



Proposal for:

# RoadX Program Support

Submitted to:



**COLORADO**  
Department of  
Transportation

April 7, 2016





# Mr. Kozinski and Members of RoadX Initiative,

## Congratulations to CDOT

for advancing the RoadX Program, a forward-thinking and transformative undertaking that will save and enhance lives by advancing Colorado's transportation system. Through this program, CDOT wishes to enhance the quality of life and environment for Colorado's citizens by embracing innovation and technology to the fullest extent and deploying it quickly to shape the future of Colorado transportation. This vision inspires our senior transportation staff, excites our technology-focused experts, and motivates the collaborator in all of us to be part of this transformation.

Our approach is to provide CDOT with:

- 1 A proven, Colorado-based RoadX transportation Champion**
- 2 Innovative ideas to advance RoadX goals**
- 3 Access to any expertise needed to accelerate RoadX ideas toward implementation.**

We also understand that to be successful, the RoadX Program must support and focus on cultural changes, establish innovation policy, identify and evaluate technologies, maximize the RoadX investment, and manage the risks associated with deploying innovative programs.

## The CH2M Core Team and RoadX Champion

CH2M is a family of employees who have built deep relationships with CDOT and share your values. Our RoadX Champion, Mary Jo Vobejda, PE, is known for her success in managing large Colorado transportation corridors for CDOT and implementing projects through collaboration, customer focus, leadership, partnerships, creative integrated solutions, fiscal accountability, balanced solutions, and social responsibility. Mary Jo has completed projects across the country, while focusing her career in Colorado. She understands the politics and policies of transportation, how it effects Colorado's economy, and the daily influences mobility makes on Colorado's citizens.

As our proposal details, Mary Jo has laid out a suggested process the RoadX Champion Team might use to quickly and effectively move projects forward. Collaboration and decision making are the hallmarks of Mary Jo's career and successes. Working with stakeholders with differing views, making decisions when no perfect solution exists, and moving projects to construction are the areas of expertise Mary Jo will bring to the RoadX Champion Team.

Mary Jo and CH2M transportation innovators have worked as trusted partners with CDOT for more than 30 years. They have helped to plan, design, and implement state, regional and local transportation programs/projects that focus on improving the safety of urban and rural highway travelers, increase network mobility, and maximize the reliability of our Colorado transportation network. CH2M has listened to your goals and effectively implemented solutions to not only meet your goals, but also to provide scalable and flexible solutions as your needs evolve.

## Access to Technology Expertise to Implement RoadX

CH2M brings local capabilities to CDOT to implement innovative projects. CH2M's technologists and engineers are known for their ability to develop and incubate ideas, leverage relationships with industry, and capitalize on world-class innovators. Our Denver-based national experts have access to international innovators and advanced new technology programs including adopting European "managed motorways" strategies to CDOT's early active traffic management approach for I-70, innovative finance including road usage charging, and implementation of the first satellite-based heavy tow program along the mountain corridor.

The skills of our team cover a very wide range of capabilities, including finance, advanced technologies, project implementation, and knowledge of all transportation modes. Our strong partnerships with innovative technology firms, vendors, and suppliers will bring added expertise in innovative applications of technology, wireless communications networks, big data fusion centers, real-time traffic data and analysis, connected vehicle networks, mobile computing, and communications security. Our relationships with the private sector, including consultants, universities, and recognized subject matter experts, will also supplement CDOT with expertise such as data analytics, decision support systems, and transportation analytics.

As our proposal demonstrates, CH2M has local expertise in advanced transportation technologies and project innovations, with Mike Warren, project manager for road usage charging, autonomous vehicle/connected vehicle (AV/CV) policy development, and smart cities; Dan Baxter, project manager for the City of Centennial Intelligent Transportation System (ITS) Master Plan; Lindsay Ritter, innovative practice lead for asset management and transportation management; and several others. Augmenting our team are several well-respected local companies: GBSM, Pat Noyes & Associates, and Spy Pond LLC, all of whom have employees who we believe are critical in promoting RoadX. Our global expertise includes design and deployment of advanced technologies in AV/CV and mobility management. Further, we have established relationships and partnerships with countless industry leaders, such as Microsoft, INRIX, Cisco, Econolite, and Savari Networks.



