



The California Department of Transportation

The Caltrans Strategic Research Plan

Caltrans Improves Mobility Across California

2008/2009

Division of Research and Innovation
Approved by the RDSC 8/18/2009

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Introduction

*"Would you tell me, please, which way I ought to go from here?"
"That depends a good deal on where you want to get to," said the Cat.
-Alice's Adventures in Wonderland-*

While Alice's plight is entertaining, the same dilemma can be costly and painful for organizations with no clear direction. This Strategic Research Plan provides guidance to California Department of Transportation (Department, [Caltrans](#)) and its partners on where Caltrans would like to "get to" with transportation research. This document discusses the importance of transportation research, the methodology employed to create the Strategic Research Plan, and information about key, priority research questions Caltrans seeks to answer.

The importance of transportation research is summarized in the following statement by the Transportation Research Board (TRB) [Research and Technology Coordinating Committee](#):

The need for innovation in the [transportation] sector has never been greater. Publicly funded highway research programs have developed innovations that have resulted in longer-lived assets at lower costs, reduced environmental impacts, saved lives, and improved economic efficiency. However, additional innovation will be needed to improve safety, reduce congestion, address environmental and energy concerns, and provide the quality highway system the nation's citizens expect.¹

Though few will debate the importance of transportation research, the current national economic state threatens precious research funding. With scarce resources it becomes important for transportation organizations to target research investments judiciously.

¹ Transportation Research Board of the National Academies. 2008. *The Federal Highway Investment In Highway Research 2006-2009 Strengths and Weaknesses*. Special Report 295. <http://onlinepubs.trb.org/Onlinepubs/sr/sr295prepub.pdf>

Caltrans as a Transportation Researcher

Caltrans' Division of Research and Innovation ([DRI](#)) is the facilitator of the Department's transportation research program. DRI sets the Department's research agenda based on the involvement and participation of its internal and external customers, performs applied research, performs research for all modes of transportation, provides technical assistance to its customers for deployment of research products, and engages in both short-term and long-term research. DRI engages the entire Department as a customer in all aspects of the research process. [Appendix A](#) provides an overview of the DRI research governance model and shows how DRI involves its stakeholders.

Why Develop a Strategic Research Plan?

Strategic research planning provides the framework for Caltrans and its partners to collaborate and to ensure research resources are directed to the most crucial research needs. It is Caltrans' vision that this plan will help find new resources for new and continued research, cultivate opportunities for collaboration on research with new and existing partners, and target existing Departmental resources to provide the greatest benefit for Caltrans and the travelling public.

Internally, Caltrans will use the Strategic Research Plan to guide what research is proposed and selected. In that way the Strategic Research Plan becomes a compass which ensures selected projects are aligned with the Department's strategic direction. In addition, Caltrans will overlay the framework provided by the Strategic Research Plan onto the existing body of research to gauge the overall alignment of the Department's research portfolio. Caltrans will identify projects not closely aligned with the plan and determine if they should be concluded in order to shift resources to higher priority research.

Externally, Caltrans contributes to and partners with [University Transportation Centers](#), [PATH](#), [TRB](#), [AASHTO](#), other DOTs, and other transportation research organizations nationwide. Caltrans will use the Strategic Research Plan to communicate the Department's priorities externally in order to find partners, reduce duplication of effort, and potentially influence the broader transportation research landscape.

In addition, the Strategic Research Plan helps to break down silos of transportation research. Traditionally, transportation research originate within the programs with a "good idea" to address a point of pain. The scope and the results of the research exist within narrowly defined, program silos (See [figure 1](#)). The Strategic Research Plan demonstrates the interrelated nature of research: improved mobility reduces congestion, improves safety, and reduces greenhouse gas emissions; and improved safety reduces incidents and improves mobility (See [figure 2](#)). The Strategic Research Plan transcends program by unifying the efforts of multiple programs and partners on mutual research questions.

Figure 1 - Traditional View of Research

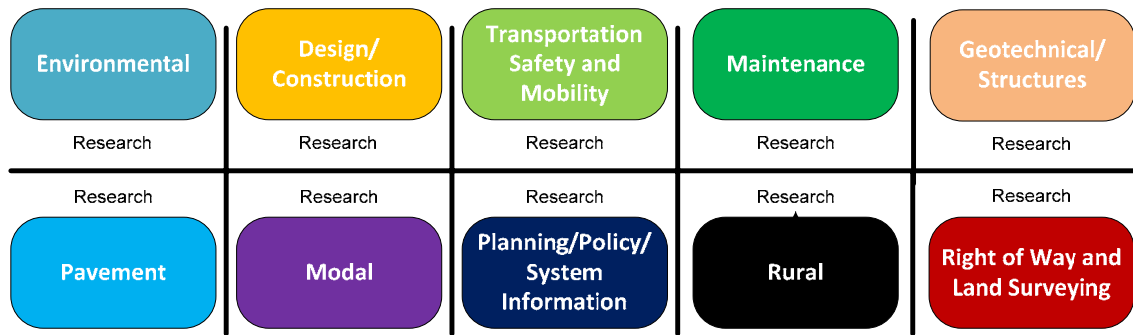
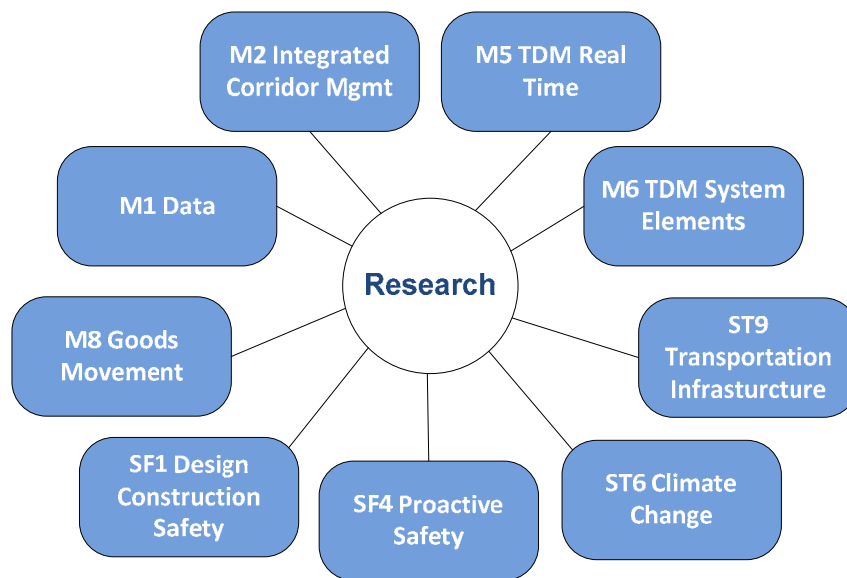


Figure 2 - Strategic View of Research



The Caltrans Strategic Research Plan Methodology

The strategic direction for Caltrans has been detailed in the Department's [2007 – 2012 Strategic Plan](#) (Strategic Plan). The plan focuses the Department on five goals related to safety, mobility, delivery, stewardship, and service. Each goal has multiple objectives and each objective lists multiple strategies for the Department to employ in order to achieve the desired objective and, ultimately, the goal. The Strategic Plan provided the foundation for this Strategic Research Plan.

Strategic Research Plan Workshops

DRI sought department wide input into the creation of the Strategic Research Plan via workshops held for each goal. DRI reviewed the existing body of Caltrans transportation research to identify research stakeholders for each goal and invited all to participate. The format of the workshops was to brainstorm research questions for each strategic plan objective (i.e. Where can research help Caltrans achieve this objective?). The next step required participants to group and refine questions to identify higher level research questions. The final step had the workgroup participants rank the questions. The results of the

workshops may be found in [Appendix B](#). The appendix shows the higher level research questions developed by the workgroups and the supporting, or lower level questions.

The results of the workgroups were 38 research questions across the five goals: delivery had eight questions, mobility had nine questions, safety had six questions, stewardship had nine questions, and service had six questions. The 38 research questions are what Caltrans refers to as the “Strategic Research Questions” (SRQs) because each question relates to research intended to help the Department achieve objectives and goals for the strategic plan. The complete list of SRQs is contained in [Appendix C](#).

Strategic Research Question Prioritization

While SRQs ranked within their goal are useful when guiding research within the goal, Caltrans sought to also rank all 38 SRQs independent of the goals. In order to accomplish this, DRI developed an online survey to measure dimensions of importance and urgency for each SRQ and invited all workshop participants to complete it. [Appendix D](#) contains a description of the survey and charts the results of the survey.

Using the results of the survey, Caltrans grouped the SRQs into three categories:

- **Priority SRQs** – Research questions which, when answered, offer the greatest potential for significant achievement of a Caltrans Strategic Plan objective and goal;
- **Best Practice SRQs** – Research questions which, while important, appear best suited to research related to the implementation of existing best practices in the field; and
- **Low Priority SRQs** – Research questions which yield the least potential for substantial advancement with research.

Of the 38 SRQs, nine were allocated to the priority category, 15 to best practice, and 14 to low priority ([Appendix E](#)). [Table 1](#) shows a count of SRQs as they distribute between strategic plan goals and the prioritized category. What becomes apparent is that mobility, safety, and stewardship are the current priorities for the research questions. This does not necessarily mean that these goals are perceived to be more important than delivery and service. Rather, the mobility, safety, and stewardship goals and objectives lend themselves more to research.

Table 1 - Strategic Research Questions by Goal and Priority

	Delivery	Mobility	Safety	Service	Stewardship
Priority SRQ	0	5	2	0	2
Best Practice SRQ	2	3	3	3	4
Low Priority SRQ	6	1	1	3	3

The Strategic Research Questions and the Existing Portfolio of Research

In order to facilitate a gap analysis, Caltrans mapped the existing research agenda to the SRQs. [Appendix F](#) contains a table which shows the funds allocated by fiscal year for each SRQ. The

information on the table shows that all priority SRQs have at least some funds allocated to research in them. However, some best practice and low priority SRQs have no funds allocated. They are:

- Best Practice SRQs with no funds allocated
 - ST2 Lifecycle Budgeting for Infrastructure
 - SV4 Employee Retention
 - D4 Purpose and Need
 - D6 Engineering Estimates
- Low Priority SRQs with no funds allocated
 - D8 Capital Support Costs
 - ST1 Financial Flexibility
 - ST4 Cultural Resources
 - ST8 Excess Property Management

The fact that no funds have been allocated to some of the best practice and low priority SRQs is not necessarily an issue. Caltrans seeks to focus resources on the priority SRQs so, over time, Caltrans could experience additional best practice and low priority SRQs without funds allocated. In addition, the existing body of research was developed in the absence of the framework provided by the strategic research plan.

Another measure of how the existing body of research aligns with the strategic research plan can be found in looking at how the funds have been allocated across priority, best practice, and low priority SRQs. Based on the dollars allocated, we see that Caltrans allocated funds as follows:

- Priority SRQ funds allocated = 66 percent of total research funds
- Best practice SRQ funds allocated = 23 percent of total research funds
- Low priority SRQ funds allocated = 11 percent of total research funds

Again, we see that the existing body of research aligns with the framework provided by the strategic research plan. Moving forward, Caltrans may wish to see resources shift from the best practice and low priority SRQs to the priority SRQs; essentially, this analysis baselines the existing portfolio of research for future comparison.

The Priority Strategic Research Questions

This section provides an overview of each of the nine priority SRQs. For each SRQ, Caltrans states the question, provides a brief background into the nuances of the question, lists additional questions which surfaced during the planning workshops, and provides a sampling of research projects underway.

Priority SRQ Profile: M1 Data

Priority Question:

How can we improve/enhance data collection and interpretation across modes?

Background:

The timely, accurate, and comprehensive collection and interpretation of transportation data plays a fundamental role in Caltrans' ability to effectively manage its transportation system. The Strategic Growth Plan referenced in the Caltrans Strategic Plan refers to the State Highway System as a pyramid with system monitoring and evaluation as the, "foundation upon which all other strategies are built."²

During the DRI SRQ workshops, the background research questions that contributed to the M1 Data question included:

- What causes the most delay in each corridor?
- How can we monitor performance in real time?
- How can we better interpret traffic and travel data?
- What is the best way to measure and interpret reliability?
- How can we better collect information about travelers and traveler behavior?

Caltrans Research Underway:

A sample of Caltrans research for this SRQ includes the following projects:

- Better Use of Roadway Detection Data
- Rural and Small Urban Transit ITS
- Commercial Vehicle Remote Sensing for Weigh in Motion
- Roadway Detector System Evaluation
- Highway Traffic Flow Reconstruction Using GPS Phone Sensor Networks
- Freeway Corridor Deployment of an Anonymous Vehicle Tracking for an Online Real-Time Traffic Performance Measurement Tool
- Generating Real-time Travel Times and Loop Diagnostics from Existing Field Hardware

Priority SRQ Profile: M2 Integrated Corridor Management

Priority Question:

How can we optimize movement through a corridor?

Background:

The Caltrans Strategic Plan emphasizes mobility as a top priority. Integrated Corridor Management (ICM) has become a central strategy in delivering this priority. The Strategic Plan states ICM can be used by various institutional partner agencies to, "manage the corridor as an integrated asset in order to improve travel time reliability and predictability, help manage congestion, and empower travelers through better information and more choices."³

In addition to efforts underway to define this research question, state Proposition 1B, the Corridor Mobility Improvement Account, has allocated \$4.5 billion for 55 projects in 30 counties slated for construction within the next four years. Caltrans is leading the development of corridor system management plans (CSMPs) for all corridors receiving funds from Proposition 1B. CSMPs provide for the

² The California Department of Transportation. 2007. *The Caltrans Strategic Plan 2007-2012*. Page 13. <http://www.dot.ca.gov/docs/StrategicPlan2007-2012.pdf>

³ The California Department of Transportation. 2007. *The Caltrans Strategic Plan 2007-2012*. Page 29. <http://www.dot.ca.gov/docs/StrategicPlan2007-2012.pdf>

integrated management of travel modes and roadways so as to facilitate the efficient and effective mobility of people and goods within California's most congested transportation corridors. Each CSMP presents an analysis of existing and future traffic conditions and proposes traffic management strategies and transportation improvements to maintain and enhance mobility. CSMP's will address State Highways, local roadways, transit, and other transportation modes.

