

Statewide ITS Architecture Assessment and Support

ITS Architecture Development and Maintenance:
Barriers and Opportunities



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Statewide ITS Architecture Assessment and Support



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1. Introduction

1.1 Project Overview

The *Statewide ITS Architecture Assessment and Support* project provided technical assistance to Caltrans in assessing compliance of the Statewide and Regional Intelligent Transportation Systems (ITS) Architectures with federal requirements and the current state of the practice. Secondly, it assessed how the architectures are used in support of transportation planning activities and project development. For both of the above, the Project Team identified those areas where the architectures are in compliance and are being used as intended, as well as those areas where architectures are non-compliant, are not being maintained, or are not being used for integrated planning and project development. The primary outcome of this effort is updated guidance on the use of ITS architectures as part of transportation planning and project development activities.

1.2 Purpose of this Document

The purpose of this document is to summarize the specific issues and concerns with use of Statewide and Regional ITS Architectures (SWITSA and RITSAs) from information collected through meetings and discussions with Caltrans and regional stakeholders who have developed and maintained RITSAs. Also documented are potential means to enhance the value of these products to support program development and Traffic Systems Management and Operations (TSMO) activities. The goal is to define a way forward relative to using ITS architectures in a changing transportation environment through developing a suitable business case which addresses benefits associated with enhanced use of SWITSA and RITSAs, taking into particular consideration Connected Corridor activities and emerging applications such as connected and autonomous vehicles (CAV).

In parallel with the investigations in this report, the team developed a White Paper defining the business case for SWITSA and RITSAs based on SWOT considerations and future activities involving connected and automated vehicles, including recommended approaches to mitigate particular issues and challenges relative to updated processes for architecture use.

1.3 Task Approach

The approach to the work documented in this report reflected the results of the first project Stakeholder Advisory Committee (SAC) workshop held in October 2016 in San Francisco, and hosted by the Metropolitan Transportation Commission. The SAC make-up, as well as participation, involved a number of staff with a more technical orientation than expected. Even further understanding of current architecture usage barriers and opportunities was achieved through direct contact and coordination with stakeholders who were providing responses directly to the team as part of questionnaires provided through this effort.



Two distinct tracks were taken in assessing barriers and opportunities relative to RITSA development and use. One was an objective review of known barriers from an institutional, procedural and budgetary perspective toward using and maintaining the architecture. The second was through a questionnaire that looked at current agency ITS development activities and addressed why many of the architectures have not been updated or revised, as well as what is needed to encourage and justify RITSA use. The end result is that there are clear opportunities for use of regional and statewide ITS architectures, but they require further information, examples of successful application, and guidance on how better to perform RITSA development and share information between regions.

2. Assessment of Barriers to Architecture Use

This section addresses barriers to use of RITSAs that have limited their effectiveness and incorporation into ITS programs and planning activities. The assessment consists of both a review of current policies, procedures and institutional structure as well as observations from stakeholders as part of a questionnaire performed by the Project Team.

2.1 Federal and State Policies

2.1.1 Planning-Related

The development, use and maintenance of California's RITSAs are required to meet federal requirements defined by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA). These regulations were established to address the need to work toward regionally integrated transportation systems. This FHWA Final Rule and the parallel FTA Policy (23 CFR 940.9) were developed without reference to proposed changes to the transportation planning process considered at the same time. Those changes had been proposed in a draft regulation entitled "Statewide Transportation Planning; Metropolitan Transportation Planning", which had a relationship to ITS and operations in general and specifically relating to the Final Rule. It stated "Include an ITS integration strategy for the purposes of guiding and coordinating the management and funding of ITS investments. The proposed regulation also required an agreement among agencies planning and implementing ITS projects and was intended to ensure that the planning and operating agencies specifically agree on an approach for integrated ITS implementation. With the update to the planning regulation not approved, no mention of the development of an integration strategy at the planning level occurred.

Given that the Final Rule does not require or reference an integration strategy, it remained the intent that regional ITS architectures be based on established, collaborative regional transportation planning processes. A need arose to provide more specific guidance on the definition of a region. As such, the definition of a region was revised to indicate that the Metropolitan Planning Area (MPA) should be the



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minimum area considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture within a metropolitan area.

The outcome from ITS not being directly addressed in the current Federal planning regulations has been that regional planners responsible for long-range transportation policy planning have not been effectively informed of its importance, nor have they received education and training addressing the link to and consistency with RITSAs. The same holds true for FHWA planners within the California Division. In short, ITS has been mainly considered as an operations initiative to be handled by engineering staff.

As a result, emphasis gravitates to the more familiar interface between planning and engineering associated with selecting projects for federal funding and preparing a four-year Transportation Improvement Program (TIP). The irony of the regional emphasis of current Federal policy is that metropolitan planning organizations (MPOs) became the owners/initiators of RITSAs in California, often with little knowledge of their background, their relationship to traditional planning processes, or benefits. FHWA, State, and regional planning process expertise/knowledge in discussions has often been missing.

The reality within California is that assignment for RITSA direction has often given to a staff person within the MPO as a collateral duty of facilitator, rarely having the time needed for the effort. With little clear understanding of the relationship between ITS development and operations, involvement from the long-range planners in the organization has often not been pursued, nor in most cases has it occurred, largely due to unfamiliarity with RITSA in general for both the facilitating staff and long-range planners.

Resulting organizational staffing challenges have included the following:

- Considerable learning curve
- Proficiency needed before using
- Maintenance requiring substantial staff or consultant time
- Support to implementing agencies during their learning curve

Many agencies do not feel they have the training or resources to use and maintain their RITSAs, nor does it appear there is much incentive to do so (i.e., the value is questioned).