## Conflict Identification and Opportunities

For the past 10 years, CH2M has proudly and successfully represented the City of Centennial in public works and design initiatives, such as management of the transportation infrastructure from signals to pavement, and special planning projects such as the City of Centennial ITS Master Plan. This work continues today.

CH2M leads the sales-tax funded infrastructure program for the City of Commerce City, which is on track to deliver five public works projects within the next 4 years. This work began in 2014 and continues today. Our role includes helping to manage specific roadway projects, such as improvements to 112th Street, managing the overall program budget, and supporting the city's efforts to evolve its staff and processes to better maintain a city expected to have 100,000 citizens.

CH2M has supported planning, environmental, design and construction projects for CDOT, FHWA, and FTA. These projects give us insights into the transportation challenges of states and cities. We will bring our local relationships to RoadX to strength the benefits for both CDOT and our municipal partners.

## Defining Success

CH2M looks forward to the opportunity Road X provides for our small business partners. CH2M understands and agrees to the administrative terms and conditions proposed by CDOT in the Request for Proposals. The innovation in selection, contracting, and collaborative project implementation in this initiative reflect the way the RoadX project will be implemented.

RoadX is the future of transportation, and this will involve redefining mobility. For today's users, mobility includes the ability to choose between modes of travel and times of travel that best suit an individual's needs, and the reliability of these choices. Providing options that accommodate work schedules, fit budgets, internet options that allow for remote work, technology options that allow everyone accessibility, and the information to personalize choices will define successful transportation projects in the future.

RoadX collaboration and cooperation require a uniquely qualified group of champions. CDOT required professionals with an understanding of Colorado's transportation needs, Colorado's citizens, our economy, and who have a vision for the future. We are excited to offer the CH2M team as a collaborative, decision-making team that offers these attributes and which will move RoadX projects toward implementation.

We appreciate your consideration of CH2M as a part of your RoadX team.

Sincerely,  
CH2M

Mary Jo Vobejda, PE  
RoadX Champion

Christine Bisio, PE  
Southwest Geographic Manager

# 1. Mary Jo Vobejda – CH2M RoadX Champion

CH2M's RoadX Champion and primary point of contact is Mary Jo Vobejda, PE, a strong and collaborative partner for RoadX with over 30 years of experience in collaborating with CDOT on transportation initiatives.

