policy makers through timely, accurate, and complete information sharing on key deliverables of transport research projects.

TRIP provides European-wide and national-level overviews of transportation research activities [3] and contains the following:

- A project database of 7,537 transportation research-related projects

- Country profiles, including national institutions and organizations responsible for funding, promoting, and supporting transport research

- Programs for research and innovation in transportation

- Policy brochures presenting results of pertinent research according to policy topics and research summaries on 24 transportation themes

- Latest news and events in transportation research, policies, and innovation

3.3 Connected Vehicle Trade Association (CVTA)

The CVTA is a nonprofit business league that was formed to create "a world where safe, efficient, effective travel is enabled through real time traveler connectivity." It was established to facilitate the interaction between and advance the interests of groups involved in connected vehicles, and provide an education program that addresses all sectors [4]. It is a facilitator of collaboration and consensus between companies, organizations, and governmental entities involved in developing vehicle communication technologies, although membership is open to any corporation, public entity, standards organization, educational institution, or qualified individual.

Since 2010, the CVTA has hosted an annual summit where industry leaders can get together and discuss not only what is happening in connected vehicle technologies, but also what should happen next. Participants in this summit include automakers, hardware, software, services and communications companies, insurers, and state and federal government officials. The annual summit provides information on the connected vehicle market and market integration, federal policy, regulation, and security issues, business models, apps, content, data, and analytics.

3.4 The GSMA Connected Car Forum (CCF)

The Groupe Spécial Mobile Association's (GSMA) CCF is a platform for automakers and mobile operators to share information and cooperate on issues relating to connected vehicle deployment. The CCF has set a goal that 50% of vehicles sold in 2015 will include wireless connection technologies (either embedded or through smartphone integration) and 100% of all cars will be connected by 2025 [5]. The forum hopes that through their meetings, automakers and mobile operators will be able to dismantle the barriers to connected car deployment and speed the adoption of telematics and infotainment services. The CCF is held in London five times annually for invited participants. Current participants include mobile network operators such as AT&T, Bell Canada, China Mobile, China Telecom, China Unicom, Deutsche Telecom, Orange, Rogers, Softbank, Telecom Italia, Telefonica, Telenor, Telstra, Turkcell, Verizon Wireless, and Vodafone, and automakers such as Audi, BMW, Chrysler, Fiat, Ford, GM, Honda,

Hyundai, Jaguar Land Rover, Mazda, Nissan, Peugeot, Renault, Toyota, Volvo, and Volkswagen.

3.5 Car Connectivity Consortium (CCC)

The CCC is dedicated to developing global standards for in-car connectivity of smartphones. Members include nearly 100 of the world leaders in the automotive, mobile communications, and consumer electronics industries, and the member companies represent over 70% of the world's market share in vehicles and over 60% of the world's market share in smartphones [6]. Their responsibilities include the writing of technical specifications, building test tools for certification of products, providing user-interface guidelines to support application developers, and ensuring an easy experience for users through publicity and trademark enforcement. The operations of the CC are divided into four separate Work Groups: Ecosystem, User Experience, Technical, and Certification. The first technological effort from the CCC is MirrorLink™, which will allow consumers to access their phones through dashboard or steering wheel controls, and is designed to maximize interoperability. It also sets a standard that the CCC hopes will be used by all automakers for how apps are displayed on the dashboard screen.

3.6 Mobile Autonomous Robotics Technology Initiative (MARTI)

The Mobile Autonomous Robotics Technology Initiative (MARTI) is a program being undertaken by the Southwest Research Institute (SwRI) in San Antonio, Texas. The aim of the MARTI program is "to investigate and develop sensor, computer and mobile technologies that could be utilized to augment a commercial off-the-shelf vehicle platform to provide autonomous vehicle capabilities that can operate and perform specific tasks as well as improve safety and mobility in urban trafficked and off-road environments." [7] The research resulted in a self-driving vehicle platform that uses a combination of LIDAR, vision, DSRC communications, and GPS technologies to navigate streets autonomously. SwRI is able to assess sensor and algorithm performance over a wide array of environments, missions, and behaviors.