Another potential barrier for some RITSAs not demonstrating a link to the region's transportation plans may be a result of the tools used to develop the RITSA. Turbo Architecture, for example, is a software tool provided by the Federal government to develop and maintain ITS architectures. With basic lack of understanding of RITSAs and familiarity with the software, the tool is often unused once the RITSA development is completed.. Even when RITSA updates do occur, corresponding changes may not occur in the Turbo Architecture tool.



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Most of California's RITSAs include plans for their ongoing use and maintenance as required by the FHWA Final Rule and FTA policy. However, there is little evidence that the RITSA maintainers as a whole are following these plans. There are many reasons for a region's poor RITSA maintenance record, including include limited staff resources and architecture knowledge, as well as a belief among some respondents that RITSAs have limited value.

At the State level, Caltrans established a Statewide ITS Architecture (SWITSA), yet there has been uncertainty as to its usefulness. Most Caltrans Districts have participated in the RITSA developments as a stakeholder in their regions, yet participation has been predominantly by operations staff. District planners, just as their regional and local peers, have little knowledge of the usefulness of a RITSA; therefore, their contribution to SWITSA and RITSA development discussions have generally been minimal.

2.1.2 Implementation-Related

RITSA development and concept discussions became a predominantly implementation-oriented effort. Rule 23 CFR 940.11 required that a systems engineering analysis be utilized for projects (regardless of size or budget) to be Federally-funded, including the project ITS architecture being a part or subset of the RITSA. California was one of first states to establish a process to carry out the requirements of 23 CFR 940.11. Several states have since patterned their own process to reflect the California guidance. Caltrans and FHWA developed a Systems Engineering Guidebook for ITS, that assists the State and local agencies in applying Systems Engineering in a standardized process, and recommends guidance through best practices and lessons learned. A project sponsor is required to complete a Systems Engineering Review Form (SERF) at project initiation, to assure conformance with the pertinent RITSA. As with planners in a transportation organization, project sponsors may confront challenges to incorporating systems engineering and RITSA, including:

- Infrequent use (especially for smaller agencies)
- Very steep learning curve
- Frequent staff changes requiring re-investment in learning
- Implementation decisions often constrained by legacy investments and funding availability
- Most current RITSAs are not sufficiently detailed for project guidance

2.1.3 Institutional Structure

Staffing is a huge obstacle to RITSA improvement, use, and maintenance. There is a learning curve, proficiency needed, resource time needed, and staff changes that often occur. This can also include the challenge introduced by implementing agencies having their own priorities and funds. All of these can hamper an agency responsible for "owning" and maintaining the RITSA. Consultant assistance is an option, but there is always the question of how much of the work effort should be relinquished while allowing the agency to retain some level of knowledge and control.



In the last 10 years, emphasis in Federal guidance has been placed on an objectives-driven, performance based approach for planning and planning-for-operations and management, which has been reinforced as part of the MAP-21 and FAST transportation funding reauthorization activities over the past decade. The National ITS Architecture has also been improved to specifically address planning goals and objectives through Turbo Architecture (now known as the Regional Architecture Development for Intelligent Transportation, or RAD-IT, tool).

Connecting the two processes combines the strong basis for selecting strategies in planning for operations with the strength of the architecture development process in defining an integrated framework based on selected services. As a result, opportunity exists for significant more outreach and education for the integration of operations planning and the RITSA. FHWA and Caltrans each have initiatives for TSMO and Planning for Operations. Caltrans has presented operational forums throughout the State, and training and workshops are available through FHWA. Such outreach to agency planners should be at least at a level equivalent to that given to operations staff and project sponsors. This level of training certainly needs to be more aggressively pursued by agencies and made more readily available by FHWA and Caltrans, along with case studies of peer success in achieving the integration needed.

2.2 Stakeholder Perspective on Barriers to RITSA Use

The Project Team developed a questionnaire with the purpose of learning more about the barriers and opportunities encountered by stakeholders in RITSA development, maintenance and use. The questionnaire provided respondents an opportunity to provide detailed answers that were specific to their experiences. Based on the responses, the Project Team followed up with some respondents to learn more information. The discussion here first addresses the overall questionnaire, with the subsections below addressing specific barriers to RITSA use from the perspective of the various architecture stakeholders. Section 3 discusses and presents the responses related to opportunities to use architectures to better support ITS planning and implementation.

2.2.1 Target Audience

The target audience for the Barriers and Opportunities Questionnaire consisted of the following groups:

- RITSA Owners
- RITSA Developers
- RITSA Maintainers
- ITS Project Sponsors and RITSA Stakeholders

The Project Team distributed the questionnaire to 25 individuals representing all California RITSA's and all target audience groups.



2.2.2 Questionnaire Process

The Project Team developed a questionnaire using the online tool SurveyMonkey. The questionnaire asked questions about the stakeholders' perceived RITSA barrier and opportunities. Responses were multiple choice with some written responses that added detail. **Appendix A** of this document includes the questions asked. Invitations sent to the target audience with the intent that appropriate staff from their agency would respond.

The subsections below contain the responses related to barriers to RITSA use, while Section 3 addresses potential opportunities.

2.2.3 Stakeholder Responses (Barriers)

The Project Team received eight complete responses, and those responses represented all target audience groups. The Project Team compiled responses and followed up with some respondents for further information. In most cases, each respondent represented multiple groups, such as an individual being a RITSA owner, developer and maintainer. Responses are under the following categories:

- Architecture Applicability
- Staff Resources and Training

Section 3 addresses opportunities in each of the above categories along with potential opportunities at the Federal and State levels to support RITSA development, use and maintenance.