During the DRI SRQ workshops, the background research questions that led the final M2 ICM question included:

- What are the institutional challenges to implementing ICM?
- How can we optimize mobility across modes and jurisdictions?
- How to balance route and intersection capacities?
- How should we effectively manage incidents across networks?

Caltrans Research Underway:

A sample of Caltrans research for this SRQ includes the following projects:

- Improving Performance of Coordinated Signal Control Systems Using Signal and Loop Data
- Optimal Adaptive Traffic Control for Corridor Networks
- Advanced Transportation Management Systems (ATMS) Testbed Program
- Evaluation of Open Road Electronic Toll Collection for California Application
- Corridor Management Plan Demonstration Finalization and Initial Implementation
- On-Ramp Metering and Commuter Delay: A Before and After Study
- High-Occupancy Vehicle (HOV) System Analysis Tools

Priority SRQ Profile: M5 Travel Demand Management (Real Time)

Priority Question:

What are the most effective real-time strategies to influence travel demand?

Background:

The goal with M5 Travel Demand Management (Real Time) is to influence decisions made by the traveling public while they are en route. The Federal Highway Administration conducted a Demand Management [international scan](#) to assess European experience in managing the demand for automobile and truck travel through a variety of means, including traveler information, technology, improved modal options, pricing, and new institutional arrangements. Within California lies great potential to implement real time demand management strategies.

Even though much is underway in the Travel Demand Management (TDM) arena, there is still much to learn and understand. The importance of this is that “real time” is new to California. For example, until recently, California did not travel time or incident information on changeable message signs which have been in use since the early 1970's. In addition, system elements have not been dynamic (e.g., adaptive ramp metering), California has the technology and needs to find the best ways to use it (e.g. Traffic Management Centers). Finally, California needs to learn more about the “human factor” in the TDM equation. What info will impact driver decisions? What is the impact of affecting driver decisions?

During the DRI SRQ workshops, the background research questions that led the final M5 Travel Demand Management (Real Time) question included:

- How to adjust the time when travel occurs (Freight & Passenger)?
- What pricing strategies are most effective?
- How to provide timely and accurate information to travelers within and between modes?

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Preparing the Way for Vehicle Infrastructure Integration
- Optimal use of CMS for displaying Travel Times
- Microsimulation Modeling of High Occupancy Toll (HOT) Concept in HOV Lanes
- Effectiveness of Information and Control Intelligent Transportation System Field Elements on Commuter Trips
- Dynamic Control Strategies to Increase HOV Lane Vehicle Speeds

Priority SRQ Profile: M6 Travel Demand Management (System Elements)

Priority Question:

What transportation system elements and land use options are most effective in reducing travel demand by enhancing choices?

Background:

In order to be able to effectively manage travel demand, California must provide travelers with viable travel options. This SRQ seeks to identify system elements that need to be in place in order to complete the TDM system. “System elements” include transit-oriented land use and transit system improvements (e.g., bus rapid transit), bicycle facilities (e.g., bike lanes, bike lockers, or bike parking), and pedestrian-oriented land uses and facilities.

During the DRI SRQ workshops, the background research questions that led the final M6 Travel Demand Management (System Elements) question included:

- How to increase substitutions for travel?
- How to improve service quality of public transportation?
- How to influence transportation land use compatibility?
- How to increase the use of non-motorized modes?
- How to improve access to public transportation?
- How can traveler information be used to influence traveler behavior?

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Bus Rapid Transit Development Strategies
- Implementation of Integrated Land Use/Economic/Transportation Model
- Measuring Bicycle/Pedestrian Activity and Relationship to Land Use
-
- Deploying Portable Advanced Traveler Information Systems (PATIS)
- One Dedicated Lane for Two-Direction Bus Rapid Transit

- Provision of Road Capacity Through Privately Built Roads: Capacity, Pricing, and Competition issues

Priority SRQ Profile: M8 Goods Movement

Priority Question:

How can we improve goods movement throughout the State to generate jobs, increase mobility and relieve traffic congestion, improve air quality and protect public health, enhance public and port safety and improve California's quality of life?

Background:

Goods movement focuses on getting goods efficiently and effectively from their point of origin to their destination. The issues surrounding goods movement concern how crowded and congested cities can efficiently move goods and provide transportation infrastructure to support economic growth. The conundrum of congestion and goods movement is what makes the research question with M8 Goods Movement fertile ground. A quick scan shows much research is underway federally, with other states, and within academia; however, much remains to be answered.

California punctuated the importance of goods movement when it completed the [California Goods Movement Action Plan](#) and passed the [Strategic Growth Plan](#). The Strategic Growth Plan targeted \$3.1 billion to relieve traffic congestion along major trade corridors, improve freight rail facilities, and enhance the movement of goods from port to marketplace.

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Addressing Goods Movement Challenges in California
- Truck Access and Parking
- Weigh in Motion (WIM) Studies and Evaluations
- BART Air Freight

Priority SRQ Profile: SF1 Design/Construction Safety

Priority Question:

What design features and construction standards can be utilized to improve highway safety?

Background:

The first objective in the Caltrans Strategic Plan is to reduce the fatality rate on the California State Highway System to 1.00/100 million vehicle miles traveled (MVMT) and continuously reduce the rate annually thereafter toward a goal of the lowest rate in the nation. In addition, California developed the Strategic Highway Safety Plan ([SHSP](#)) to identify and define challenge areas for California to target improvement. An analysis of collision factors in the SHSP indicates that “the roadway” factors into collisions in up to 34 percent of all incidents. Multiple SHSP challenge areas specifically call out the need to focus attention on the potential for improved safety through design and construction improvement.

During the DRI SRQ workshops, the background research questions that led the final SF1 Design/Construction Safety question included:

- What design construction standards most improve highway safety for the traveling public?
 - How do modifications to specified road geometrics affect safety?
 - How do design standards impact safety for the traveling public?
 - Develop/use new strategies/criteria for two-lane highway safety.
 - Are there infrastructure strategies that would change driver behavior patterns?
 - Assessing the effects of high temperatures and fire on concrete and steel.
 - What project features that improve safety? (i.e. wider shoulders)
- What design construction standards and strategies work best to reduce exposure of transportation workers?
 - Are there lower maintenance sign post systems than wood posts to decrease worker exposure?
 - Development of RAPID facility restoration techniques
 - What can be done in designing projects (geometrics, pavement design, etc.) to reduce future exposure to maintenance workers?
 - Accelerated Bridge Construction to reduce workers exposure and Improve construction zone safety

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Earthquake Ground Motion Hazard Characterization
- Improved Earth Retaining Systems
- Develop and Deploy Ground Improvement Technologies
- Improved LRFD Specifications for California Bridge Design
- Improved Highway Design Methods for Desert Storms
- Practical Implementation of High-Performance Materials
- Structure Design Details for Blast and Extreme Events

Priority SRQ Profile: SF4 Proactive Safety

Priority Question:

What can Caltrans do to mitigate collisions?

Background:

The body of research both within Caltrans and nationally is well-formed when it comes to incident management; however, the mitigation of collisions represents an area where research could generate improvement. In addition to the design and construction aspects Caltrans discusses in SF1, Caltrans has the opportunity to conduct research into proactive ways to mitigate collisions and fatalities on the roadway. As with SF1, the SF4 ties to the strategic plan objective to reduce the fatality rate on the California state highway system to 1.00/100 MVMT and the [SHSP](#). Most recent data for the fatality rate per MVMT shows that California is at 1.27/100 MVMT. This equates to 4,197 fatalities on California's

roadway in 2006 (According to the California Highway Patrol [Statewide Integrated Traffic Records System](#)). All of this punctuates why SF4 Proactive Safety research is a priority.

During the DRI SRQ, the background research questions that led the final SF1 Design/Construction Safety question included:

- How can we be more proactive and identify systemic issues?
- What strategies could be implemented to reduce secondary incidents from occurring while the initial incident is being addressed?
- What are the most proactive safety strategies that would reduce fatalities?
- Would truck rest-stops help reduce/prevent big-rig accidents in metropolitan areas?
- How do we measure effectiveness of non-engineering countermeasures on safety?

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Investigation of the Crashworthiness of Barrier-Mounted Hardware
- Development and Testing of a Low-Profile Barrier
- Estimating Pedestrian Accident Exposure
- Transit Rail Right of Way Safety
- Assessing Automated Speed Enforcement (ASE) Systems in California
- Methods to Address Headlight Glare
- Countermeasure Performance for Ramp/Freeway Collisions

Priority SRQ Profile: ST6 Climate Change

Priority Question:

How can Strategic Growth Planning be advanced through addressing climate change adaptations and mitigations?

Background:

The importance of mitigating the contribution to and effects of climate change is of vital importance to California. According to the California Air Resources Board ([CARB](#)), California produces roughly 1.4 percent of the world's, and 6.2 percent of the total U.S., greenhouse gases. Within California, Transportation activities are responsible for 38 percent of the greenhouse gas emissions. ([AB 32 Scoping Plan](#)). This prompted Governor Schwarzenegger to sign AB 32 in September 2009. AB 32 requires CARB to adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance. Both Caltrans and transportation research have a role to play when it comes to climate change.

During the DRI SRQ workshops, the background research questions that led the final ST6 Climate Change question included:

- Mitigations: How do we reduce transportation impacts on Climate Change and GHG emission production?
- Adaptations: How do reduce the impacts of Climate Change on transportation systems and communities?

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Climate Change: Assembly Bill 32: Global Warming Solutions Act
- Irrigation - Identify Ways to Conserve Water and Reduce Irrigation Life-cycle Costs
- Sustainable Transportation Energy Pathways

Priority SRQ Profile: ST9 Transportation Infrastructure

Priority Question:

How can we optimize the performance of our transportation infrastructure?

Background:

ST9 Transportation Infrastructure represents a comprehensive question, but at its essence this question speaks to the maintenance and efficient use of Caltrans resources: pavement, structures, maintenance stations, office buildings, etc. The numbers are staggering. According to the Highway Performance Monitoring System (HPMS) [2007 Public Road Data report](#), Caltrans maintains 15,269 miles of roadway which equates to 50,732 lane miles; enough pavement to circle the Earth two full times. The [Division of Equipment](#) states Caltrans uses more than 13,000 pieces of equipment to carry out its mission. When it comes to bridges, the [Division of Maintenance](#) reports Caltrans is responsible for maintaining the safety and integrity of over 24,000 bridges owned by the State of California and California's local government agencies. Finally, all of this takes place on over 350,000 acres of Right of Way owned or controlled by the department. Much can be gained from research into this area.

During the DRI SRQ workshops, the background research questions that led the final SF1

Design/Construction Safety question included:

- Tools: How do we improve transportation infrastructure design analysis, performance prediction and verification tools to better determine the safest, most cost effective infrastructure designs?
- Recycling: How can we use recycled materials in our products while maintaining quality objectives?
- Transportation Infrastructure Design Effectiveness: What are the attributes that achieve the safest, longest lasting, most cost-effective, and aesthetically pleasing transportation infrastructure?
- Transportation Infrastructure Selection: What are the best practices in transportation infrastructure type selection?
- Transportation Infrastructure Management: How can we better monitor, evaluate and measure transportation performance to prioritize and optimize available resources while meeting an acceptable level of performance, safety and service?

Caltrans Research Underway:

A sample of Caltrans research underway for this SRQ includes the following projects:

- Development of an Aerial Platform System for Bridge Inspection
- Rapidly Assess Structural Capacity and Remaining Service Life
- Managing Corrosive Environments

- Rapid Post-earthquake Notification of Potential Bridge Damage
- Accelerated Bridge Construction to Reduce Time/Traffic Impacts
- Pavement Management System
- Quiet Pavements

Conclusions

There is much to do in the arena of transportation research. With the Strategic Research Plan and DRI Caltrans is in position to execute research which has significant impact for the resources expended. The Caltrans Strategic Research Plan answers the questions about where Caltrans wants to go with regards to transportation research. However, research is not static, it changes course based on the information collected. Like the research it guides, the Strategic Research Plan will be updated yearly to reflect new information affecting transportation.