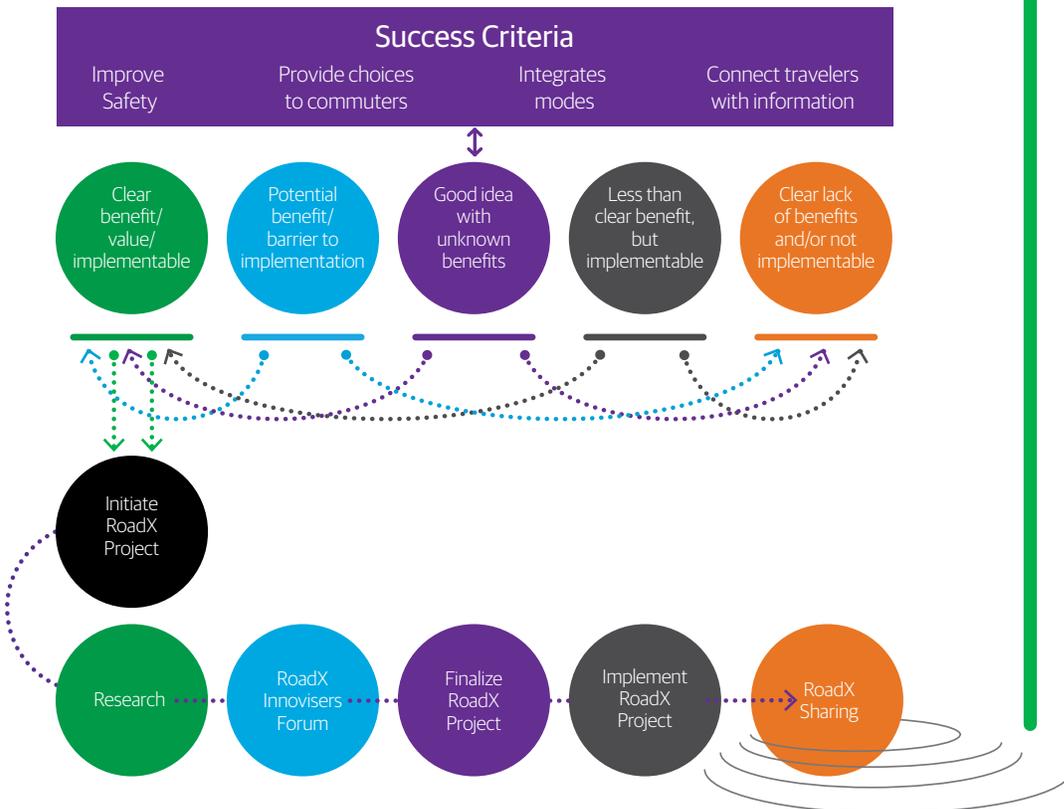


Mary Jo Vobejda is an experienced innovator, facilitator, and collaborator. She has brought innovation to life through facilitation, collaboration and the application of technologies for countless projects throughout Colorado that have exceeded CDOT's goals of improving urban mobility, rural safety, and freight efficiency. Mary Jo has experience on multiple projects and multiple corridors.

Mary Jo's strongest skills focus on creating and successfully applying collaborative decision-making processes that guide program participants and diverse groups through chartering, visioning, setting goals, and building and maintaining consensus. Over her career, she has developed numerous processes and engagement rules that have led to concise and widely-accepted visions and project charters, comprehensive and easily followed plans, and sound and concise performance metrics, and that have garnered stakeholder and public buy-in to many sensitive transportation initiatives. Mary Jo will work to develop common goals and customized approaches for RoadX that lead to implementable project solutions. She has developed a process that the RoadX Champion Team could use to vet ideas.

Mary Jo is a Colorado native and a Colorado registered PE, receiving her degrees from the University of Colorado. She has worked at CH2M's Colorado headquarters for her entire career and is very knowledgeable of the firm's capabilities and resources for innovative program delivery. As CH2M's RoadX Champion, she will work as a team partner with the CDOT RoadX team to bring the full resources of CH2M and our expansive portfolio of partners to bring Colorado's world-class transportation innovation vision to reality.

## Champion Team Vetting Process



## Mary Jo's collaboration accomplishments include:

- I-70 Context Sensitive Solutions Project:** Facilitated hundreds of meetings among thousands of stakeholders spanning 2 CDOT regions, 3 Transportation Commission areas, 5 counties, and 27 municipalities.
- I-70 Mountain Corridor Visioning for Idaho Springs (Twin Tunnels):** Brokered agreements between CDOT and Clear Creek County. Technical experts from around the world came together for 5 working days and brainstormed ideas, evaluated solutions, and proposed a vision and solution, which have been successfully implemented.
- New Pueblo Freeway Environmental Impact Study:** Collaborated between CDOT and City and County of Pueblo to plan the interstate, local network, and trail improvements. Beginning with a day-long stakeholder workshop, this project gained the support of neighbors, business owners, agencies, and municipalities over 2 years of meetings.



The RoadX Champion Team will vet ideas using agreed upon Success Criteria to identify designs with clear benefits that are implementable. These ideas will initiate RoadX Projects.

## 2. CH2M Team

CH2M sees RoadX as an innovative collaboration between policy, governance, investment, public information, technology, engineering, and project delivery. As such, we are proposing a diverse and cohesive team that spans every major facet of this innovative collaboration. Supporting Mary Jo is our team of seasoned professionals, each with a large network of relationships, that when coupled with CH2M's vast network of partners, brings a comprehensive "Rolodex" spanning every facet of transportation.



Mike Warren, PMP  
Innovative Program Delivery (Colorado-based)  
*B.S., Engineering Management*

Mike Warren brings his 20 years of experience in innovative program delivery, spanning multiple state and federal agencies, to introduce and identify best practices for deploying complex programs. His expertise includes project management, policy development, economic analysis, big data integration, smart infrastructure, autonomous and connected vehicles, and communications systems design. Mike is the project manager for the Colorado Road Usage Charge Pilot Research Study for CDOT and was the project manager for the Road Usage Charge pilot programs for the Oregon DOT; he is the technical policy lead for the Nevada DOT's autonomous vehicle/connected vehicle (AV/CV) policy studies.