2.2.3.1 Architecture Applicability

The questions on Architectural Applicability were designed to evaluate the stakeholders' perception of their RITSAs' applicability to their ITS activities during planning and implementation, and to understand how a RITSA may be made more relevant to those processes. The responses (Figure 1) largely indicated that their RITSAs were underutilized as a tool for ITS project planning. Key barriers identified as part of follow-up with the stakeholders after the questionnaire included:

- Complicated architecture format not readily understandable by all stakeholders
- Difficulty in accessing output in a usable format
- Not updated to represent most recent technologies such as connected vehicles.

When asked if there is a “clear understanding (by management and staff) of the value of the RITSA during ITS project planning, development, design, and implementation,” the majority of respondents said they did not know or did not believe there is a clear understanding.



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The respondents indicated that there is a need for better examples and reports resulting from the RITSA that are more directly applicable to ITS planning and implementation. A respondent stated, “RITSA could benefit from a new report format that includes better descriptions, examples of projects from similarly-sized areas, and a list of best practices, rather than just a report that is mostly tables.” Multiple respondents felt that demonstration of RITSA applicability would be appropriate, using examples and information about “best practices” in Architecture use. Two respondents indicated that updated RITSA information should relate to the use of Architecture in planning and implementing current transportation initiatives such as “active transportation” and TSMO.

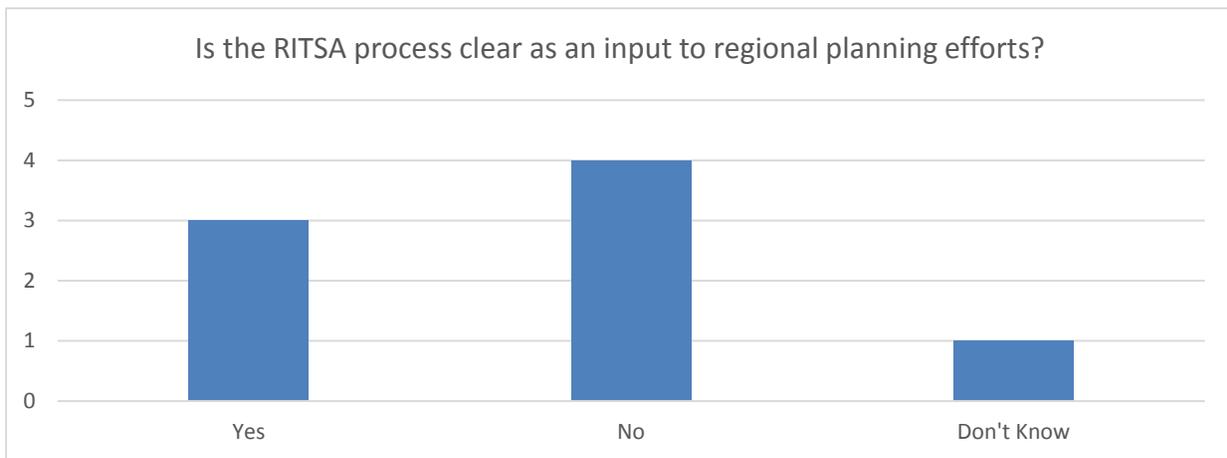


Figure 1: Stakeholder Views on RITSA Process as Input to Regional Planning

Respondents indicated that there is a need for the RITSA to be a “clear input into regional transportation planning efforts.” However, the majority of respondents believed that their RITSAs currently are not used as an input. The responses suggested that this is, at least in part, because regional stakeholders are not aware of the RITSA contents and how they apply to the planning process.

One respondent suggested that transportation agencies “have traffic master plans that are very similar to the National ITS Architecture. It is very surprising that many of the plans are developed from the ground up, when the National ITS Architecture already provides most, if not all the elements from the top down.” Respondents also indicated that the role of the RITSA is to identify projects “at the highest level of abstraction, and then work with project development teams to evolve these into full project delivery architectures.”

Respondents were almost unanimously uncertain whether the RITSA is the appropriate process for integrating advanced technology such as autonomous and connected vehicles. One respondent stated a “RITSA may be appropriate, but not sufficient; there are also broader regional policy issues that need to be addressed, in other forums, that are in addition to, and in coordination with, the RITSA



process.” Another respondent stated that the RITSA tools are too limited to properly integrate advanced technologies.

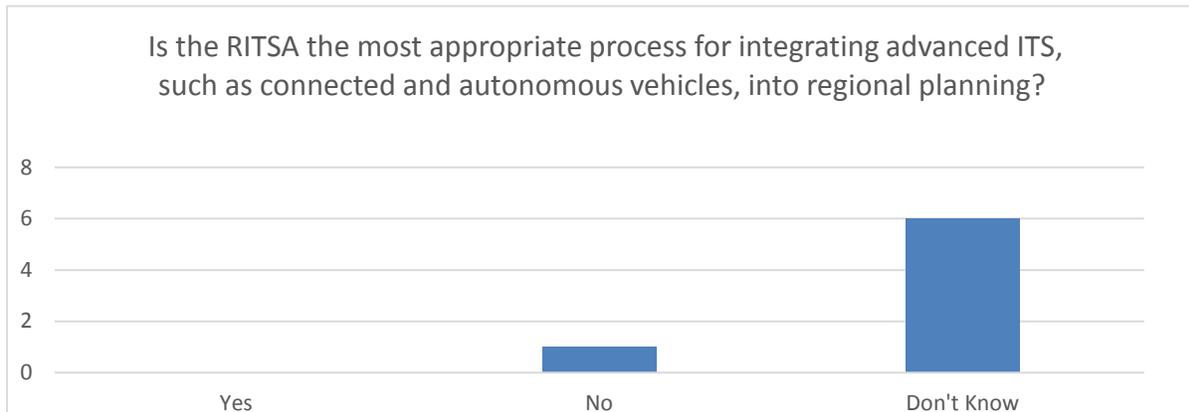


Figure 2: Stakeholder Views on RITSA as an Appropriate Process for Incorporating Advanced ITS Activities

2.2.3.2 Staff Resources and Training

The purpose of the questions on staff resources and training were to assess the respondents' perceptions of what is required to maintain and support a RITSA, and whether the resources available are appropriate. As a whole, it was not clear to the respondents what resources are required and, as a result, the appropriate resources and training have not been provided. The key resources and training barriers identified were:

- Low priority of RITSA by the stakeholders' executive level staff.
- Staff turnovers resulting in loss of RITSA knowledge and skills.
- Training resources not updated to represent most recent technologies such as connected vehicles.