3.7 DARPA Grand Challenge

The Defense Advanced Research Projects Agency (DARPA) began a $1 million prize competition for driverless vehicles in 2004. The program was authorized by Congress in hopes that it would spur innovation that would lead to making one-third of military ground forces autonomous by 2015. The first challenge was held in March 2004 and had over 100 teams registered. The first year, none of the entrants were able to complete the 150 mile off-road route, thus no prize money was awarded. The next year, the prize money was doubled and the race reduced to 132 miles. In the second challenge, 5 of the 195 teams entered were able to complete the course, with the best time and grand prize money going to a team from Stanford University [5]. The third challenge was held in 2007, and took place in an urban environment [8]. Vehicles were required to obey all traffic regulations while negotiating obstacles and merging with other traffic. The prize money was again increased, and 11 teams were granted $1 million in funding for the event. Ultimately six teams were able to complete the circuit, with a joint venture by Carnegie Mellon University and GM taking home the grand prize.

Based on the review of the current state of the practice in technology development programs, the TTTF has observed the following:

- Texas is falling behind in organizing and developing programs and initiatives for new transportation technologies.

- Existing research programs have intensively invested funding and resources in emerging transportation technology R&D, as reviewed by TTTF. It is not necessary for Texas to replicate those research programs. Texas should track the latest technology developments and take advantage of the research outcomes of those programs.

- Texas should develop an innovative research consortium and initiatives that take advantage of Texas' traditional status of a state with fast-growing economy, government leadership, strong technology R&D resources, and the healthy and welcoming environment for public and private investors.

The above observations lead the TTTF team to plans for developing a new PPC that attract, facilitate, and showcase Texas transportation technology innovations.

4. Texas PPC Examples

There are a range of approaches to creating an organizational structure that facilitates economic development in emerging industries via collaboration and coordination among the public, private, and not-for-profit/academic sectors. In particular, most organizations will fall into one of two broad areas of emphasis: 1) research consortia, who collaborate to create intellectual capital and technology that can be shared for common benefit; and 2) incubators/commercialization efforts, which focus on bringing new and evolving technologies to market. Following are several examples from Texas and beyond.

4.1 SEMATECH and MCC

SEMATECH and MCC were both created in response to concerns about the US falling behind offshore competitors in technology manufacturing during the 1980s. Called a "technological catalyst," the SEMATECH government-academia-industry partnership was dedicated to "fundamental change in manufacturing technology and the domestic infrastructure to provide United States semiconductor companies the capability to be world-class suppliers." [9] Among early participants were 31 universities in 14 states, along with private member companies including AT&T, IBM, Intel, Hewlett-Packard, NCR Corporation, Rockwell International, and Texas Instruments. Commitments included a program of "precompetitive" generic R&D to apply software solutions to the nation's manufacturing problems, efforts to design factories for the twenty-first century using modeling, simulation, and computer-integrated manufacturing, and reduction of the time between new generations of technology.

In late 1982, several major computer and semiconductor manufacturers in the United States banded together and founded MCC as an American answer to Japan's Fifth Generation Project, a large research project aimed at producing a new kind of computer by 1991 [10]. Many European and American computer companies considered this new initiative an attempt to fully control the world's high-end computer market, and MCC was created, in part, as a defensive move against that threat. Despite this purpose and the background of its senior staff, MCC accepted no

government funding for many years. In the 1980s its major programs were packaging, software engineering, CAD, and advanced computer architectures. The latter comprised artificial intelligence, human interface, database, and parallel processing, with the latter two merging in the late 1980s [11]. Many of the early shareholder firms were mainframe computer companies under stress in the 1980s. Over the years, MCC's membership diversified to include a broad range of high-profile corporations involved in information technology products, as well as government R&D agencies and leading universities. The organization was disbanded in 2000 [12].

Prior to MCC, a research university typically did not play an active role in economic development, relying instead on external players to commercialize the intellectual capital created as part of its research and programs. For the University of Texas, MCC changed the equation, resulting in 30 endowed professorships and a major boost in the prestige of its engineering programs. It also created the momentum that led to UT's IC^2 Institute, which contributes to technology development and commercialization to this day [13].

Despite the popularity of the incubators' ideas in technology development, there have been very limited dedicated transportation incubators. The most notable two incubators on development transportation technologies include the Transportation Technology Ventures and CALSTART.