Scott Ingvaldstad  
Outreach, Marketing and Branding (Colorado-based)  
*B.A., Political Science*

Scott Ingvaldstad brings his vast experience and legislative networks to RoadX to serve as a liaison between the RoadX team and state and federal legislators and grant program owners to identify, draft, and ratify legislative policies. Scott has a strong track record of managing multiple stakeholder interests and building support for multi-stakeholder projects, focusing on garnering political support from bipartisan legislators. Scott, in collaboration with our partners GBSM and Pat Noyes and Associates, will collaborate with legislative stakeholders and the general public.



Dan Baxter  
Technology Applications (Colorado-based)  
*B.E., Civil Engineering*

Dan Baxter, transportation chief technologist, brings 30 years of intelligent transportation system (ITS) experience and a vast network of technology partners to RoadX. Most recently he served as the project manager for the City of Centennial Colorado ITS Master Plan, which lays the foundation for our proposed innovative idea. For CDOT, Dan developed the active traffic management system concept of operations for the I-70 Mountain Corridor. Dan also leads and chairs several Transportation Research Board committees on transportation technology, including ITS, connected vehicles (CVs), and active traffic management.



Susan Martinovitch  
Policy  
*B.S., Civil Engineering*

Susan Martinovitch brings her experience as former director of Nevada DOT to identify policies and initiatives to further promote innovation while maximizing CDOT investments and identifying operational efficiencies. Susan develops and promotes policies supporting many innovative transportation programs across the country. She is a nationally recognized expert in surface transportation development and former president of American Association of State Highway Transportation Officials (AASHTO).



Lindsay Ritter  
Partnerships and Alliances (Colorado-based)  
*B.A., Political Science*

Lindsay Ritter brings niche expertise in collaboration, facilitation, and leadership of cross-discipline initiatives spanning the public and private sectors. Lindsay is CH2M's portfolio manager for several key programs such as City of Centennial (CO), and John's Creek (GA), where her development of partnerships and alliances has transformed these cities into innovative models for modernizing and improving city operations. Lindsay is also leading a cross-divisional effort to best align project selection and prioritization with CDOT's goals (preservation, economic vitality, safety, and enhanced mobility). Previously, Lindsay lead CH2M operational sustainability program, developing a collaborative alliance between 100+ public and private client to advance sustainability. This program earned an Innovations Award in 2011 from the National Association of Water Companies.



Willie Franklin  
Small Business Engagement (Colorado-based)  
*BASc, Business Administration and Management*

As CH2M's manager of supplier diversity and small business programs, Willie Franklin will serve as the conduit between the RoadX team and our expansive network of small business partners. He will liaise with our existing small business partners: Pat Noyes & Associates, Spy Pond Partners, and GBSM; as well as other small business partners to identify niche needs and maximize CDOT's small business investments.



## We Will Maximize Small Business Engagement

As CDOT has stated, many small businesses and sole proprietors have ideas and resources that can contribute to the success of the RoadX program. Willie Franklin, CH2M's manager of supplier diversity and small business programs, will lead up our small business engagement efforts, identifying potential niche small business partners to further augment our team and fulfill CDOT's visions for RoadX. Through Willie's efforts, our small business partners have received revenues exceeding \$3.22B over the past 4 years..

## Innovation Partners

We are pleased to partner with the following companies, commercial partners, and universities. This group provides a representative set of the partners CH2M can access for RoadX.

- **GBSM**, led by Steve Coffin, will provide expertise in strategic communications, outreach, branding, and public education
- **Microsoft** will provide the Mobility Management Hub for our proposed concept, a fully interoperable data sharing center that will collect, process, and disseminate information to RoadX clients and users.
- **Qualcomm** will deploy the dedicated short-range communications (DSRC) radios for both vehicles and infrastructure needed to support our proposed concept.
- **Savari Networks** will provide wireless and onboard vehicle sensors supporting the coexistence of AVs and CVs with other vehicles, bicycles, and pedestrians.
- **Universities:** CH2M has strategic partnerships with Denver University and Colorado State University, focused on advancing the state of transportation through innovative initiatives. Our partnership with DU is creating an incubator for improving freight mobility.
- **Pat Noyes & Associates** will support strategic planning, transportation systems management and operations integration, assist with public outreach, and organizational collaboration.
- **Spy Pond Partners**, a CDOT-certified emerging small business, led by Scott Ritchrath, brings expertise in investment, financing, and legislative policy.
- **Cisco** brings data security and interoperability integration technology to the RoadX transportation data systems.
- **Econolite** will modernize traffic signal controllers throughout our proposed concept to support AV/CV demonstrations.
- **INRIX** is a provider of real-time, historical, and predictive traffic information supporting navigation and traffic-enabled solutions.