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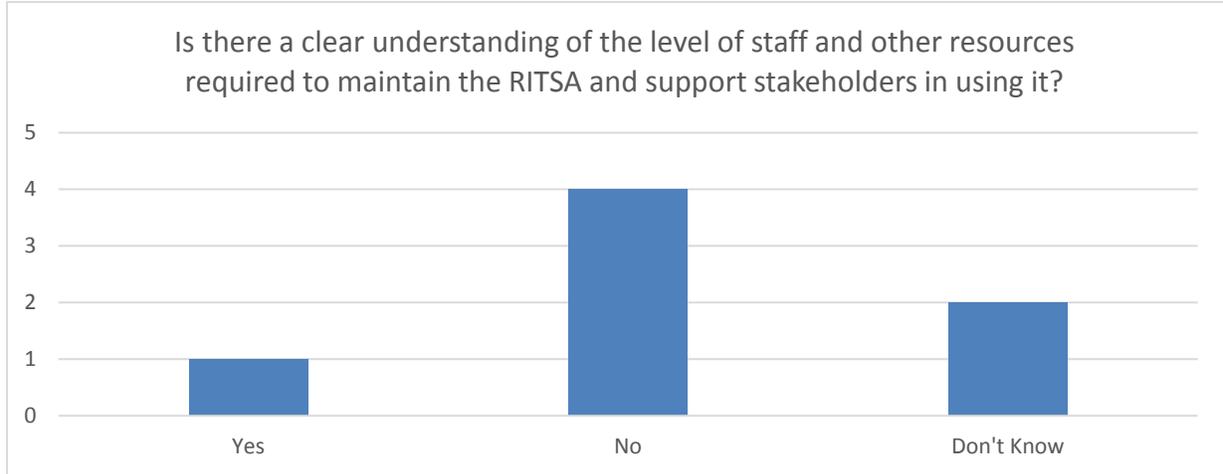


Figure 3: Stakeholder Views Regarding Understanding of Staff and Resources Needed to Support RITSA

Further, none of the respondents believed their agency had dedicated adequate resources to RITSA maintenance and support. The reasons for this include the concern that the RITSA requires similar training and maintenance regardless of the size of the region it covers, and the owning agency’s staff. Others noted that the RITSA is usually an additional responsibility for the maintainers. One comment was that “staffing is fixed by positions and budgets. (Staffing) is not determined by actual inventory; therefore, priorities are set by the most visible asset.” One respondent said that because RITSA maintenance requirements have not been enforced, as a result the RITSA “has very little value as a means to obtain the needed personnel to maintain it and the political capital needed to obtain funds

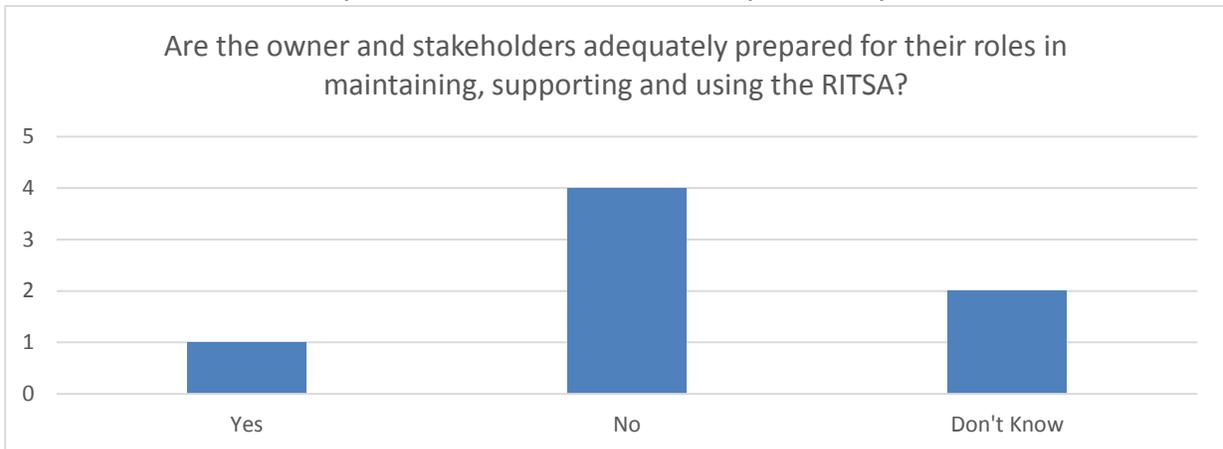


Figure 4: Stakeholder Views Regarding Preparedness for Maintaining, Supporting and Using RITSAs

to implement the systems desired through the architecture.”

As per Figure 4 below, most respondents said they did not believe staff at their agency were adequately prepared for their roles in maintaining, supporting and using their RITSA. One concern was



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that when staff changes within an agency, new staff does not necessarily receive the same training or experience as previous staff in RITSA maintenance and support. Another concern is that as priorities shift for an agency, the RITSA may be deemed less important and staff time is taken away from its maintenance and support. Another respondent indicated that while they currently do not have adequate resources, they expected to add staffing to support their next generation of RITSA, which will contain connected vehicle projects. The implication is that the respondent perceives the RITSA to be more valuable once it includes connected vehicles.