4.2 Transportation Technology Venues (TTV)

Founded in 2012 by tech entrepreneur Jim Disanto, TTV is the first dedicated incubator on internet-connected vehicles [14]. A seed venture capital fund and business accelerator, TTV believes that the connected vehicle technologies hold the keys to solve worldwide transportation issues, potentially improving safety, reducing congestion, decreasing energy usage and pollution, increasing efficiency and resource utilization, providing entertainment, and reducing costs. TTV recognizes a combination of recent technology shifts and emerging consumer trends including internet-connected cars, V2V communications, crowd sourcing, and resource sharing.

TTV provides two main value-added services to transportation-focused startup businesses:

Resources: TTV provides technical assistance with software development, including access to automotive software development kits, technical know-how, and testing and quality assurance validation with fleets. TTV also has substantial connections with automotive original equipment manufacturers, tier one suppliers, fleet management companies, academic and government institutions, and businesses participating in the transportation supply chain. These relationships are leveraged to help new companies commercialize their products and gain much needed early market traction.

Financing: TTV will help qualified new businesses raise seed level funding to develop and launch their new product and/or service. TTV has investment syndication experience and partners who will help fund a good opportunity.

TTV provides these services to help launch new businesses that may originate from

- university researchers and scientists who have a new promising technology and desire to form a startup company;

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- entrepreneurs in the field who need resources and money; and

- spin-offs from larger transportation-related businesses.

TTV's main mission is to help launch new businesses that may originate from university researchers and scientists with promising new technologies and the desire to form a startup company focusing on transportation-related issues. TTV's portfolio includes several pioneering companies in the area of CV-cellular technologies, including Waze:

- **Auto Advantage Group**: A software and services company focused on capturing automotive data and storing it in the cloud. Such data includes real-time engine drive/power train performance, vehicle diagnostics codes, and sensor information and location. This "Big Data " from automotive sources will be used to drive an e-commerce network of automotive services [15].

- **MobiWize**: MobiWize offers horizon-predictive fuel-economy solutions to improve vehicle fuel efficiency and fleet eco-driving performance, while distinguishing driving inefficiency from poor vehicle performance. MobiWize uses its real-time learning system to determine for each individual vehicle the most economical acceleration profile and speed to drive, under various vehicle loads, road slopes, and other conditions that influence fuel consumption [16].

- **Quanergy**: Quanergy is a new Silicon-Valley technology company developing smart sensing solutions for real-time 3D mapping and object detection, tracking, and classification.

- **Robingets**: Robin Labs is the developer of Robin, a personal eyes-free conversational speech-based assistant for the road.

- **Intrans**: Intrans.com is a San Francisco-based software/cloud services company providing tracking and load matching for shippers, carriers, and logistics providers. The Intrans service lowers costs and increases efficiencies for transportation providers and users and does not require any special hardware installations in vehicles.

- **Mishor3D**: An Israeli-based software technology company specializing in 3D augmented reality for passenger vehicles. The Mishor3D Shadowbox reality engine provides near perfect rendering and positioning of navigation- and safety-related images and graphics in modern head-up display systems.

- **Waze** (Past): Waze is the world's fastest-growing community-based traffic and navigation app. Drivers share real-time traffic and road info, saving everyone time, gas, and money on their daily commute. Waze was recently acquired by Google, Inc.

- **TuneIn** (Past): TuneIn is the world's premier internet radio guide providing consumers with easy access from smartphones, web browsers, consumer devices, and car infotainment systems to over 70,000 radio stations globally and two million on-demand programs, such as podcasts, concerts, and interviews.

- **Yamei** (Past): Yamei Electronics provides remote communication solutions, focusing on the safety of vehicles and drivers in the China automotive market. Yamei products bring peace of mind, convenience, and improved productivity to vehicle and fleet owners throughout China and other Asian countries.

4.3 CALSTART (Clean Transportation Technologies and Solutions)

CALSTART, founded in 1992, is dedicated to clean transportation technologies that improve the air quality, secure the nation's transportation energy future, create economic opportunities, and reduce greenhouse gas emissions [17]. CALSTART identifies three main integrated challenges facing future transportation systems: urban air quality, energy security, and climate change (Figure 2).

Figure 2. CALSTART Perspectives. [17]

CALSTART's perspective on tackling these three environmental challenges is to seek integrated solutions that address all these issues. This strategy contrasts with the development of single-benefit solutions that may fix one problem but negatively affect the others. CALSTART employs a four-pronged approach to advance the clean transportation technology industry.