Appendices

[Appendix A](#) – The Caltrans Research Governance Structure

[Appendix B](#) – The SRQ Workshop Results

[Appendix C](#) – The SRQs Grouped By Caltrans Strategic Plan Goal

[Appendix D](#) – The SRQ Prioritization Survey

[Appendix E](#) – The SRQs Grouped By Priority

[Appendix F](#) – Research Funding

[Appendix G](#) – List of Links

Appendix A – Caltrans Research Governance Structure

DRI Research Organizational Structure

Research and Deployment Steering Committee (RDSC)

- Caltrans Deputy Directors and District Directors
- Approves annual Research Agenda
- Supports deployment of research products

Research and Deployment
Steering Committee
(RDSC)

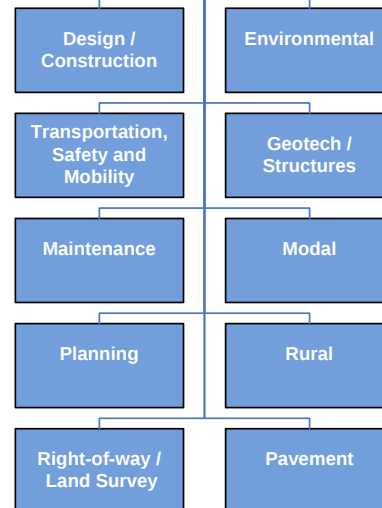
Research Deployment Advisory Committee (RDAC)

- Created to advise the RDSC
- Comprised of the functional managers from the PSCs
- Ranks and prioritizes projects in Research Agenda
- Recommends annual Research Agenda to RDSC
- Supports deployment of research products

Research and Deployment
Advisory Committee
(RDAC)

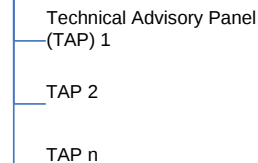
Program Steering Committees (PSCs)

- Each PSC is lead by a Caltrans functional area manager
- The PSC is usually the customer/beneficiary of the research
- Manage their program of research

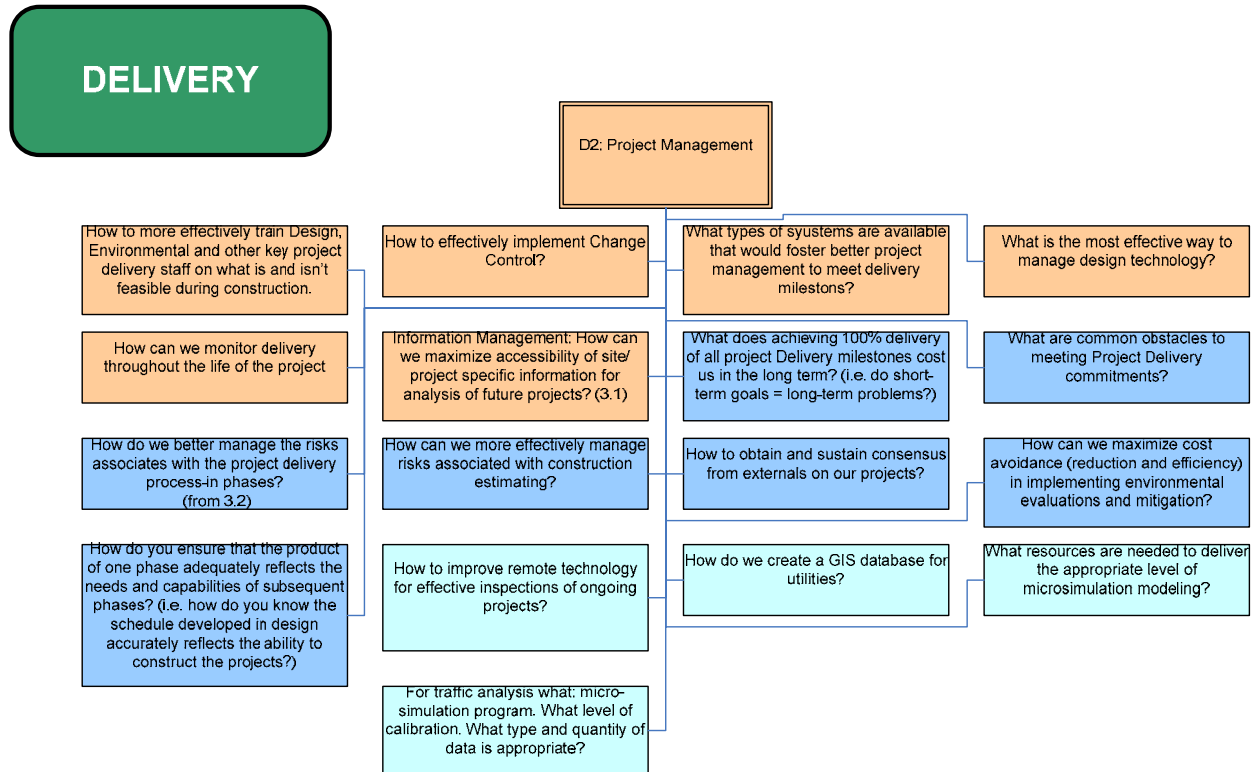


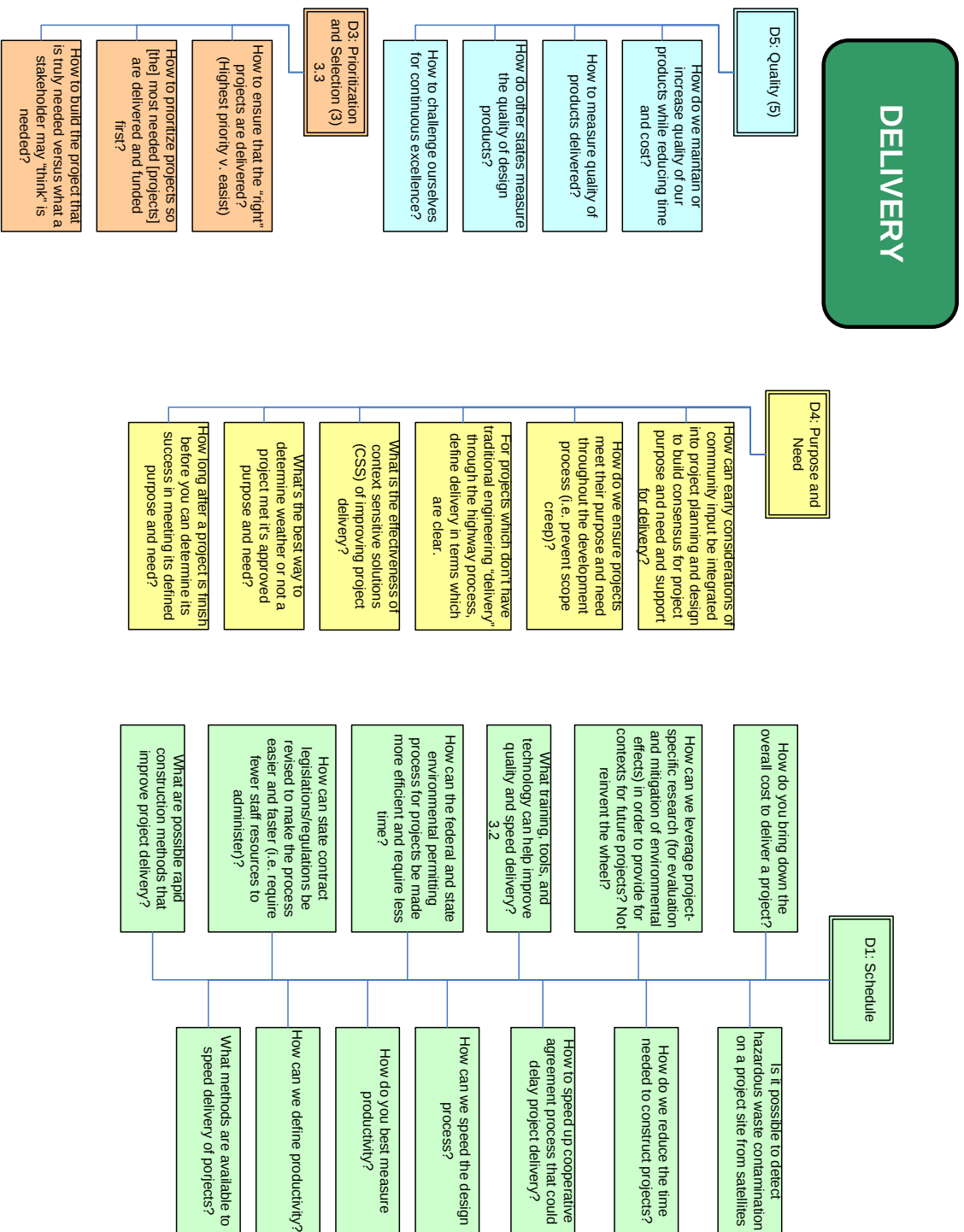
Technical Advisory Panels (TAPs)

- Created to support the PSCs
- Comprised of Caltrans subject matter experts
- Help the PSCs determine what research projects to conduct



Appendix B – The SRQ Workshop Results





DELIVERY

D7 & D8: What research can we do to lower the cost of delivery (support and capital)? What should they be? How can we manage cost?

How to reduce support/cap ratio for minor program?

What are other DOT's support: capitol costs? For those that are lower, how are they achieving this?

What contracting methods are available to speed delivery and lower costs?

What is the support/cap ratio for similar DOTs or transportation agencies performing similar programs?

How to more efficiently deliver projects? Streamline?

Have projects been analyzed by WBS to determine where cost overruns occur?

What are the key causes of re-work during the design process?

What are the primary causes of cost growth during construction?

What is the benchmark for overhead costs for similar DOTs?

What are the tools to reduce the overhead cost but not impact support/cap ratio?

What are the total costs related to the projects? Lifecycle?

Why construction component costs 14-18% of capitol costs?

What percent of overhead are other states experiencing?

What support to capitol ratio are other states experiencing?

Obj 3.3/3.4
How can better/more efficient designs be incorporated into projects to keep costs low and meet approved purpose and need?

How can we identify and measure costs for evaluation and mitigation?
3.1 Find efficiency through accurate cost comparisons and projections

What the effect of projects going to Construction and \$ bid/ \$engineering estimate by district and by month? By \$ volume of contract?

What is/are the appropriate functional charging rates to each phase? (i.e. what percentage of the construction phase should be expended by construction, design, traffic, etc.?

What percentage of construction support costs should be spent on ensuring compliance with specifications versus compliance with non-project-related administration demands (labor compliance, recycling, legislative, etc.)

D6: How can Caltrans improve engineering estimates? (O)
3.5

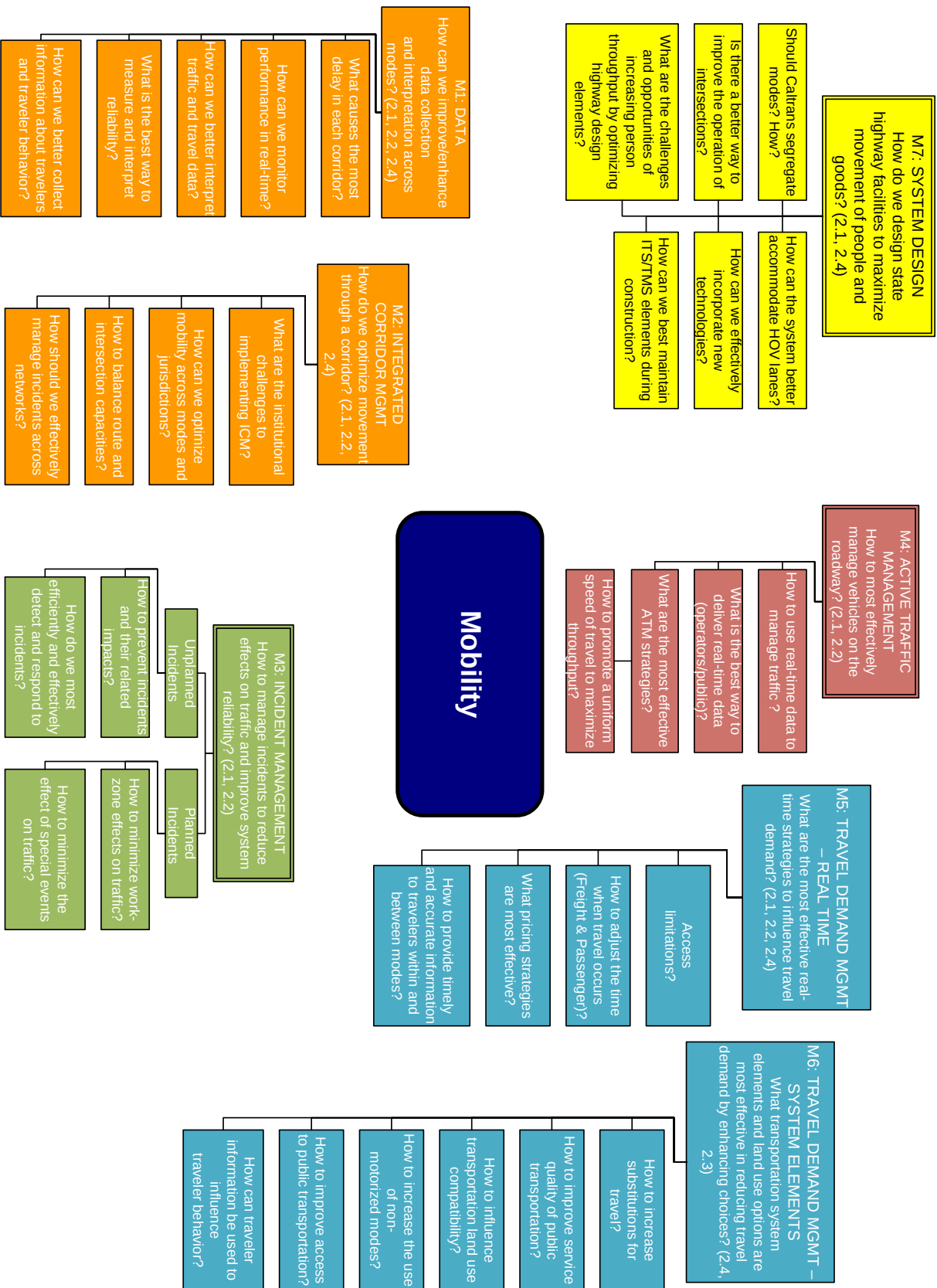
What tools and methods are available to ensure engineering estimates adequately reflect market conditions?