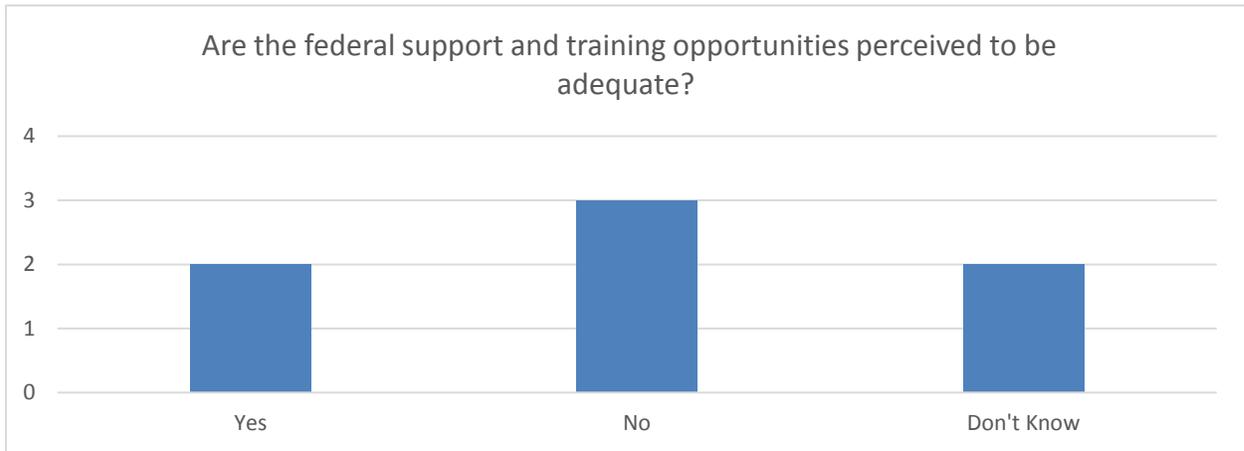


Figure 5: Stakeholder Views on Adequacy of Federal Support and Training

Federal training has been provided since the beginning of the National ITS Architecture program, with capacity-building provided throughout the country as needed in support of RITSA development activities. However, per Figure 5 below, most respondents felt that federal training was not adequate, or didn't know. One of those who responded "Don't Know" said they had not participated in training in more than five years. However, a respondent who had taken training recently stated that it had been adequate.

In particular, there was interest from respondents for training that could focus on RITSA use and less on federal rule compliance or high-level overviews. Perceptions were that more "hands-on" training would support better maintenance and use activities. A respondent stated that training updates should address current advanced technologies such as connected and autonomous vehicles and their role within the RITSA. It should be noted that the new version of the National ITS Architecture (ARC-IT) incorporates the CVRIA, and that training is being updated to correspond with these revisions.

None of the respondents stated that there was a defined transition plan (see Figure 6) that identified which staff or entity within a region would maintain and support a RITSA if the currently responsible staff left. Some respondents indicated the RITSA was a low priority for the owner, so no transition plan was developed. A rural region pointed out that the agency staff was small and already performing many other functions. However, a major metropolitan area respondent said that he was the only



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person on staff with RITSA experience, and all others with knowledge had moved on and not been replaced. Another stated, “Original staff have retired. Existing staff have a general awareness and understanding of the RITSA, but must juggle many other responsibilities within the agency.”

In addition, one respondent pointed out that most RITSA development is outsourced, meaning that the skills to develop and maintain a RITSA are not adequately built by the owning agency.

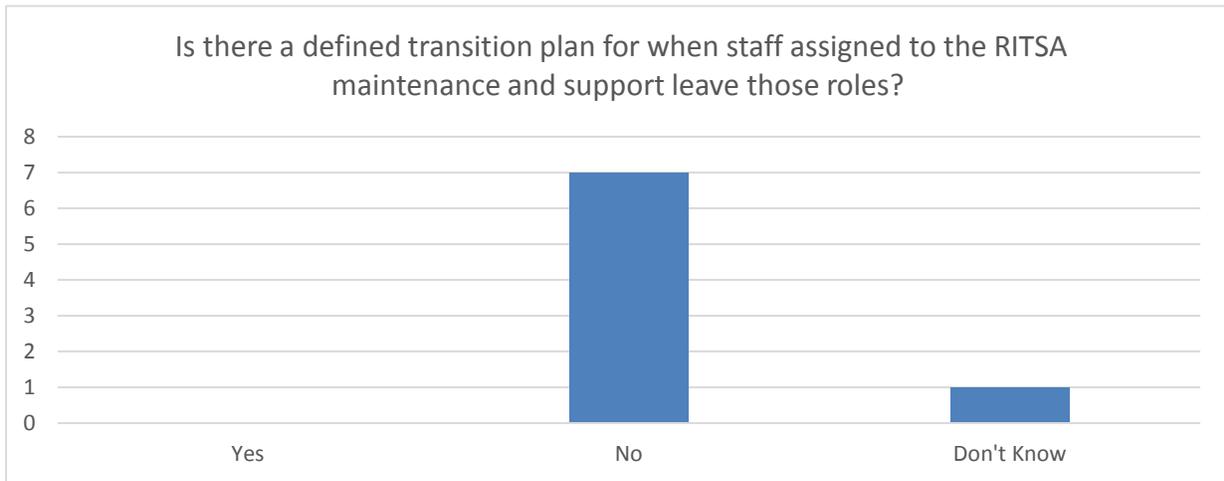


Figure 6: Stakeholder Responses Relative to Current RITSA Transition Planning Activities