- Clean transportation industry services: Providing value-added services to companies such as timely information, partnering, new business opportunities, conferences, and technology evaluation.

- Clean transportation solution group: Acting as a consultant to ports, property developers, transit districts, and fleets seeking to implement cost-effective customized solutions.

- Technology commercialization: Identifying opportunities, building teams, securing funding, and advancing technology, vehicles, fuels, and systems.

- Policy: Advancing key policies, advising policymakers, and helping companies plan for the future.

CALSTART has been the major force in advancing the clean transportation technology industry for over 20 years and has had significant impact on the policy making in both California and Washington, DC. In 1992, when CALSTART was funded, it received initial state and federal grants of $6 million. It is now an organization of nearly 140 businesses across the nation and derives three quarters of its funding from its member companies rather than from state or federal funding.

4.4 Austin Technology Incubator (ATI)

ATI harnesses business, government, and academic resources to provide strategic counsel, operational guidance, and infrastructure support to its member companies to help them transition into successful, high growth technology businesses.

Since its founding in 1989, ATI has worked with over 200 companies, helping them raise over $1 billion in investor capital [18]. ATI has worked with over 100 companies in the last 5 years (including the recent recession) with over $250 million in investor capital. Meanwhile, the ATI alumni companies realized approximately $400 million in exit value. Around 75% those companies also actively seek and secured external. ATI has an admission rate of 3–10% for the 100–150 prospective companies applying annually for membership in the incubator. Such strict selectivity provides confidence and credibility for investors, executive talent, and mentors. As a program of the IC² Institute of The University of Texas at Austin, ATI fulfills two objectives: promote economic development in Central Texas through entrepreneurial wealth and job creation, and provide a "teaching laboratory" in applied entrepreneurship for UT-Austin students. ATI works closely with other similar commercial and business-building programs at the university. However, ATI does not require applicants' technology be based on UT-Austin technology, or indeed have any formal connection to the university other than ATI membership.

ATI has over 20 years of experience adding value to technology start-ups. And, based on that experience, the incubation model has evolved as Austin's tech economy has grown and developed. Today, the belief is that the early stage community is best served by offering a broad business building platform, but complementing that with industry-specific capabilities. To that end, ATI has invested in developing domain expertise and market- and technology-specific networks of advisors and investors in four areas:

- Information technology (broadly defined to cover both software and silicon)
- Wireless telecommunications (again, covering both hardware infrastructure and software tools)
- Bioscience (with a human health focus, from device to therapeutics.)
- Clean energy/clean technology (with a strong sub-focus on electric power, although ATI welcomes applications from alternative fuels companies)

Each focus area has a dedicated ATI director, board of advisors, intern resources, and network of industry experts. In addition, ATI works with investors whose investment theses match their technologies: since implementing this model, over 75% of ATI members have attracted funding.

5. Transportation Technology Development Stakeholders

Technology development, especially at the early stages of development, requires collaborations among government agencies, research institutes, and R&D forces in the industry. In transportation, the establishment of reliable partnership between public and private sectors is especially critical when dealing with the transportation system, a large-scale, 24/7, civilian system. Different parties hold different resources, advantages, and disadvantages in technology development.

- **Legislative councils and policy-making agencies**: Several technologies reviewed by the TTTF such as autonomous vehicles, connected vehicles, and cloud computing, rely heavily on the legislation and policy readiness for the authorization, license management, funding, or even testing on public roads (e.g., autonomous vehicles). The PPC needs to provide open communication and frequent updates of the latest technology development and research needs with legislative councils and agencies. In many cases, the consortium should provide forward-thinking observations to prepare for short-, medium-, and long-term visions.

- **Public and private funding sources**: As lifelines of technology R&D, connecting funding sources with R&D groups are the major task of a PPC. The consortium needs to take advantage of the strong economic growth and the tradition of healthy relationships between technology communities and private investors in Texas. Furthermore, the consortium can also help research entities compete for public funds targeting emerging transportation technologies.

- **Transportation agencies**: Transportation agencies plan and manage the system. They can help provide policy and legislative support. They are also major sources of transportation data, such as planning data, infrastructure data, construction, incident data, and traffic detector data on major highways.