## 3. CH2M Areas of Expertise

To support Mary Jo and RoadX, we propose several key functional areas:

**INNOVATIVE PROGRAM DELIVERY:** Industry-leading expertise in successfully integrating processes and technologies into innovative program delivery, risk and quality management, planning, and deployment oversight.

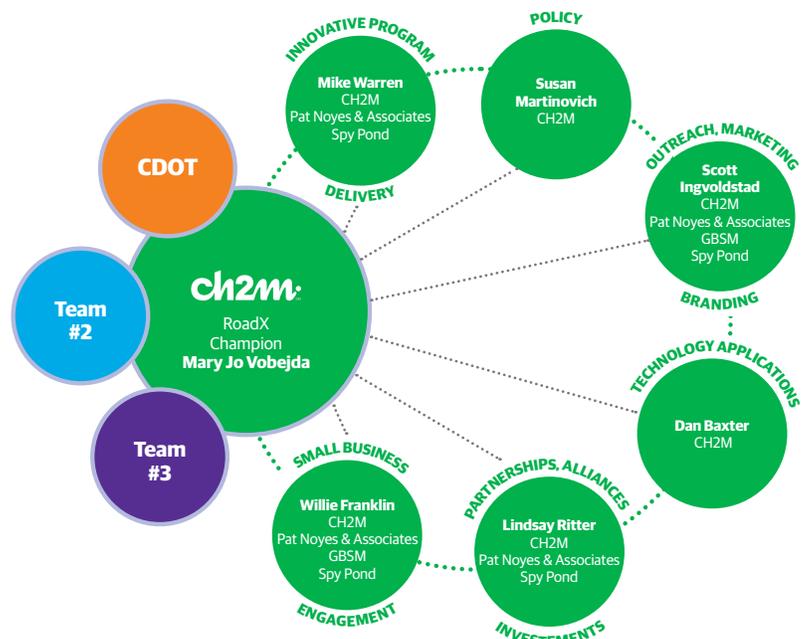
**POLICY:** Liaise between the RoadX Champion Team and local, state, and federal legislators to develop and promote policies related to furthering innovative transportation initiatives

**OUTREACH, MARKETING, AND BRANDING:** Inform, educate, and promote buy-in for the RoadX vision and programs to legislators, private sector, other organizations, and the general public.

**TECHNOLOGY APPLICATION:** Identify, evaluate, and promote breakthrough technologies that promote transportation innovation and provide the needed flexibility to support evolving RoadX needs.

**PARTNERSHIPS, ALLIANCES, AND INVESTMENTS:** Collaborate and establish public-private partnerships, governance, and agreements to further RoadX investments and showcase emerging technologies.

**SMALL BUSINESS ENGAGEMENT:** Promote economic development by expanding small business involvement to exceed CDOT contracting goals through meaningful engagement on innovative breakthroughs.



## Implementation

High-quality project implementations that improves safety, provides commuter choices, integrates modes, connects travelers with information that supports the widespread use of connected vehicles and other emerging technology.

# 4. Examples of Work in a Collaborative Environment

CH2M has identified a series of projects that showcase our expertise while meeting the CDOT Success Criteria using our proposed Functional Areas.

PROJECT	ROADX SUCCESS CRITERIA					CH2M AREAS OF EXPERTISE				
	Improved Safety	Provide choices to commuters	Multi-modal integration	Connected travelers	Innovative Program Delivery	Policy	Outreach, Marketing, & Branding	Technology Application	Partnerships, Alliances, & Investments	Small Business Engagement
I-70 Visioning for Idaho Springs and the Twin Tunnels	●	●	●	●	●	●	●		●	●
I-70 Mountain Corridor CSS Guidance	●	●	●	●	●	●	●	●	●	●
New Pueblo Freeway EIS	●				●	●	●		●	●
Centennial ITS Master Plan	●	●	●	●			●	●	●	●
AOne+ Venture, UK	●	●	●	●	●	●	●	●	●	●
Crossrail Innovation Program, UK	●	●	●	●	●	●	●	●	●	●

## I-70 Context Sensitive Solutions (CSS) Guidance Project; CDOT; I-70 Mountain Corridor

Mary Jo developed guidelines for engineering designs, aesthetic treatments, impact mitigation, and construction procedures along the I-70 Mountain Corridor. The project goal was to have the corridor become the nation's standard for collaboration, partnerships, transportation innovation, and environmental sustainability. To develop and promote the CSS approach, Mary Jo facilitated hundreds of meetings among thousands of stakeholders spanning 2 CDOT regions, 3 Transportation Commission areas, 5 counties, and 27 municipalities. Use of the guidelines broke 20 years of no work on the corridor. In the last 4 years \$200M of improves, supported by stakeholders, have been constructed.