It is important to note that many of the stakeholders have developed maintenance plans for their architectures in the past. As shown in Figure 7, several respondents said they did not know if their maintenance plans identified initial and ongoing training activities. One respondent indicated that

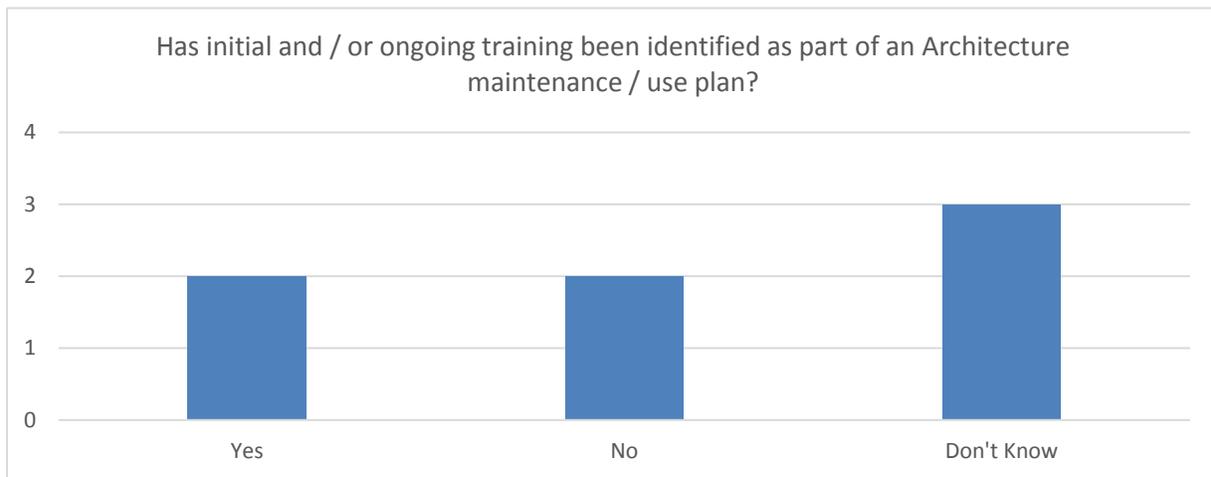


Figure 7: Stakeholder Responses on Identifying Training as Part of an Architecture Maintenance / Use Plan

ongoing training is a staff resource issue, and since the RITSA is a low priority, no training has been



performed. Of the two “Yes” responses, one indicated that only training during development has been performed, and that was more than five years ago. The other “Yes” respondent indicated, as did a “No” respondent, that ongoing training will be part of the maintenance plans in their upcoming RITSA updates.

2.3 Institutional Considerations

Other thoughts and comments related to institutional considerations (including the role of Federal, state and local agencies) are as follows:

- RITSA tools and format are outdated and need to be more consistent with current Information Technology (IT) applications – for one, the IT interpretation of a system architecture differs from that typically found in a RITSA. Secondly, the older architecture frameworks do not address the widespread availability of user apps on mobile smartphone and related development of privatized services.
- Support during development may not be as beneficial to agencies as support during maintenance, given that RITSA development has historically been performed by consultants.

3. Assessment of Opportunities for RITSA Use

This section focuses on opportunities for architecture use based on responses to the questionnaire described in Section 2 as well as on follow-up comments provided by the various stakeholders. In general, these opportunities address how Federal, State and Local resources as well as various policies and procedures could be enhanced or modified to facilitate the use of RITSA and to better utilize its output and results to support ITS program development and implementation activities. The first part of this section addresses the specific responses to the questionnaire, while the second part provides a summary of key opportunities based on the responses and follow-up comments from the stakeholders.

3.1 Institutional Resources to Support RITSA

As discussed below, specific items in the questionnaire relate to the Federal, State and Local resources that could support RITSA owners and stakeholders during RITSA maintenance and use. Key opportunities include:

- Developing a repository for RITSA examples, best practices and detailed guidance.
- State or regional groups of RITSA developers and maintainers that share information via the web or in person workshops.



3.1.1 Establishing User Groups

The respondents indicated overwhelmingly (see Figure 8) that they would benefit from a statewide or regional user group that supported their RITSA development and use. The respondents indicated that the format could be “web groups” and a web site dedicated to sharing RITSA information, including procurement documents, maintenance plans and full RITSA documentation. In addition, webinars or sessions as part of statewide and regional transportation conferences would allow stakeholders to meet and discuss RITSA issues. Stakeholders suggested that in-person meetings and webinars could be quarterly or semi-annual.