- **Research institutes**: Research institutes are a major R&D force during the initial development of technologies. They can carry out innovative and fundamental research that would not be cost-effective at industry R&D departments. Meanwhile, research institutes can also conduct unbiased third-party evaluation studies for newly developed technologies or products. Many research efforts and ideas have later been commercialized.

- **Automobile industry**: The automobile industry has the capability of adopting and marketing new vehicle technologies. They are major R&D forces in many vehicle-based technologies. Additionally, many manufacturers partner with companies from other industries, such as cellular providers, mobile device companies, and hardware and software companies, on technology development and deployment. The business nature of manufacturing firms makes them highly effective in developing, promoting, and implementing new technologies.

- **Traveler information and transportation service providers**: These firms have been a rising force over the last decade in the transportation industry. Data and service providers have already replaced the traditional roles of transportation agencies in delivering many intelligent transportation systems to travelers. With the

rapid development in communication technologies, location technologies, and smartphones, these providers should continue to significant improve their data quality and services. Furthermore, these providers are commercial entities pursuing profits, so many of their data sources will likely come with licensing costs that may not be affordable to many developers, especially during the initial prototyping and experimental stages.

- **Other technology companies**: One key observation in this study is that the new technologies are no longer simple transportation solutions that can be developed only by transportation engineers and car manufacturers. Technologies such as cloud computing, crowdsourcing, even CV-cellular technologies have been intensively studied or even implemented in other technology industries. Those parties can provide needed technology and resources for the implementation of new transportation technologies.

6. Key Issues for Establishing a PPC

To establish the PPC, TTTF identified the following key issues and concerns to be addressed, including missions and goals, funding, organizational structure, business plan/model, and qualifications, regulations, and evaluations.

6.1 Missions and Goals

- What will the PPC's areas of focus be?
- What will the PPC's goals, objectives, and tasks be?
- What time horizon appropriately allows for objectives and goals to be met?
- What will important dates be for submitting ideas, funding, applications, etc.?

6.2 Funding

- What are typical funding sources and what are known issues with funding sources?
- What should the initial budget be and how can the research team seek and attract capital?
- What resources will be necessary and what resources will be available
- Is there a maximum or minimum threshold for consortia investments?

6.3 Organizational Structure

- How are participants selected, evaluated, and represented?
- How are participants sought or attracted?
- How are they structured and sponsored, and what is the leadership hierarchy?
- How will the PPC ensure that the right mix of expertise is available?

- What should the ideal mix of consortia partners be?

6.4 Business Plan/Model

- How does the PPC ensure that its activities will result in achieving the specified goals, deliverables, and objectives?

- How will sale of products developed through the consortium be credited? What other issue will arise with sales, patents, and other PCC products?

- How will teaming and partnering be encouraged or enforced?

- If multiple partners propose projects or testing in the same focus area, is it preferable to combine or select the best fit?

- Is cost sharing required, or will it be considered favorably during the proposal review process?

- How will confidential/proprietary information of partners be handled and protected?

6.5 Qualifications, Regulations, and Evaluations

- Can non-Texan, foreign, or multi-national companies be involved in the consortium, and if so, what proportion of the value of the consortium may they represent? Can members of the consortia be from across the nation or should there be a state focus?

- Will there be any encouragement or mandate to maximize the number of small- or medium-sized enterprises involved in the consortium?

- How will potential partners demonstration their qualifications?

- Are there activities that should not be allowed within the consortium?

- What reporting requirements should be required?

7. TTTF Work Plan for the PPC

TTTF's work plan for establishing the PPC includes three major phases: preparation and outreach, consortium formation, and transition towards operations.

Phase I: Preparation and Planning (9–12 months)

The objectives of Phase I include 1) seeking governmental, policy, and legislative support for PPC, 2) communicating with major stakeholder groups, and 3) developing the business plan.

Task 1: Initial Authorization, Policy, and Legislative Preparations (6 months)

The TTTF will seek governmental authorizations and policy and legislative support for the development of the PPC. The TTTF will identify the decision-making agencies. The TTTF will

present and discuss the PPC's visions, motivations, and plans with the key decision-making and legislative groups in the government, and will provide necessary documents to facilitate such communications. Furthermore, once the business plan is fully developed, the TTTF will seek approval and authorization from related agencies.