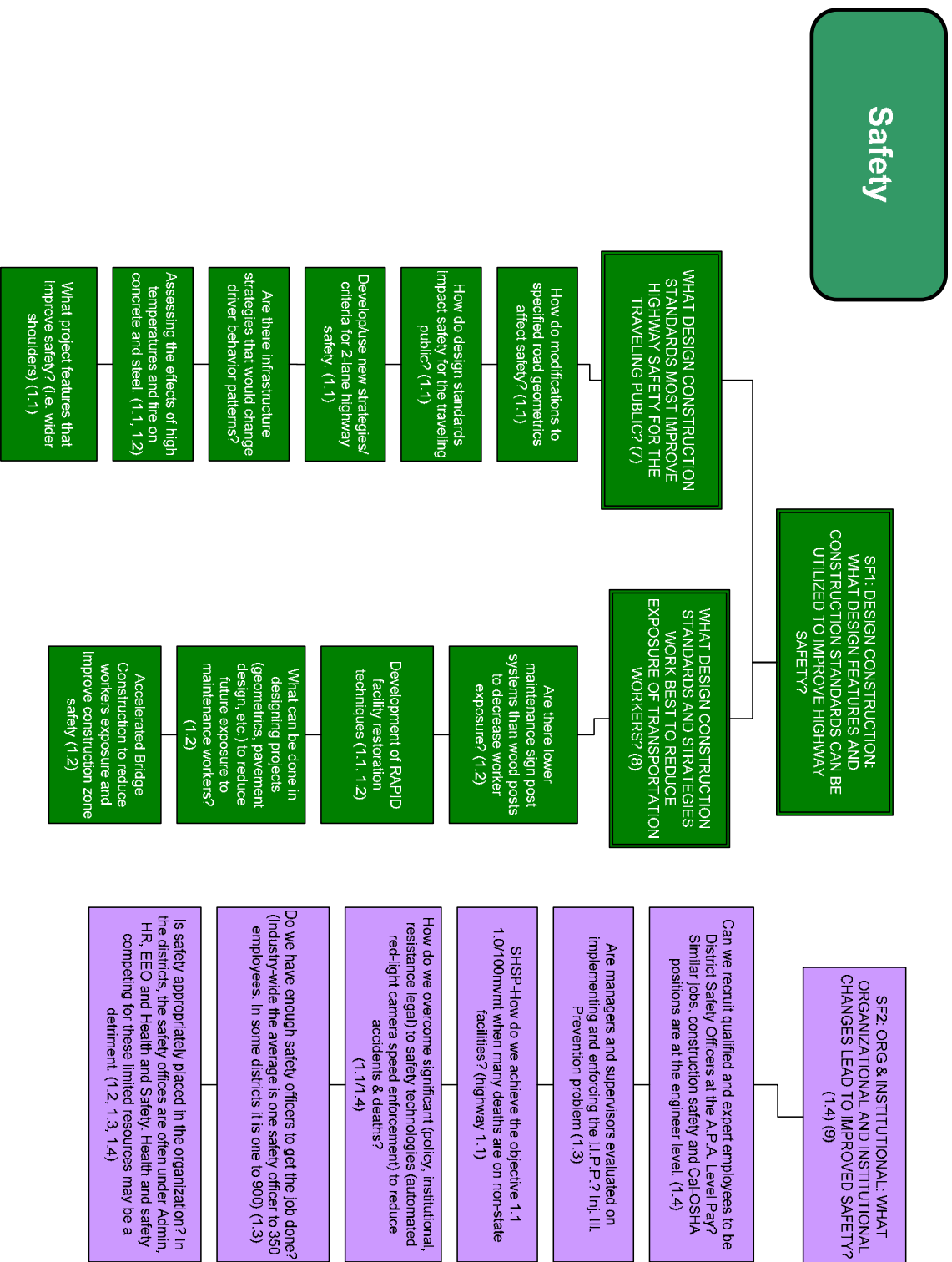
What tool/best practices to forecast cost of labor and materials?

How can we improve the accuracy of construction estimates?

How can project estimators be trained so costs are close to actual costs?
-In house

How can the project description be best written so contractors can accurately bid their contracts so as not to exceed the original allotment? (i.e. how do you accurately forecast rising product costs to minimize cost overruns?)





Safety

SF6: DRIVER BEHAVIOR: HOW CAN CALTRANS GET DRIVERS TO OPERATE THEIR VEHICLES MORE SAFELY? (13)

How can accidents in low visibility conditions (dust & fog) be reduced? (1.1)

How can the magnitude of fatal and injury accidents on the road network be communicated to the public and decision-makers? (1.1)

Improve safety in heavy fog. (1.1)

What is the effectiveness of establishing double fine zones, in terms of changing driver behavior and reducing collisions? (1.1)

How can driver distraction be identified and reduced? (1.1)

How does driver fatigue & stress, particularly as experienced during most congested hours, lead to potential for accidents? (1.1)

What factors/causes contribute to fatalities, injuries that are not directly within Caltrans control? What can Caltrans do about them? (1.1)

Have big rig truck involved crashes increased? And, if so, where, when, and why? Are new strategies to address big rig crashes required? If so, what are they? (1.1)

Can automated speed enforcement, or greater means of controlling errant drivers, be tested to determine their effectiveness on CA roadways? (1.1)

How do we reduce collisions with wild animals (deer, elk, etc)? (1.1)

SF5: REACTIVE SAFETY: WHAT CAN CALTRANS DO ONCE COLLISIONS OCCUR? (17)

How to integrate safety data systems for accessibility and analysis and management. TASSAS, SWITRS, EMS, Hospital, Judicial, Courts, etc. Include employee safety data! (1.1)

What is the best way to identify high collision concentration location layers (e.g. trucks, M/C, ped/bikes)? (1.1)

Identify data needs/reqt. For local roads so that high collision concentration locations can be strategically identified and addressed. (1.1)

What other factors need to be considered beside the "5R" to select projects for programming?

How can Caltrans assist with EMS Response?

SF4: PROACTIVE SAFETY: WHAT CAN CALTRANS DO TO MITIGATE COLLISIONS? (9)

How can we be more proactive & identify systemic issues? (1.1)

What strategies could be implemented to reduce secondary incidents from occurring while the initial incident is being addressed? (1.1)

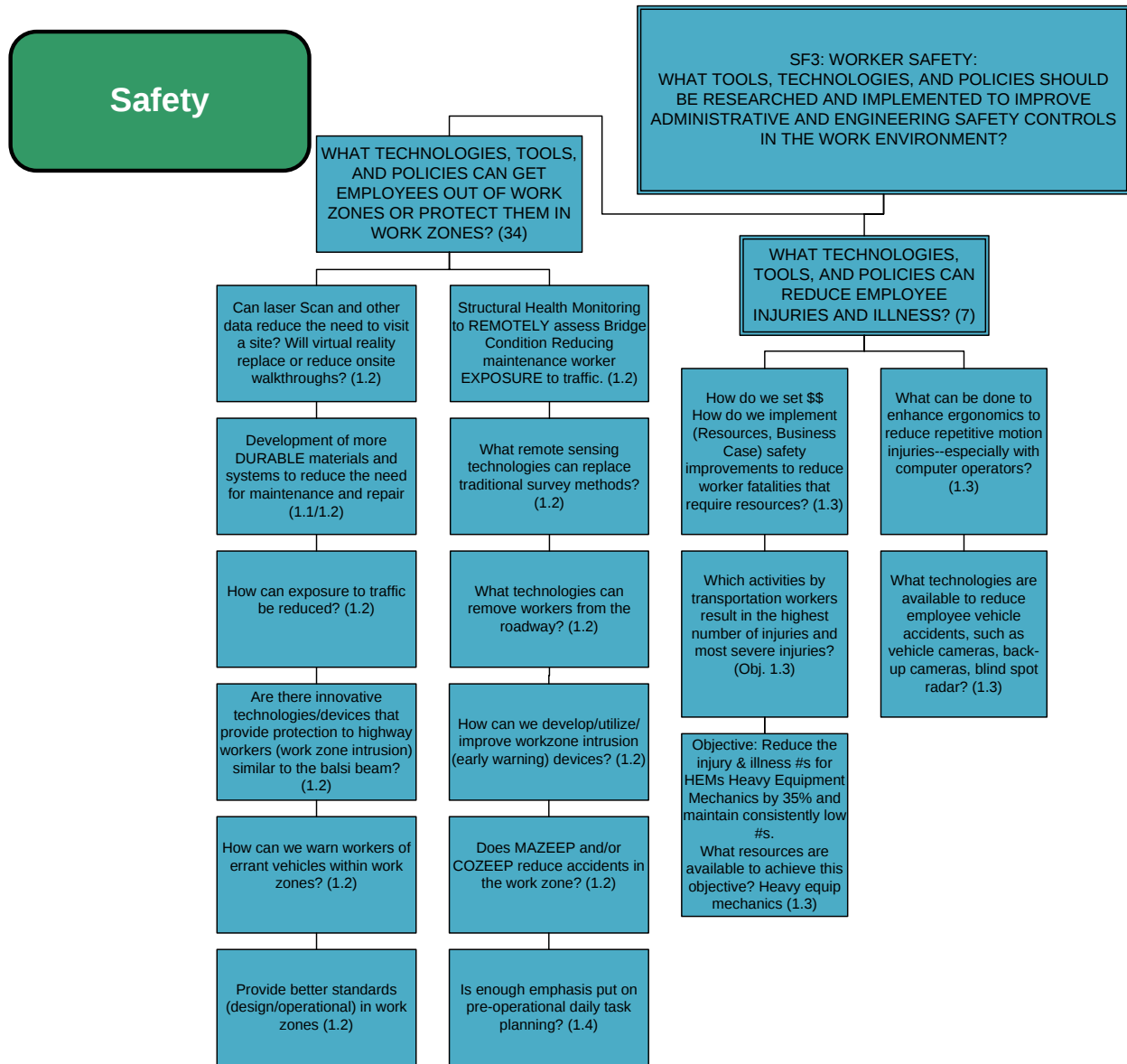
What are the most proactive safety strategies that would reduce fatalities? (1.1)

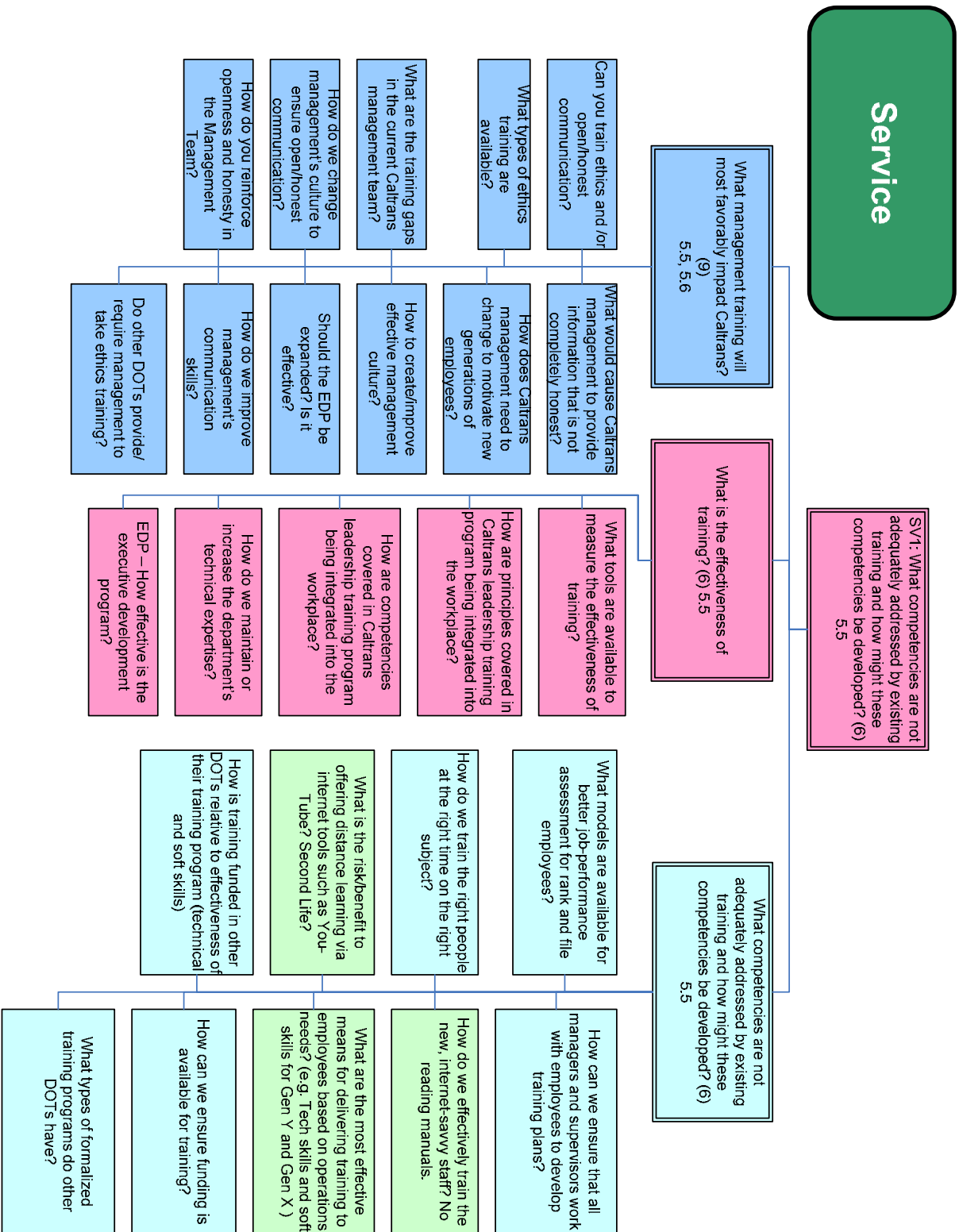
Would truck rest-stops help reduce/prevent big-rig accidents in metropolitan areas? (1.1)