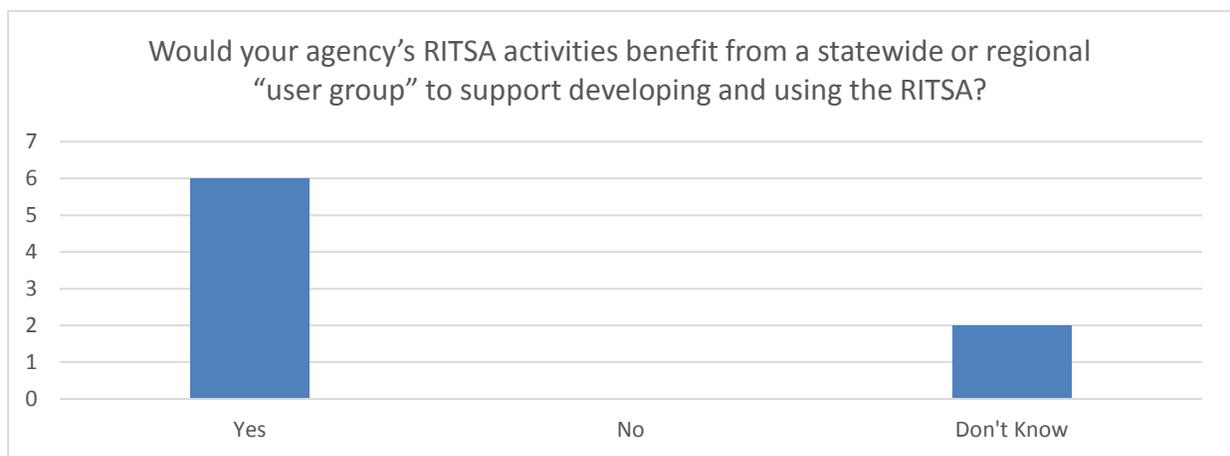


Figure 8: Stakeholder Views on Providing a Statewide RITSA “User Group”

3.1.2 Coordination and Liaison between Regions during RITSA Development and Updates

Half of the respondents said they would benefit from a liaison to other RITSA developers while in the development process. (Refer to Figure 9.) The reasons for the positive responses include the perception that an outside perspective could benefit both the developer and the liaison. A respondent representing a rural region indicated that they “rely on outside resources and experts for RITSA” development. The respondents that replied “No” or “Don’t know” stated that “RITSA development is expected to be done primarily by consultants who should have the expertise needed.” That respondent said a liaison may be more beneficial for maintenance, when the agency is responsible for the upkeep of the RITSA. Another stated that better RITSA development tools would be more beneficial than a liaison support.



3.1.3 Development of RITSA Library and Archiving Activities

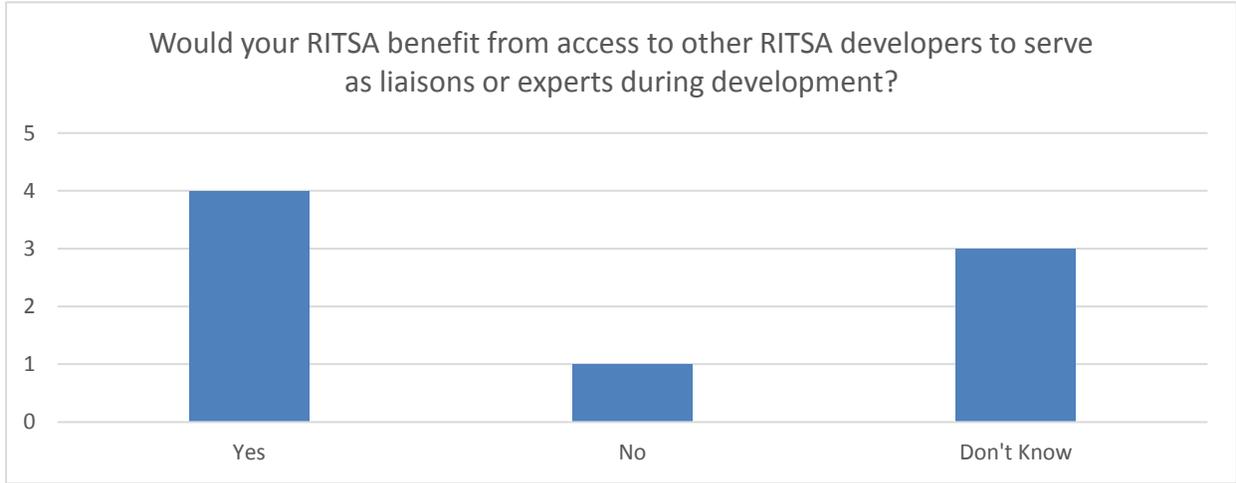


Figure 9: Stakeholder Views on Coordination and Liaison with Other RITSA Developers

As shown in Figure 10, respondents in general were very positive about the concept of an archive or library that contained RITSA development, use and maintenance information that could benefit their RITSA activities. The respondents believed that documentation should include examples, best practices and detailed guidance. However, one respondent suggested that the archive or library would have more value in coordination with better development and maintenance tools. The respondent suggested RITSAs should “transition out of the current bespoke environment, and shift to a modern architectural tools set that will allow transportation assets and capabilities to be properly represented.”

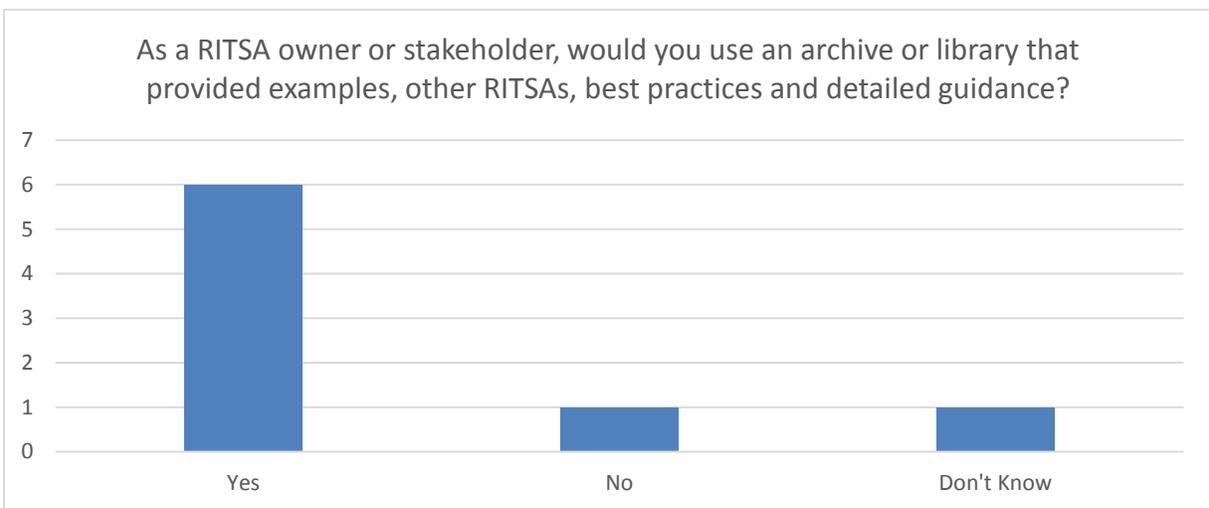


Figure 10: Stakeholder Views on Use of an Archive or Library Containing Examples, RITSAs, Best Practices and Guidance