As the Project Manager on several CDOT projects on the I-70 Mountain Corridor, I have worked with Mary Jo Vobejda and CH2M HILL on several of these projects. I have found when working to solve difficult and complex issues that Mary Jo represents a resource for brainstorming and planning meetings, as well as facilitating large, sometimes unhappy groups.

- Peter Kozinski, PE, CDOT

## I-70 Mountain Corridor Visioning for Idaho Springs and the Twin Tunnels

Mary Jo served as one of several facilitators who led CSS visioning efforts. Mary Jo brokered agreements between CDOT and Clear Creek County, and led idea incubation workshops where technical experts from around the world came

together for 5 working days and brainstormed ideas, evaluated solutions, and proposed a vision and solution, which have been successfully implemented. A shared vision was established between CDOT and Idaho Springs stakeholders for the future of I-70 throughout Idaho Springs.

I wanted to take a moment and thank you for your contribution to the Twin Tunnels Visioning Workshop ... the technical expertise you brought in developing the improvement concepts was impressive and commendable.

- Tony DeVito, PE - Region 1 Transportation Director

## Centennial ITS Plan; City of Centennial, Colorado

As part of our existing public works services contract, CH2M developed a 10-year ITS plan for the city to get the critical infrastructure in place for intelligent technology, outlining an innovative approach to managed mobility by developing a smart corridor on Arapahoe road. Leveraging collaboration, the plan entails an open source information framework to allow traffic information and analysis to be shared across jurisdictions.

## New Pueblo Freeway EIS; CDOT

Mary Jo led all project planning, decision process, and public involvement activities to develop a plan for upgrading I-25, which serves as Pueblo's "Main Street." Teamed with CDOT, she provided technical guidance, direction, and insight to the technical team throughout a public involvement process that was based on a CSS approach. In the process, thousands of stakeholders were involved in

forming recommendations. CDOT considers the project a model of public participation and integrated planning. Mary Jo collaborated between CDOT and City and County of Pueblo to plan the interstate, local network, and trail improvements for the New Pueblo Freeway. Beginning with a day-long stakeholder workshop, Mary Jo continuously garnered support of the project through neighbors, business owners, agencies, and municipalities spanning over 2 years of meetings.

## US 24 West Environmental Assessment; CDOT; West of Manitou Springs

US 24 provides a vital east-west connection for the Pikes Peak region. Short- and long-term strategies were developed that address mobility and safety in a context set by corridor users and stakeholders. Mary Jo led the transportation planning, oversaw overall project quality, performance of project staff, budget and schedule compliance, and coordination with CDOT.

Under Mary Jo's leadership, the CH2M HILL team demonstrated flexibility in considering a broad range of solutions that have benefited the various stakeholders within a corridor.

- Dave Watt, PE, Resident Engineer, Region 2

## Highway Management and Development; UK Highways Agency

One of the strongest industry examples of a collaborative partnership driving innovation is the AOne+ joint venture where CH2M, Colas, and Costain are serving as the managing agent contractor for over 1,400 miles of the UK "A" roads. AOne+ has received numerous innovative awards, including Construction News Awards: Innovation of the Year Product Innovation of the Year, 2013; Highways Magazine Excellence Award: Most Innovative Highway Authority Project/ Scheme 2013; and Highways Magazine Excellence Award: Innovative Maintenance Product of the Year, 2007.

## Crossrail Innovation Program, Delivery Partner, UK

CH2M, through Crossrail, has developed an innovation program, exchanging innovative ideas across organizations to collectively build innovative solutions by introducing innovative ideas, technologies, and practices across the industry. Crossrail is the first organization to develop a strategy and process for managing innovation, investing nearly \$500k on 300 innovations.