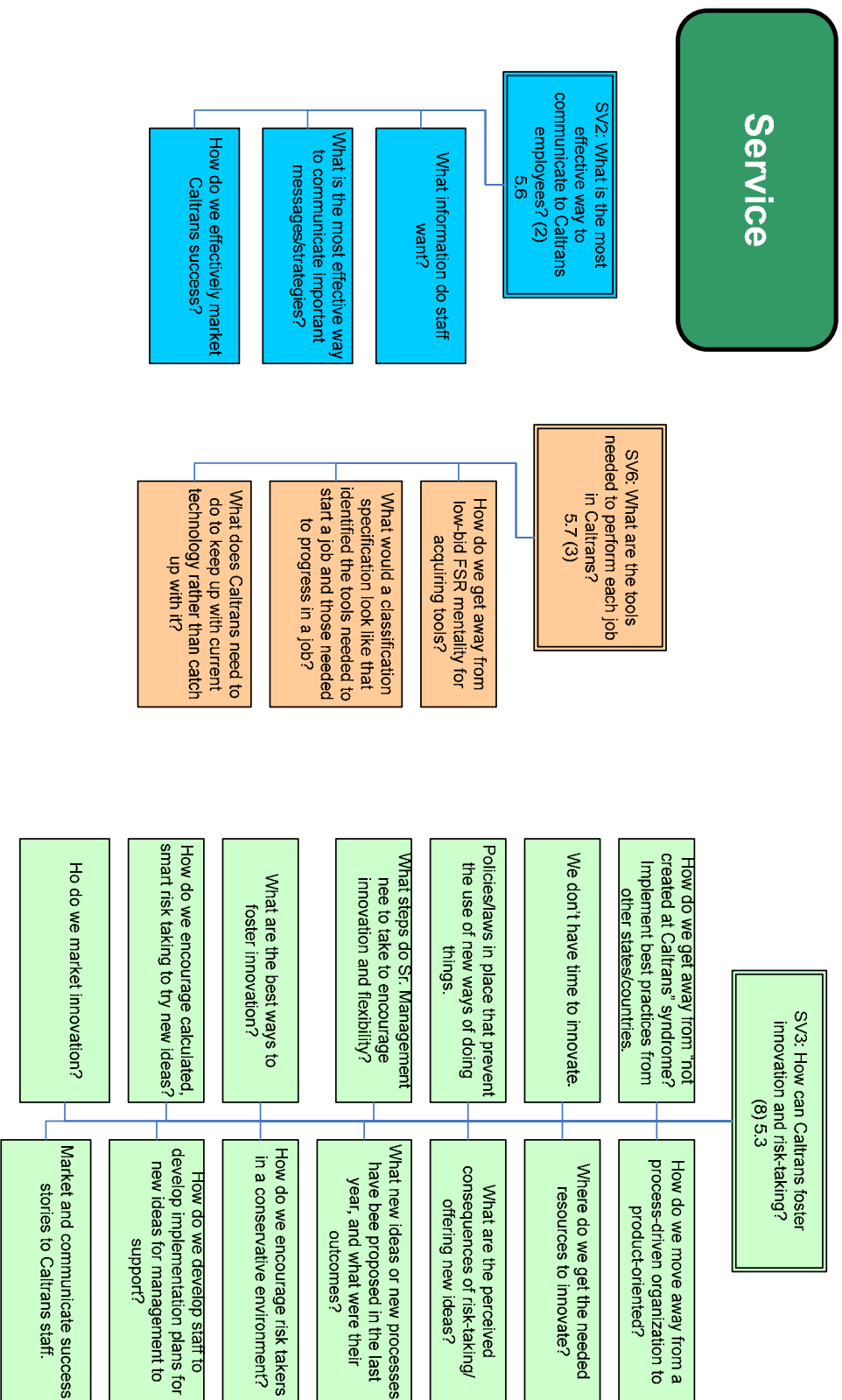
What effect increasing std speed limits (from 55 to 70 mph) has on rolotype of accidents. Relationship of speed to accidents (1.1)

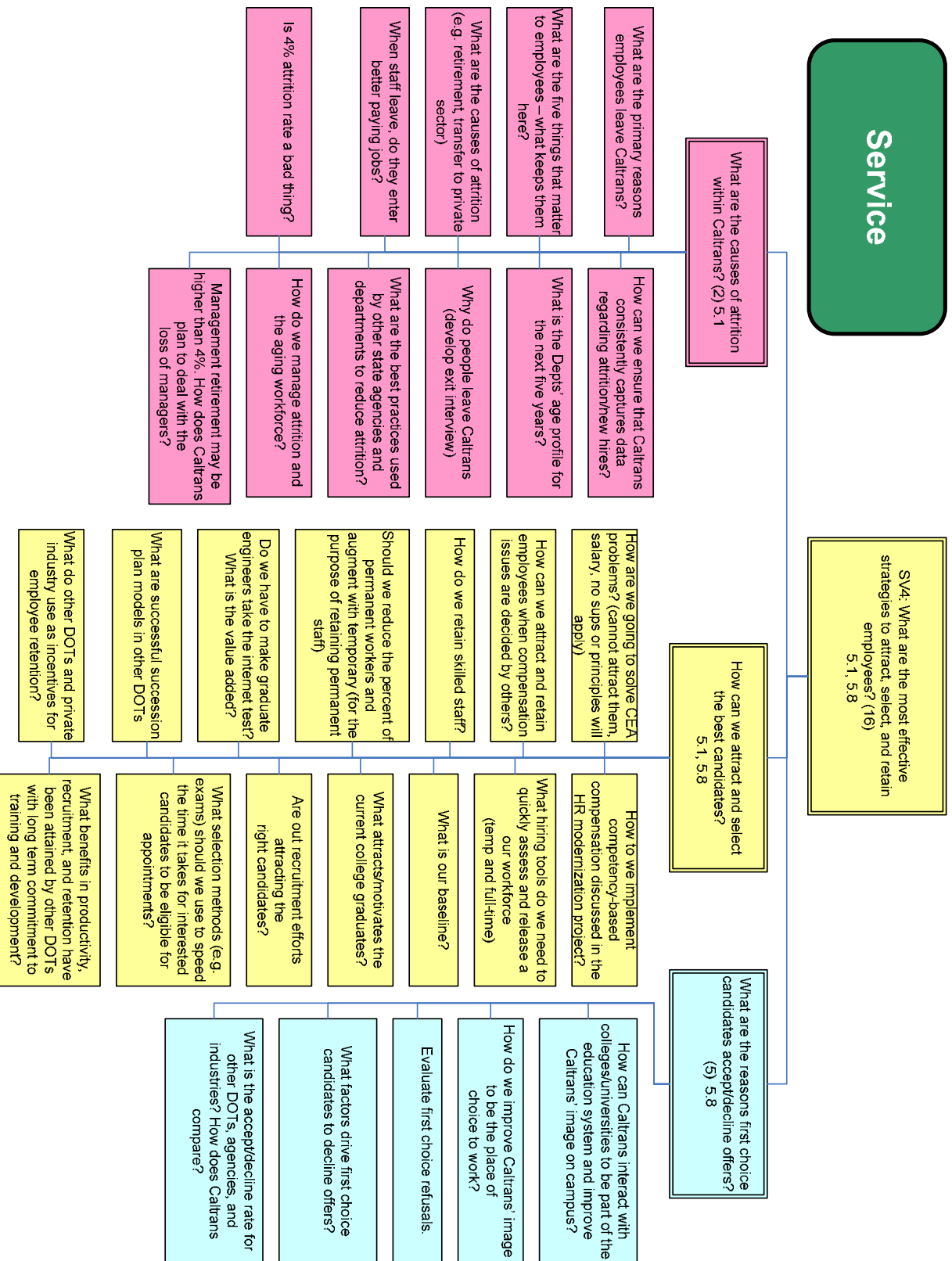
How do we measure effectiveness of non-engineering countermeasures on safety? (1.1)

How can we tie accident causes (i.e. speed, DUIs etc) with improved or concentrated enforcement? (1.1)