Task 2: Public Sector Participants Outreach (6 months)

In this task, the TTTF will identify and conduct outreach to potential participants from the public sectors such as transportation and non-transportation government agencies, research institutes, and technology organizations. During the communications, the TTTF will present the PPC ideas and plans, identify needs, and solicit suggestions from public sectors regarding the PPC.

Task 3: Private Sector Participants Outreach (6 months)

Private sector firms such as automotive companies; IT companies interested in transportation technologies; traveler information and service providers; and private R&D teams are also key components of the PPC. The TTTF will identify and reach out to the interested private sector parties and assess their needs in technology development and expectations for the PPC.

Task 4: Investors Outreach (3 months)

To ensure that the PPC has sustainable funding sources, the TTTF will begin a conversion with public and private investors early in the process. Getting investors involved in the process should not only build healthy and sustainable relations with investors, but also provide investors with sufficient time to evaluate and understand the PCC's potential for future investment decision-making.

Task 5: Success PPC Example Investigation (2 months)

With several successful transportation technology PPCs identified, it will be critical for the team to conduct a comprehensive review of their operations to develop feasible business plan for Texas. Key transportation technology PPCs such as TTV and CALSTART will be on the list of PPCs to be reviewed by the TTTF. The TTTF may also arrange direct communications with those organizations to learn their lessons and success stories.

Task 6: Initial Business Plan for PPC (6 months)

Task 6 completes the main outcome of Phase I, the detailed phase plan that will be developed based upon the discussions and feedbacks obtained from Task 3 to 5. The business plan will consist of detailed discussions on missions and goals, market and sales analysis, organization and management, and funding. The business plan will address all issues and concerns listed in Section 6.

Phase II: Formation of Consortium (12 months)

With the business plan in place, the consortium can then be initiated—both the PPC itself and the proposed incubator. Aside from general governmental, policy, and legislative support obtained in Task 1, the funding sources need to identified and secured.

Task 7: Texas Transportation PPC and Incubator Organization, Registration, and Formalization (9–12 months)

In this task, following the developed business plan, the PPC and the incubator are organized and formalized. The TTTF will assemble an organizational committee to include legal, accounting, and human resource experts. These personnel will develop legal and organization documents and obtain the registrations, licenses, and authorizations for the PPC and the incubator. The organizational committee will also rent office space, develop a website, hire staff and key personnel, and conduct public relation activities to ensure the smooth start of the consortium.

Task 8: Initial Funding Sources Seeking and Securing (6-12 months)

As a prerequisite, the process of seeking and securing funding must also start as soon as the business plan is approved. The success of this task is highly dependent on the outcome of the initial investor contacts conducted in Task 4. Task 7 and other subsequent tasks may be delayed by the status of Task 8.

Phase III: Moving Towards Operations (12 months)

After establishing the consortium, the organizational committee will oversee the initial trial operations for another 3–6 months. After this time, the consortium will be formally operated under the hired personnel.

Task 9: Public Advertisement and Outreach (3-6 months)

The main task at this stage of the PPC and incubator is to publicize and attract participants and investors, necessitating a public relations campaign. It may also be necessary to actively contact and communicate with potential candidates from the public or private sectors, in addition to the PR operations.

Task 10: Evaluation and Qualification Process (3-6 months)

To ensure the sustainability of the consortium and incubator, the membership and participants need to be reviewed and evaluated for their business potentials. A formalized evaluation procedure and qualification criteria needs to be fully developed for initial participant screening.

Task 11: Normal Operation (6 months)

After all the initial preparation and operations are completed, the organization committee may continue monitoring the hire operating team for another 3–6 months before finally being dismissed. At this time the consortium and incubator will become fully operational.

The timeline of the proposed work plan is illustrated in Table 2.

Table 2. Timeline of PPC Work Plan

FY	FY2013 (Phase I)				FY2014 (Phase II)				FY2015 (Phase III)			
Month	10–12	1–3	4–6	7–9	10–12	1–3	4–6	7–9	10–12	1–3	4–6	7–9
Task 1	▓	▓		▓								
Task 2		▓	▓									
Task 3		▓	▓									
Task 4			▓	▓								
Task 5		▓	▓									
Task 6					▓							
Task 7						▓	▓	▓				
Task 8					▓	▓	▓					
Task 9									▓	▓		
Task 10										▓	▓	
Task 11											▓	▓

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