# 5. Innovation and Our Idea

## CH2M is a leader in transportation innovation.

In this capacity, we develop tools, processes, and events to create innovative ideas and incubate them into tangible programs that exceed the needs of our clients, promote entrepreneurship, and highlight the solutions-driven attitude of our staff. Innovation is a key differentiator for our company; it is the only way to develop long-term, sustainable relationships with our clients while maintaining engaging projects for our staff. We continuously challenge and reward our staff to innovate and enhance ways we deliver our projects to exceed our clients' needs.

Within CH2M, we have several ways to encourage innovation. CH2M recently launched two firmwide crowdsourcing challenges to promote innovation while rewarding our employees. The Resilient Cities Crowdsourcing Challenge allowed employees across the firm to submit innovative ways to help cities plan, mitigate, and be more resilient to climate change and severe weather. Our second crowdsourcing initiative involved ways to address aging infrastructure. For this challenge, over 2,000 innovative ideas were presented on ways we can help our clients address the growing concern of aging infrastructure through enhanced designs, operational efficiencies, and alternative revenue and funding programs. For each of these ideas, CH2M assigns mentors, including individuals proposed for RoadX, to help these innovators vet their ideas and develop tangible problem statements, solutions, and business cases that can be used to address our client's needs.

## CH2M promotes innovation within our transportation team.

In June 2015, over 200 CH2M transportation technologists from around the world convened in Denver for the Transportation Technology Transfer (T3) conference. This 2-day conference showcased 48 different projects where CH2M is using technology and innovative processes to address our clients' most pressing needs. Several CDOT representatives also attended T3 and supported our efforts through participating in a panel discussion on ways our clients will look to innovation in the future.

Outside of CH2M, we also promote innovation for our clients and communities. Our CH2M Foundation couples innovation with philanthropy to partner with organizations in underdeveloped countries to develop sustainable communities and foster employee engagement through paid travel grants for supporting philanthropic endeavors. We partner with three large non-profit organizations—Engineers Without Borders, Water for People, and Bridges to Prosperity. As part of our client support, CH2M also hosts industry days, innovation showcases, and small business opportunity open houses to bring best-in-industry approaches forward to address our clients' most pressing issues.

### Our approach to innovation hinges on three key questions:

#### 1. Why is innovation needed?

#### 2. How can innovation be used?

#### 3. What is the innovative solution?

For RoadX, we evaluated several ideas as viable candidates, vetting each idea through these three filters. We understand the RoadX success criteria: improving safety, providing choices to commuters, multi-modal integration, and connecting travelers; and have used these criteria as the basis for answering the "Why" question. Using these criteria as the foundation, we then evaluated what ideas would maximize the CDOT investment and provide a flexible, scalable, and easily replicated model that can be used for other agencies, and neighboring states.

Our proposed idea, presented on our exhibit, uses both innovative approaches and partner investments in enhanced infrastructure that fully meet the RoadX success criteria.

This idea leverages our design activities as part of the City of Centennial ITS Master Plan, to deploy an AV/CV demonstration corridor along a section of Arapahoe Road. This demonstration corridor, further explained in our exhibit, will use modernized ITS infrastructure, enhanced data sources and analyses, and alliances with auto dealerships to provide a showcase corridor for demonstrating how AVs and CVs will interact with other vehicles, pedestrians, bicycles, and transit vehicles. In considering our three core innovation questions, the AV/CV demonstration corridor provides the following answers:

- **What is the innovative solution?** Leveraging existing investments in ITS, coupled with partnerships with key auto dealerships to deploy an AV/CV demonstration corridor.
- **How is Innovation Used?** By leveraging existing designs and infrastructure investments (through our partnership with the City of Centennial), we can further promote AV/CV acceptance.
- **Why is Innovation Needed?** The demonstration of AV/CV compatibility with multi-modal options along a highly congested corridor improves safety, provides additional choices to motorists, integrates with multi-modal options, and connects travelers through enhanced data analysis and results.

Our 11x17 exhibit explains our concept while following a format to consider as the model for future RoadX innovation proposals.



**Contact us**

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**\$ 550K**

**CREATE A MOBILITY MANAGEMENT HUB (MMH)**

The cloud based open data sharing concept includes V2I data from the street to optimize traffic flow, conduct real-time and predictive analytics, and disseminate information to AVs, CVs. CH2M partner Microsoft is able to provide tools for the creation of the most advanced Azure cloud based mobility management big data application envisioned for the mobility industry. All data flows into the hub from vehicles, mobile apps, sensors and machine to machine Internet of Things implementations as well as the traffic signal and ramp metering systems. The MMH will facilitate seamless personal mobility experiences for drivers. For example, drivers can exchange calendar entries containing location with the navigation system in a BMW.