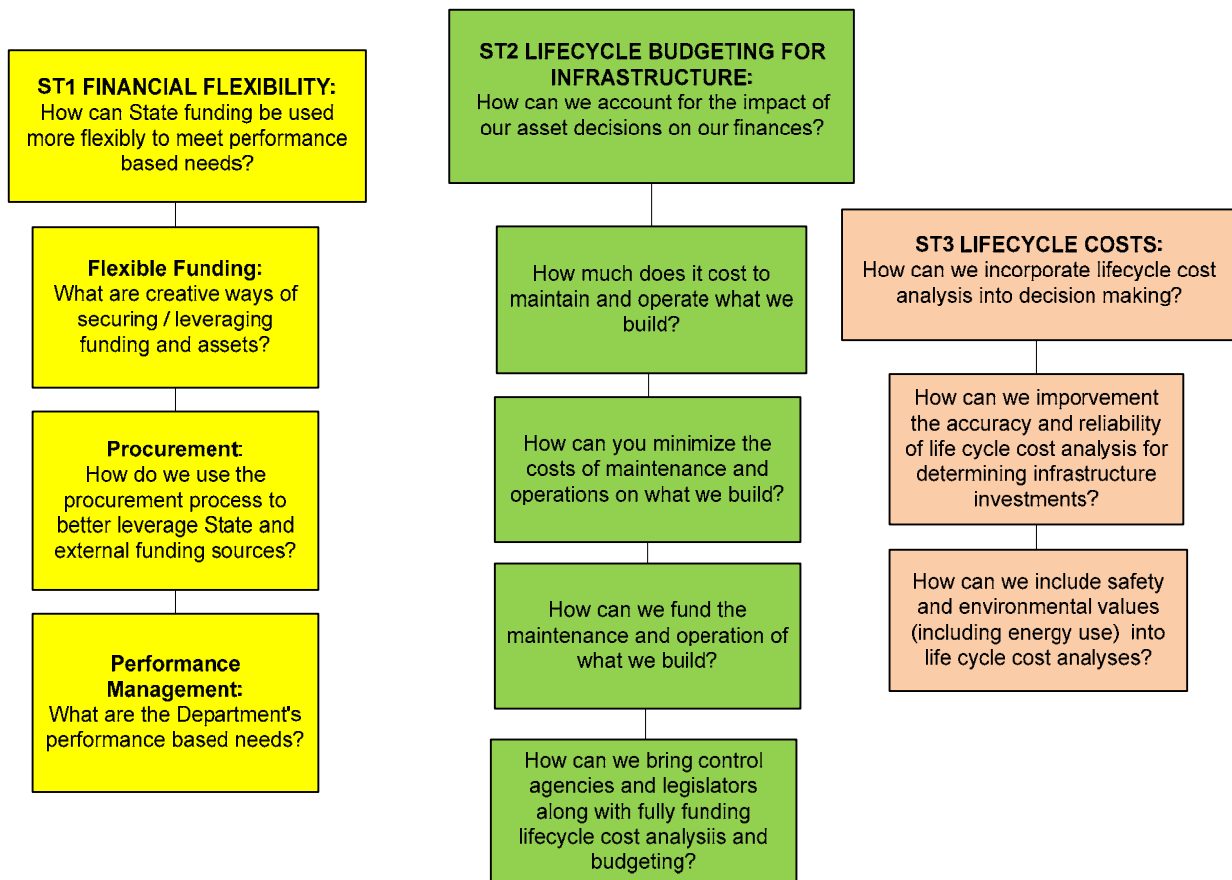


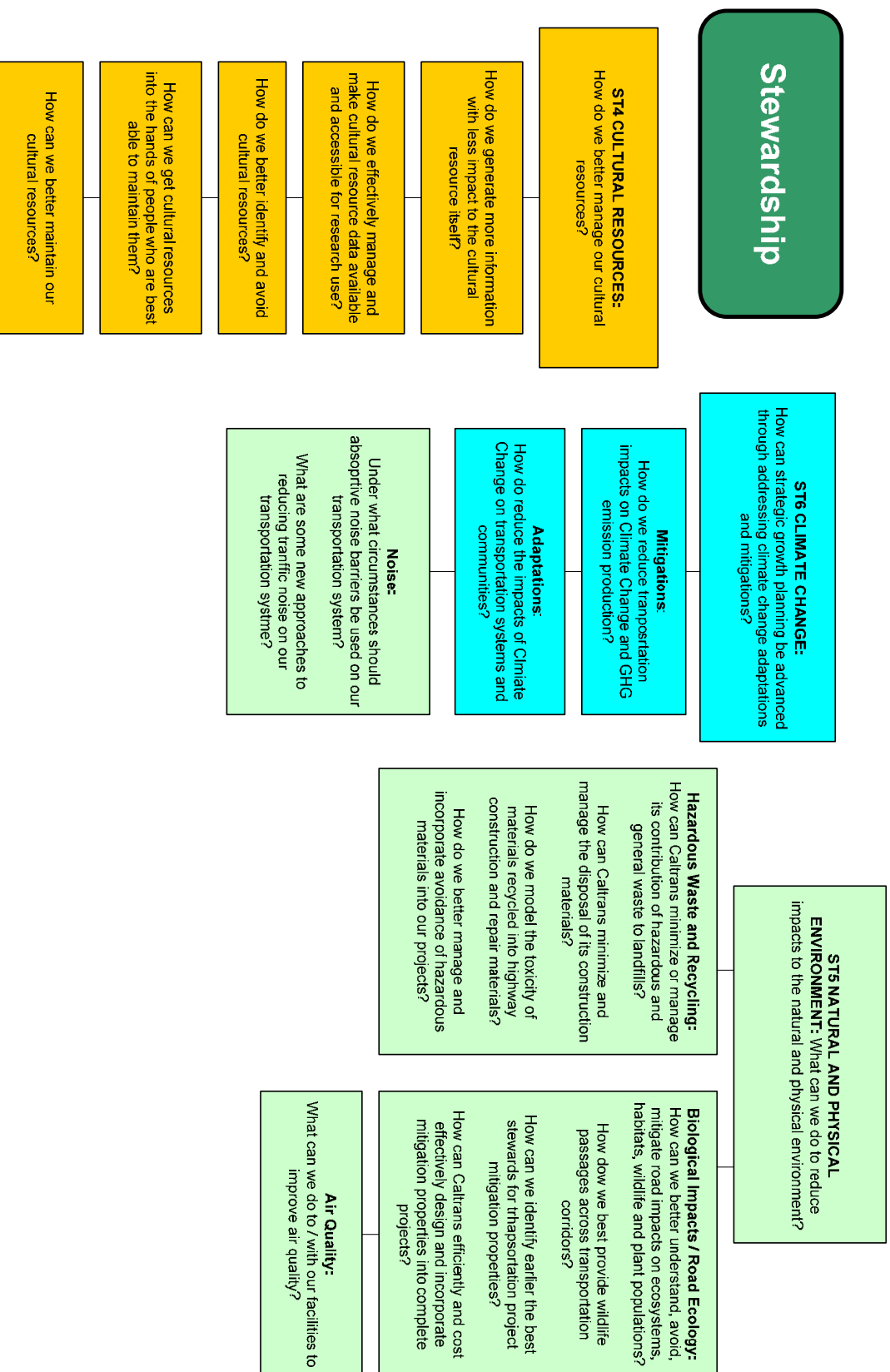


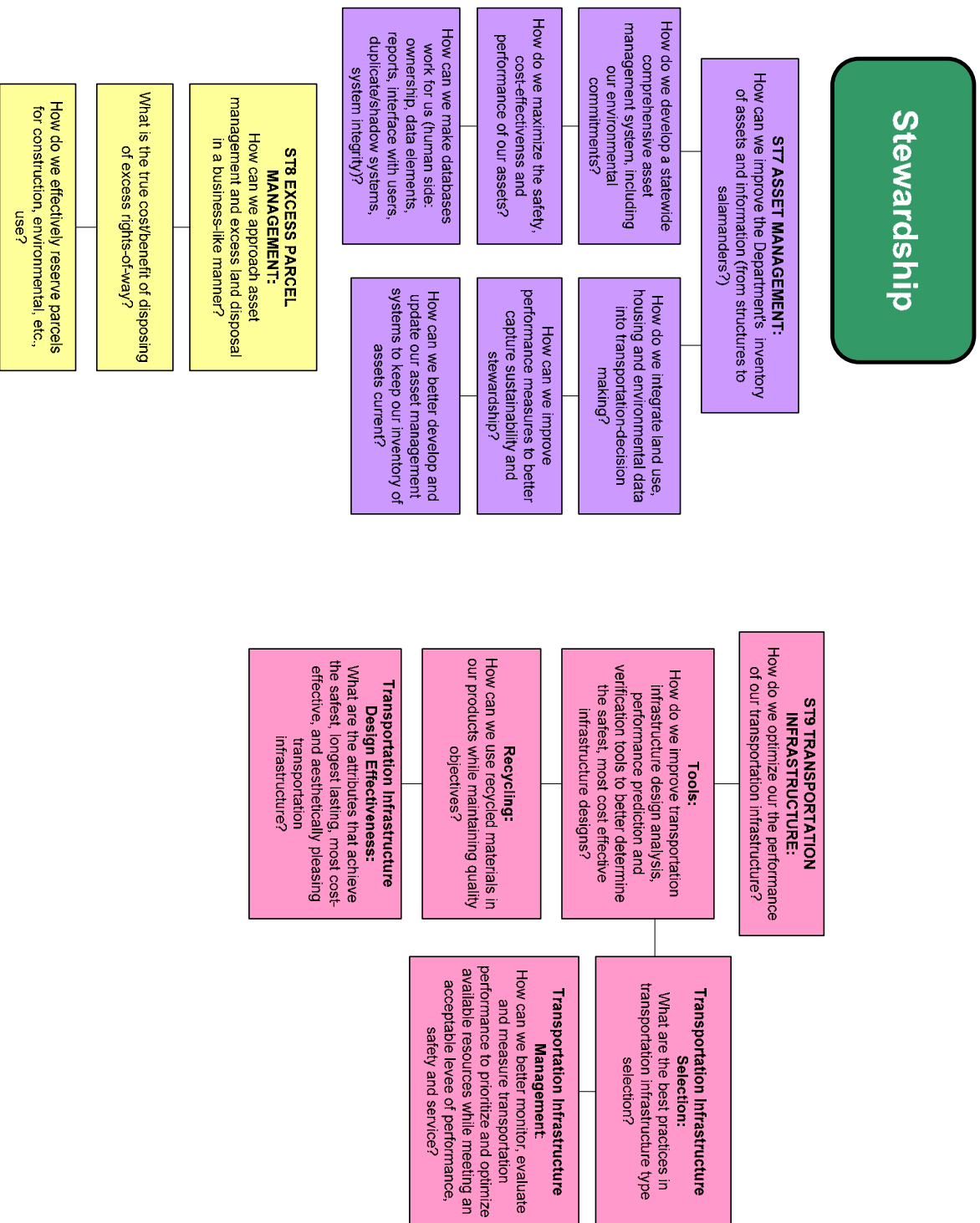




Stewardship







Appendix C – The SRQs Grouped By Caltrans Strategic Plan Goal

Delivery Goal

- D1 SCHEDULE – How can we set and meet realistically aggressive schedules?
- D2 PROJECT MANAGEMENT – How can we effectively and efficiently manage delivery throughout the life of projects?
- D3 PRIORITIZATION AND SELECTION – How can we prioritize projects so the most needed projects are delivered with the available resources?
- D4 PURPOSE AND NEED – How can we establish and meet the purpose and need of the project throughout the project development process?
- D5 QUALITY – How do we ensure that the quality level of project deliverables match the purpose and need of the project?
- D6 ENGINEERING ESTIMATES – How can Caltrans improve the accuracy of capital cost estimates?
- D7 CAPITAL COST – How can we get the best value from capital dollars?
- D8 CAPITAL SUPPORT COSTS – How can we use support resources most efficiently?

Mobility Goal

- M1 DATA - How can we improve/enhance data collection and interpretation across modes?
- M2 INTEGRATED CORRIDOR MANAGEMENT - How can we optimize movement through a corridor?
- M3 INCIDENT MANAGEMENT – How can we manage incidents to reduce effects on traffic and improve system reliability?
- M4 ACTIVE TRAFFIC MANAGEMENT – What are the most effective ways to manage vehicles on the roadway?
- M5 TRAVEL DEMAND MANAGEMENT (REAL-TIME) - What are the most effective real-time strategies to influence travel demand?
- M6 TRAVEL DEMAND MANAGEMENT (SYSTEM ELEMENTS) - What transportation system elements and land use options are most effective in reducing travel demand by enhancing choices?
- M7 SYSTEM DESIGN – How do we design State highway facilities to maximize movement of people and goods?
- M8 GOODS MOVEMENT - How can we improve goods movement throughout the State to generate jobs, increase mobility and relieve traffic congestion, improve air quality and protect public health, enhance public and port safety and improve California's quality of life?
- M9 SUSTAINABLE TRANSPORTATION AND COMMUNITIES – How can we integrate the transportation system into the community so society benefits?

Safety Goal

- SF1 DESIGN/CONSTRUCTION - What design features and construction standards can be utilized to improve highway safety?

- SF2 ORGANIZATIONAL/INSTITUTIONAL – What organizational and institutional changes lead to improved safety?
- SF3 WORKER SAFETY – What tools, technologies, and policies should be researched and implemented to improve administrative and engineering safety controls in the work environment?
- SF4 PROACTIVE SAFETY - What can Caltrans do to mitigate collisions?
- SF5 REACTIVE SAFETY – What can Caltrans do once collisions occur?
- SF6 DRIVER BEHAVIOR – How can we influence/educate drivers to operate their vehicles more safely?

Stewardship Goal

- ST1 FINANCIAL FLEXIBILITY – How can State funding be used more flexibly to meet performance-based needs?
- ST2 LIFECYCLE BUDGETING FOR INFRASTRUCTURE – How can we better measure the impact of asset decisions on Caltrans finances?
- ST3 LIFECYCLE COSTS – How can we incorporate lifecycle cost analysis into decision-making?
- ST4 CULTURAL RESOURCES – How can we better manage our cultural resources?
- ST5 NATURAL AND PHYSICAL ENVIRONMENT – What can we do to reduce impacts to the natural and physical environment?
- ST6 CLIMATE CHANGE - How can Strategic Growth Planning be advanced through addressing climate change adaptations and mitigations?
- ST7 ASSET MANAGEMENT – How can we improve corporate inventory of assets and information (from structures to salamanders)?
- ST8 EXCESS PROPERTY MANAGEMENT – How can we better approach asset management and excess land disposal in a business-like manner?
- ST9 TRANSPORTATION INFRASTRUCTURE (e.g. Pavement, Structures, Maintenance Stations, Office Buildings, and others not listed) - How can we optimize the performance of our transportation infrastructure?

Service Goal

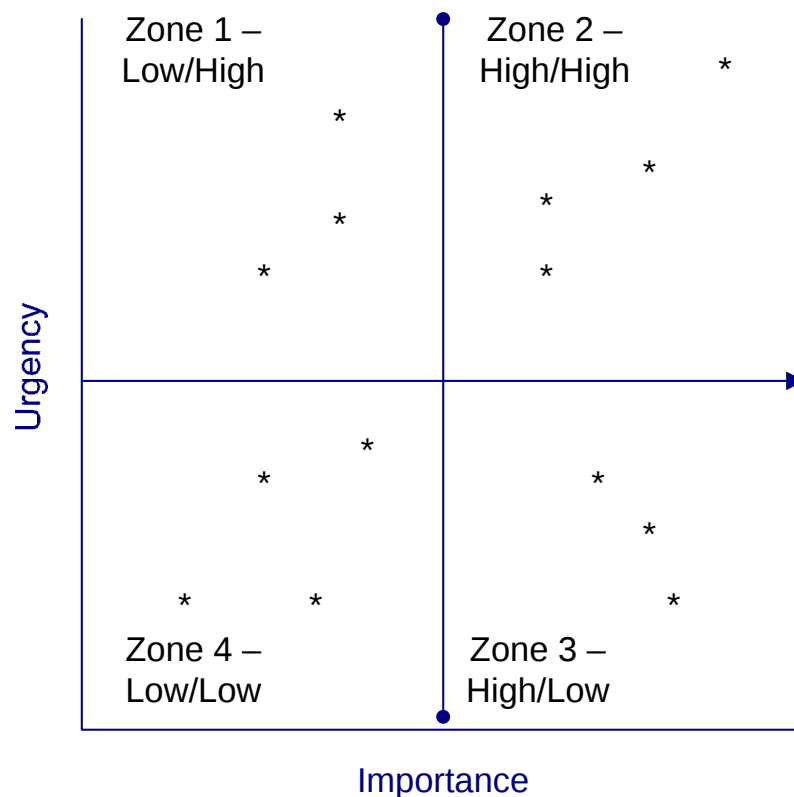
- SV1 TRAINING – What competencies are not adequately addressed by existing training and how might these competencies be developed?
- SV2 COMMUNICATION – What are the most effective ways to improve communication between Caltrans management and employees?
- SV3 INNOVATION – How can Caltrans foster innovation and risk-taking?
- SV4 EMPLOYEE RETENTION – What are the most effective strategies to attract, select, and retain employees?
- SV5 QUALITY SERVICE – What skills are necessary to develop an excellent workforce that provides quality service?
- SV6 TOOLS - What tools are needed to properly perform each job in Caltrans?

Appendix D – The SRQ Prioritization Survey

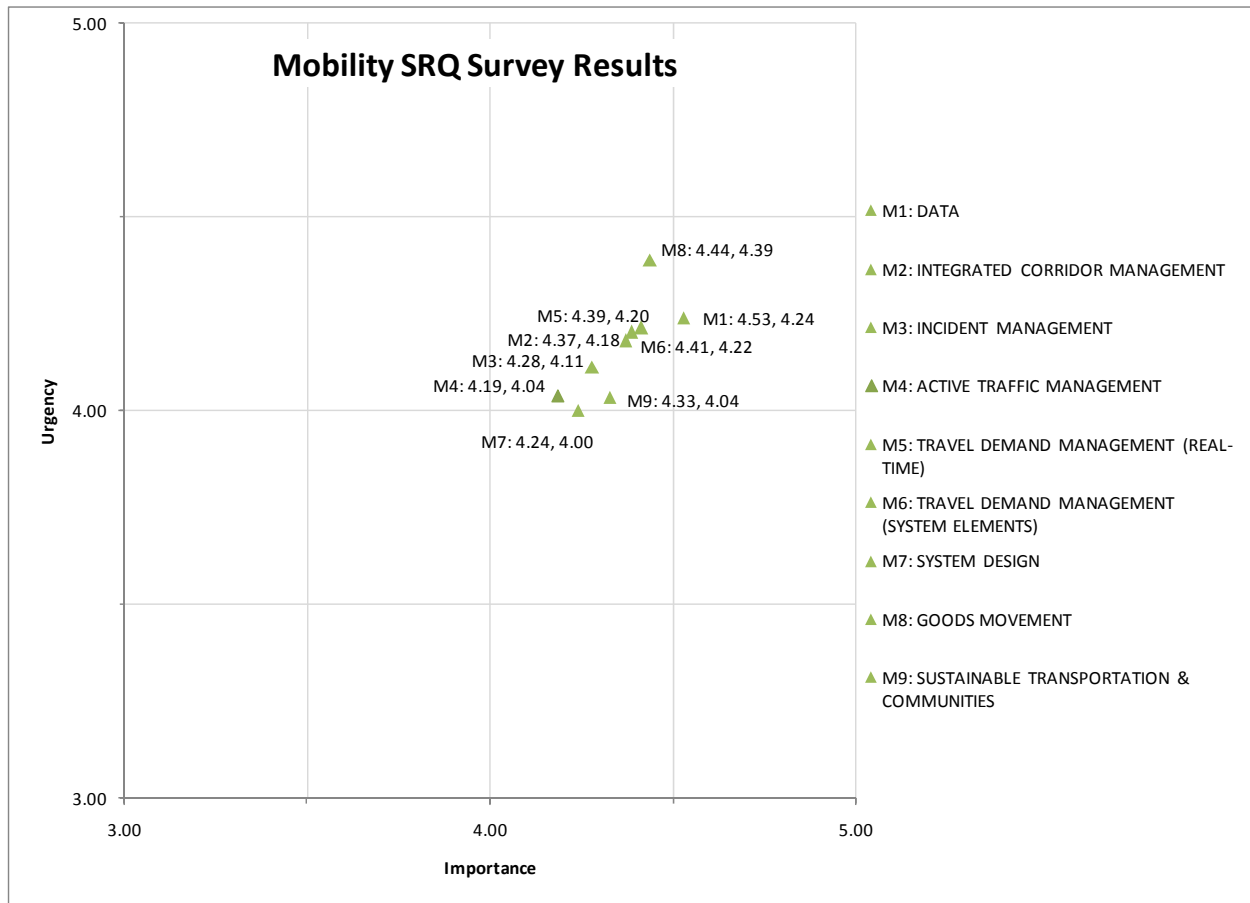
DRI surveyed all SRQ workshop participants to rate each SRQ based on dimensions of importance and urgency using the following questions and Likert scale:

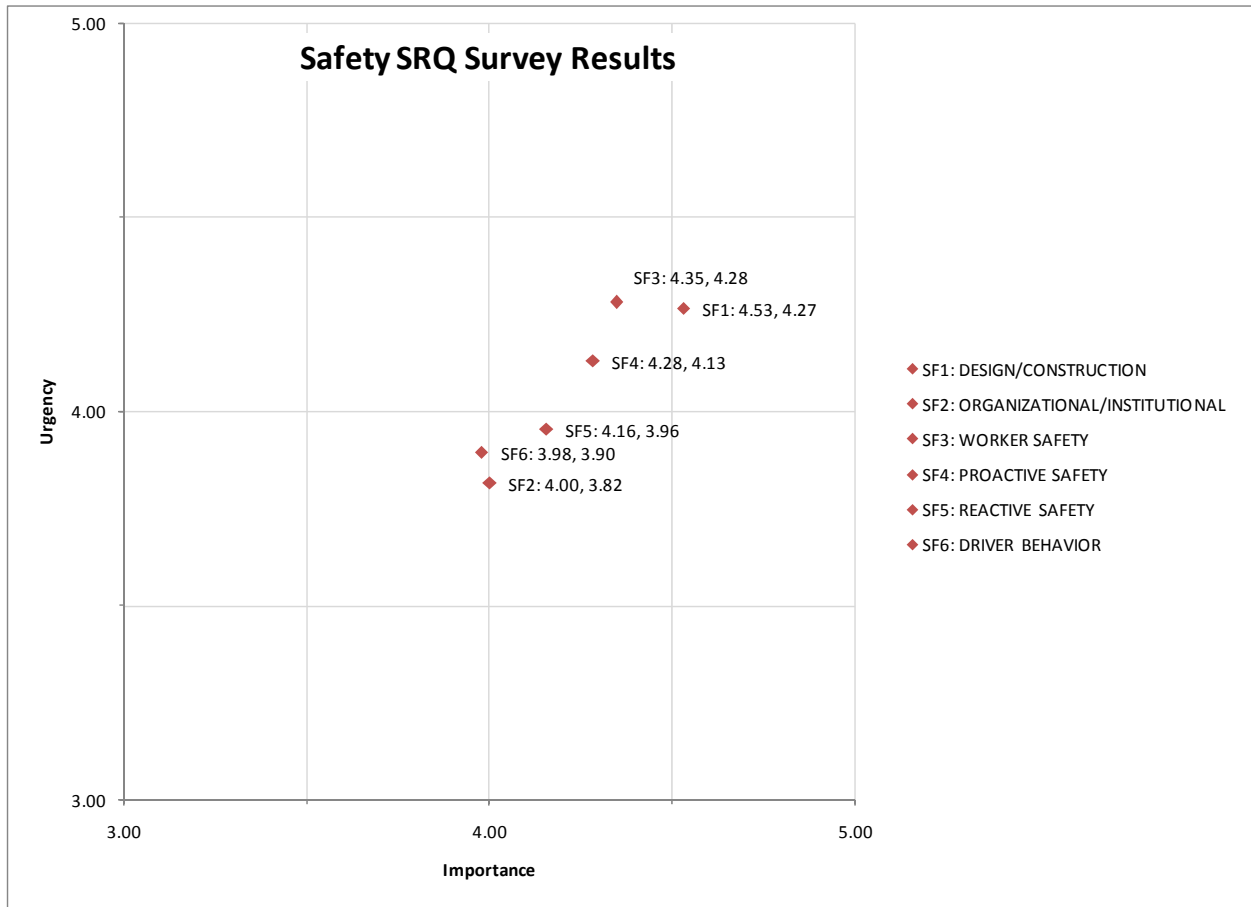
1. The Questions
 - a. Important: Answering this SRQ is important.
 - b. Urgent: Answering this SRQ is urgent.
2. Options for each question
 - a. Strongly Agree
 - b. Agree
 - c. Neither Agree nor Disagree
 - d. Disagree
 - e. Strongly Disagree
 - f. N/A No Opinion or Don't Know

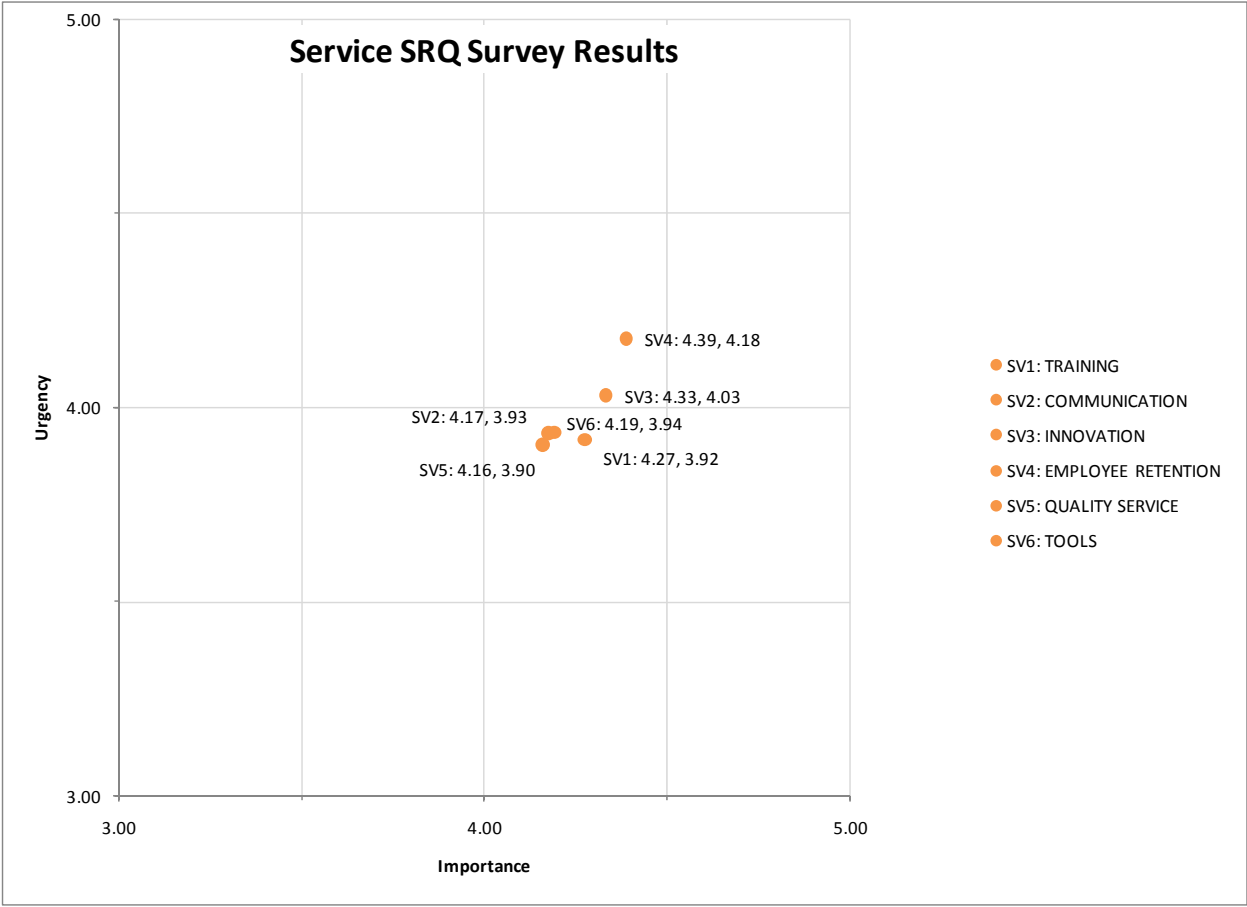
DRI compiled the results by assigning a score to the Likert response (1 – Strongly Disagree to 5 – Strongly Agree) and averaged all responses. The SRQs with the higher perceived importance and urgency would have a higher average scored. The results create a Cartesian product which DRI plotted to map the results.