**SMART RAMP METERING CONTROLLER AND DATA DETECTION**

Upgrades for the I-25 and Arapahoe Interchange to collect traffic flow and congestion information to be sent to the MMH.



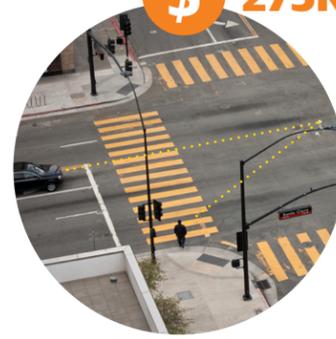
**\$ 550K**

**DEMONSTRATE VEHICLE TO VEHICLE (V2V) CAPABILITIES** including collision avoidance and semi-autonomous safety features.



**\$ 375K**

**VEHICLE TO PEDESTRIAN PHONE (V2P) Safety Application** demonstrating AV/CV collision and signal preemption for pedestrians.



**\$ 275K**

**VEHICLE TO INFRASTRUCTURE (V2I)** Demonstrating how vehicle data is collected and is used to enhance driving experiences for auto alliances.



**OPEN REGIONAL DATA SHARING** Cloud based analytics and messaging from big data mobile apps.



**CONSTRUCTION MONITORING AND ADVISORIES** I-25 & Arapahoe Interchange Construction information sent to AV/CV heads up displays.



**\$ 300K**

**UPGRADE SIGNAL CONTROLLERS** Upgrade key intersections to Econolite Cobalt CV capable controllers for enhanced traffic signal timing and data processing, open-source data, and real-time analytics for V2I communications.



**AUTONOMOUS VEHICLE FLOATING CAR STUDIES**

To measure RoadX improvements, and demonstrate AV/CV technologies and collect real-time data for the MMH.

**Arapahoe Road AV/CV Demonstration Corridor: What we would do with \$2M**

It's paramount that early investments in RoadX pilot projects deploy the best ideas of industry and produce results that garner public understanding and acceptance of the RoadX vision. For those reasons, the CH2M team proposes a Road X Autonomous and Connected Vehicle (AV/CV) Demonstration Corridor on a congested portion of Arapahoe Road, to showcase AV/CV compatibility and their interface with other mobility options (vehicles, pedestrians, bicyclists, and transit). This project will be a first of its kind collaboration comprised of diverse partnership and technological applications.

Beginning at the Arapahoe Road/Yosemite Street intersection, continue east through CDOT's I-25 intersection along a section heavily populated with automobile dealers starting at the Dayton St. interchange, ending at the Arapahoe Road/Havana Street interchange. The demonstration corridor will test AV/CV interactions using key communications mediums: Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), Vehicle to Cloud (V2X), Vehicle to Pedestrian (V2P), and Vehicle to Bicycle (V2B).

Leveraging our completed ITS infrastructure gap assessment for the City of Centennial, vested private sector partners including Econolite, Microsoft, Savari Networks, Cisco, and Qualcomm; and demonstration vehicles from local automobile dealerships; we will deploy enhanced ITS including: Cobalt CV capable signal controllers, DSRC and Bluetooth radios and encryption, enhanced roadside sensors, and aftermarket onboard units to collect, process, and analyze data from demonstration vehicles along the corridor, where CH2M currently supports transportation operations and maintenance under an existing contract.

CH2M, Cisco, and Microsoft will also develop the Mobility Management Hub (MMH), an Azure cloud-computing based, open-source platform to collect, process, analyze, and disseminate data and information to motorists, demonstration vehicles, and infrastructure managers. The MMH will integrate data from the enhanced infrastructure, probe vehicles, and traffic data sources (e.g. INRIX) across a fully interoperable, open-source data platform that can collect, process, and share information between CDOT Traffic Management Centers (TMCs) and those of other municipalities.

The RoadX AV/CV Demonstration Corridor and Mobility Management Hub provide a tangible system that improves safety, provides options to motorists, supports multimodal integration, and connects travelers. This system will leverage private sector investments to maximize CDOT dollars and provide a scalable, flexible, and easily replicated model that RoadX can use as an innovative showcase for future demonstrations.