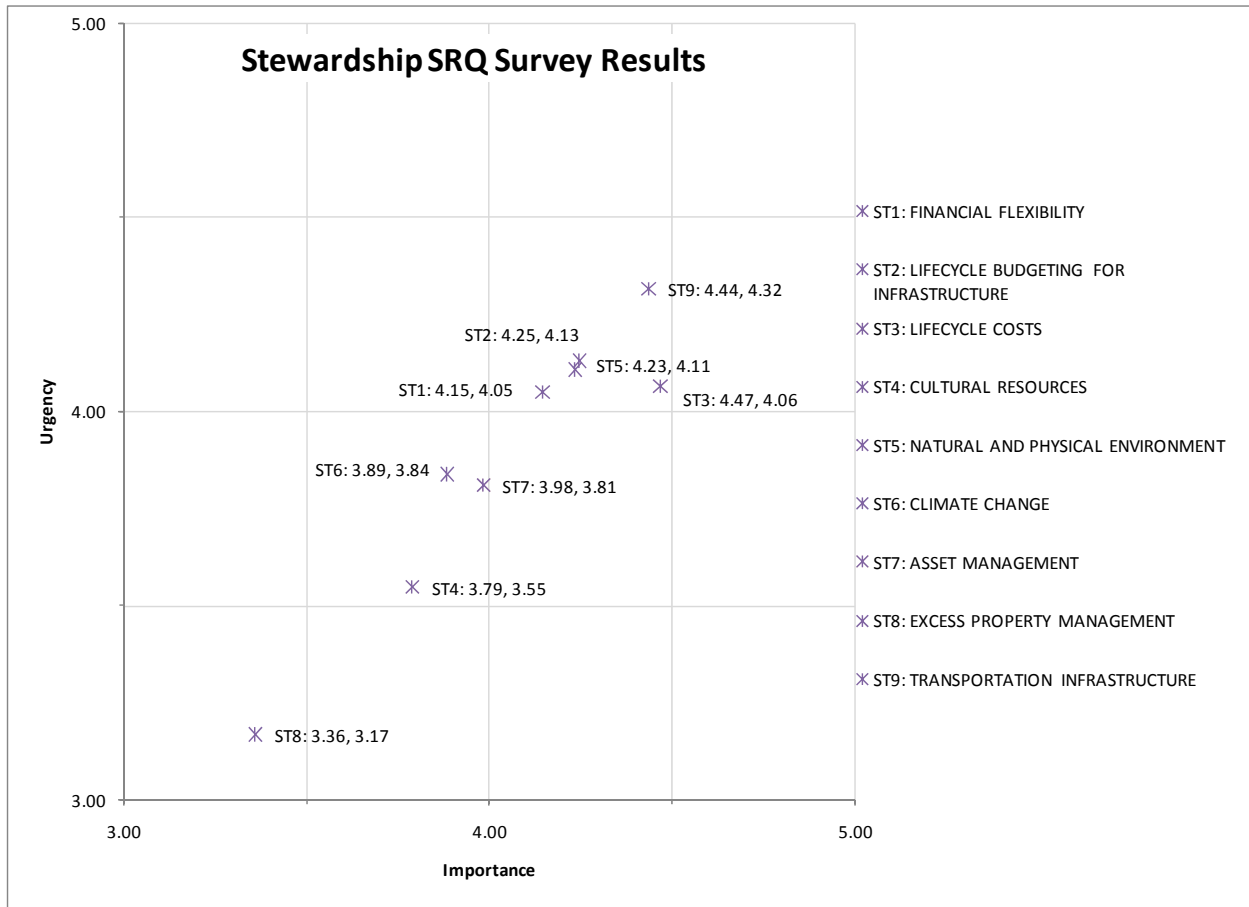


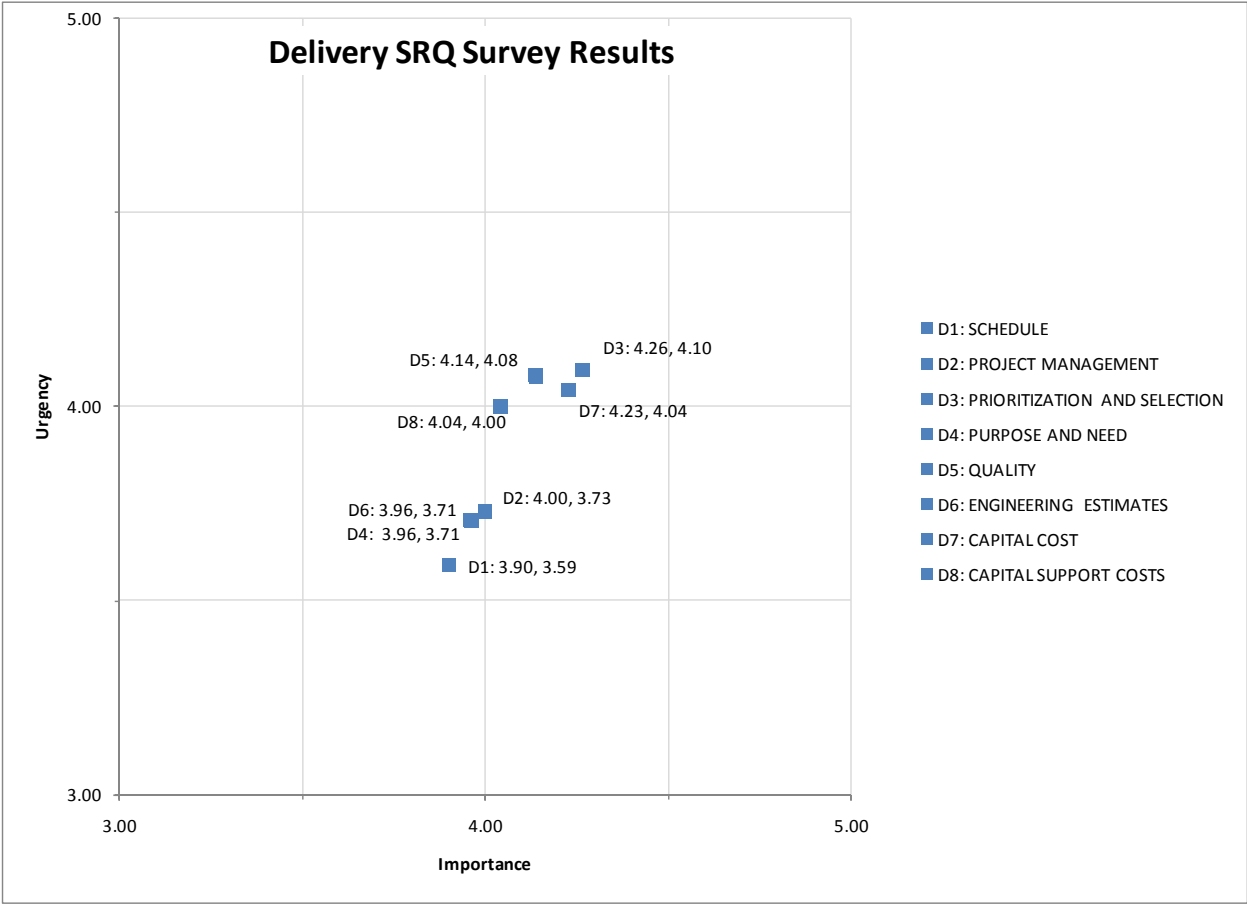
The following charts show the map for each SRQ by strategic plan goal.











Appendix E – The SRQs Grouped by Priority

Each SRQ is preceded by a code which ties it to the Department’s Strategic Plan Goal: M = Mobility, SF = Safety, ST = Stewardship, SV = Service, and D = Delivery.

Priority Research Questions

- M1 DATA - How can we improve/enhance data collection and interpretation across modes?
- M2 INTEGRATED CORRIDOR MANAGEMENT - How can we optimize movement through a corridor?
- M5 TRAVEL DEMAND MANAGEMENT (REAL-TIME) - What are the most effective real-time strategies to influence travel demand?
- M6 TRAVEL DEMAND MANAGEMENT (SYSTEM ELEMENTS) - What transportation system elements and land use options are most effective in reducing travel demand by enhancing choices?
- M8 GOODS MOVEMENT - How can we improve goods movement throughout the State to generate jobs, increase mobility and relieve traffic congestion, improve air quality and protect public health, enhance public and port safety and improve California's quality of life?
- SF1 DESIGN/CONSTRUCTION - What design features and construction standards can be utilized to improve highway safety?
- SF4 PROACTIVE SAFETY - What can Caltrans do to mitigate collisions?
- ST6 CLIMATE CHANGE - How can Strategic Growth Planning be advanced through addressing climate change adaptations and mitigations?
- ST9 TRANSPORTATION INFRASTRUCTURE (e.g. Pavement, Structures, Maintenance Stations, Office Buildings, and others not listed) - How can we optimize the performance of our transportation infrastructure?

Best Practices

- M3 INCIDENT MANAGEMENT – How can we manage incidents to reduce effects on traffic and improve system reliability?
- M4 ACTIVE TRAFFIC MANAGEMENT – What are the most effective ways to manage vehicles on the roadway?
- M9 SUSTAINABLE TRANSPORTATION AND COMMUNITIES – How can we integrate the transportation system into the community so society benefits?
- SF3 WORKER SAFETY – What tools, technologies, and policies should be researched and implemented to improve administrative and engineering safety controls in the work environment?
- SF5 REACTIVE SAFETY – What can Caltrans do once collisions occur?
- SF6 DRIVER BEHAVIOR – How can we influence/educate drivers to operate their vehicles more safely?
- ST2 LIFECYCLE BUDGETING FOR INFRASTRUCTURE – How can we better measure the impact of asset decisions on Caltrans finances?
- ST3 LIFECYCLE COSTS – How can we incorporate lifecycle cost analysis into decision-making?
- ST5 NATURAL AND PHYSICAL ENVIRONMENT – What can we do to reduce impacts to the natural and physical environment?
- ST7 ASSET MANAGEMENT – How can we improve corporate inventory of assets and information (from structures to salamanders)?
- SV3 INNOVATION – How can Caltrans foster innovation and risk-taking?

- SV4 EMPLOYEE RETENTION – What are the most effective strategies to attract, select, and retain employees?
- SV6 TOOLS - What tools are needed to properly perform each job in Caltrans?
- D4 PURPOSE AND NEED – How can we establish and meet the purpose and need of the project throughout the project development process?
- D6 ENGINEERING ESTIMATES – How can Caltrans improve the accuracy of capital cost estimates?

Low Priority

- M7 SYSTEM DESIGN – How do we design State highway facilities to maximize movement of people and goods?
- SF2 ORGANIZATIONAL/INSTITUTIONAL – What organizational and institutional changes lead to improved safety?
- D1 SCHEDULE – How can we set and meet realistically aggressive schedules?
- D2 PROJECT MANAGEMENT – How can we effectively and efficiently manage delivery throughout the life of projects?
- D3 PRIORITIZATION AND SELECTION – How can we prioritize projects so the most needed projects are delivered with the available resources?
- D5 QUALITY – How do we ensure that the quality level of project deliverables match the purpose and need of the project?
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- SV1 TRAINING – What competencies are not adequately addressed by existing training and how might these competencies be developed?
- SV2 COMMUNICATION – What are the most effective ways to improve communication between Caltrans management and employees?
- SV5 QUALITY SERVICE – What skills are necessary to develop an excellent workforce that provides quality service?
- ST1 FINANCIAL FLEXIBILITY – How can State funding be used more flexibly to meet performance-based needs?
- ST4 CULTURAL RESOURCES – How can we better manage our cultural resources?
- ST8 EXCESS PROPERTY MANAGEMENT – How can we better approach asset management and excess land disposal in a business-like manner?

Appendix F – Research Funding

Table Appendix 1 – Project Funds Allocated for SRQs by Fiscal Year

PRIORITY	CSRQ	< 07/08	07/08	08/09	09/10	> 08/09	Grand Total
P	M1 - Data	\$ 6,920,472	\$ 852,759	\$ 957,511	\$ 560,577	\$ -	\$ 9,291,319
	M2 - Integrated Corridor Mgmt.	\$ 9,073,761	\$ 2,373,842	\$ 870,762	\$ 1,265,729	\$ 3,775,180	\$ 17,359,274
	M5 - Travel Demand Mgmt. - Real Time	\$ 1,848,161	\$ 435,913	\$ 693,663	\$ 533,843	\$ -	\$ 3,511,580
	M6 - Travel Demand Mgmt. - System Elements	\$ 1,594,978	\$ 841,945	\$ 450,000		\$ -	\$ 2,886,923
	M8 - Goods Movement	\$ 1,359,441	\$ 37,882			\$ -	\$ 1,397,323
	SF1 - Design/Construction	\$ 16,157,330	\$ 5,084,766	\$ 5,281,702	\$ 2,556,334	\$ 131,099	\$ 29,211,231
	SF4 - Proactive Safety	\$ 9,013,419	\$ 6,335,515	\$ 782,139	\$ 1,461,703	\$ 934,959	\$ 18,527,735
	ST6 - Climate Change	\$ 475,307	\$ 290,018	\$ 136,761	\$ 35,000	\$ -	\$ 937,086
	ST9 - Transportation Infrastructure	\$ 13,151,581	\$ 4,289,560	\$ 3,047,000	\$ 1,931,058	\$ 285,000	\$ 22,704,198
	Subtotal	\$ 59,594,450	\$ 20,542,200	\$ 12,219,538	\$ 8,344,244	\$ 5,126,238	\$ 105,826,670
BP	M3 - Incident Management	\$ 1,002,229	\$ 226,278	\$ 210,317	\$ 41,285	\$ -	\$ 1,480,109
	M4 - Active Traffic Management	\$ 1,643,002	\$ 159,376	\$ -		\$ -	\$ 1,802,378
	M9 - Sustainable Transportation and Communi	\$ 179,019	\$ 60,000	\$ 125,000		\$ -	\$ 364,019
	SF3 - Worker Safety	\$ 9,225,555	\$ 2,079,231	\$ 1,235,861	\$ 2,093,245	\$ 1,525,976	\$ 16,159,868
	SF5 - Reactive Safety	\$ 2,893,592	\$ 213,595	\$ -		\$ -	\$ 3,107,187
	SF6 - Driver Behavior	\$ 834,941	\$ 155,596	\$ 115,853		\$ -	\$ 1,106,390
	ST3 - Lifecycle Costs	\$ -	\$ -	\$ 78,474		\$ -	\$ 78,474
	ST5 - Natural and Physical Environment	\$ 1,318,267	\$ 323,417	\$ 382,841		\$ -	\$ 2,024,525
	ST7 - Asset Management	\$ 955,633	\$ 148,200	\$ 165,250		\$ -	\$ 1,269,083
	SV3 - Innovation	\$ 8,613,792	\$ 102,000	\$ -		\$ -	\$ 8,715,792
	SV6 - Tools	\$ 73,430				\$ -	\$ 73,430
	Subtotal	\$ 26,739,461	\$ 3,467,693	\$ 2,313,596	\$ 2,134,530	\$ 1,525,976	\$ 36,181,256
L	D1 - Schedule	\$ 3,012,859	\$ 530,471	\$ -		\$ -	\$ 3,543,330
	D2 - Project Management	\$ 6,454,524	\$ 2,347,230	\$ 1,779,375	\$ 16,000	\$ -	\$ 10,597,129
	D3 - Prioritization and Selection	\$ 128,405	\$ 185,482	\$ 122,924	\$ 204,994	\$ -	\$ 641,805
	D5 - Quality	\$ 135,509	\$ -	\$ 49,067	\$ 62,930	\$ -	\$ 247,506
	M7 - System Design	\$ 1,068,493	\$ 252,652	\$ 60,000	\$ 190,000	\$ -	\$ 1,571,145
	SF2 - Organizational Institutional	\$ -	\$ 20,000	\$ 20,000		\$ -	\$ 40,000
	ST4 - Cultural Resources	\$ 50,000				\$ -	\$ 50,000
	SV1 - Training	\$ -	\$ 50,000			\$ -	\$ 50,000
	SV2 - Communication	\$ -	\$ 80,000			\$ -	\$ 80,000
	SV5 - Quality Service	\$ 205,547				\$ -	\$ 205,547
	Subtotal	\$ 11,055,337	\$ 3,465,835	\$ 2,031,366	\$ 473,924	\$ -	\$ 17,026,462
NA	NA - None Selected	\$ 18,510,402	\$ 2,471,012	\$ 2,872,000	\$ 5,225,000	\$ -	\$ 29,078,414
	Subtotal	\$ 18,510,402	\$ 2,471,012	\$ 2,872,000	\$ 5,225,000	\$ -	\$ 29,078,414
	Grand Total	\$ 115,899,649	\$ 29,946,741	\$ 19,436,500	\$ 16,177,698	\$ 6,652,214	\$ 188,112,802

Appendix G – List of Links

The following table lists all external entities referenced and hyperlinked in this document.

Reference	Hyperlink
Caltrans	http://dot.ca.gov/
Research and Technology Coordinating Committee	http://www.trb.org/news/blurp_detail.asp?ID=8152
Caltrans Division of Research and Innovation	http://www.dot.ca.gov/research/
University Transportation Centers	http://utc.dot.gov/
PATH	http://www.path.berkeley.edu/
TRB	http://www.trb.org/
AASHTO	http://www.transportation.org/
Federal Highway Administration	http://www.fhwa.dot.gov/
FHWA International Scan	http://international.fhwa.dot.gov/traveldemand/t1_p06.cfm
California Goods Movement Action Plan	http://www.arb.ca.gov/gmp/docs/gmap-1-11-07.pdf
California Strategic Growth Plan	http://gov.ca.gov/pdf/gov/CSGP.pdf
California Strategic Highway Safety Plan	http://www.dot.ca.gov/SHSP/
AB 32 Scoping Plan	http://www.arb.ca.gov/cc/scopingplan/document/appendix1.pdf
California Air Resources Board	http://www.arb.ca.gov/homepage.htm
2007 Public Road Data Report	http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2007PRD.pdf
Caltrans Division of Equipment	http://www.dot.ca.gov/hq/eqsc/index.htm
Caltrans Division of Maintenance	http://www.dot.ca.gov/hq/maint/