3.1.4 Technical Support at State Level

Most respondents stated (refer to Figure 11) that they did not know if their RITSA would benefit from technical support provided at the state level, and in general did not know what form of state support could be provided. However, some respondents also said that an appropriate state role could be to provide a library or archive, as described above. One respondent who indicated state support would be beneficial stated that the state could provide information on “how to make proposals for funding more interesting using the architecture. The architecture makes applying for grants easier as it includes all the elements that need to be in a grant, yet there is no training on the use of the architecture to apply for grant funding.”

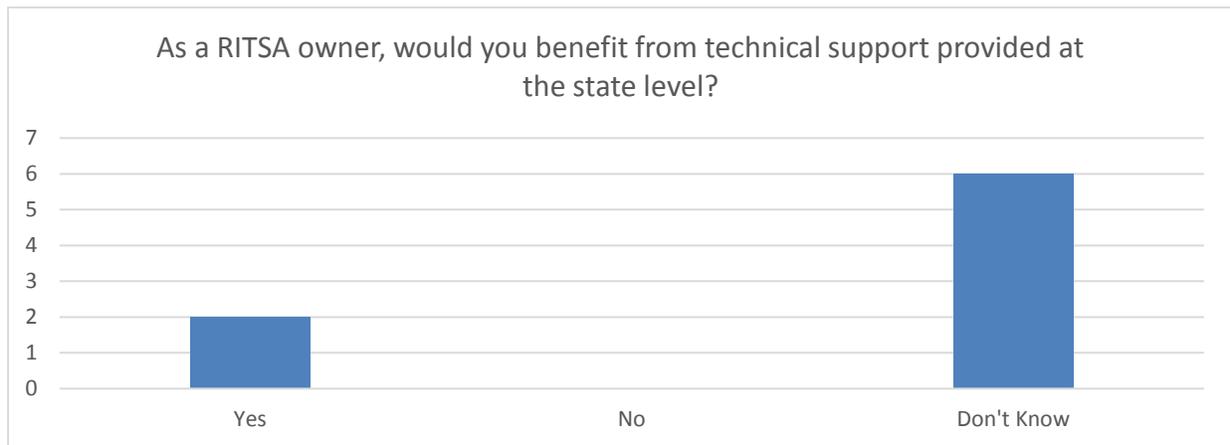


Figure 11: Stakeholder Views on Technical Support Providing at the State Level

3.2 Opportunities

The stakeholders provided a significant amount of feedback outside of the questionnaires, both in terms of written a comments, phone interviews and Stakeholder Advisory Committee meeting input. Based on this information, a series of opportunities are defined and discussed. These serve as the basis for the Business Case for RITSA development, use and maintenance activities, presented in a separate document.

Opportunities to enhance the effectiveness and value of RITSAs include the following:

- Providing Examples, Best Practices and Detailed Guidance to RITSA Owners and Users
- Improvement of Planning Procedures
- Use of RITSAs as a Tool to Incorporate Connected and Autonomous Vehicle (CAV) and Connected Corridor Activities into Regional Planning Activities
- Enhancement of Staffing and Resources to Develop, Use and Maintain RITSAs



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The following address these opportunities in further detail and should be further examined as part of developing a Business Case for use of RITSAs on a statewide basis (see Section 4) as well as further enhancement, update and maintenance of the SWITSA.

3.2.1 Providing Examples, Best Practices and Detailed Guidance

The stakeholders were asked how RITSAs could be better utilized. In general, it was felt that there is a need for better examples of how RITSAs have been used or are being used successfully order to demonstrate their value. Issues identified by the stakeholder and consultant team include:

- Demonstration of how results of architecture use yielded cost savings to the public relative to implementation of systems
- Documentation of best practices and guidance which focus on successes using RITSAs
- Creation of an updated repository of ITS architectures, current ITS procurements, guidance and training activities
- Development of specialty training activities focusing on various modes, various technical staff levels (including technical / IT-related orientation, telecommunications orientation, institutional orientation, planning orientation, etc.)
- Identifying better understandings of data and information flows (including standardization needs) for data hubs and data exchange, particularly critical between Infrastructure Owner-Operators (IOO) and OEMs (especially for connected and autonomous vehicle, or CAV applications)
- Providing a focus on developing both a SWITSA and RITSA that supports development of statewide data hub and exchange standards to support CAV

It is noted that the ITS System Builder tool has recently been enhanced by Caltrans and may serve to provide a platform for an ITS architecture repository as well as documentation of current infrastructure that is incorporated into regional and statewide architectures.

3.2.2 Improvement of Planning Procedures

The stakeholders provided some useful input on the potential for application of RITSAs to ITS and transportation planning efforts in general, as summarized below. Potential actions to address these improvements are shown in italics. This input serves as a basis for the RITSA Business Case described in a separate document.

- Planning procedures should include TSMO as a component. The RITSA would be a key element in this process. *Incorporate changes to statewide ITS planning guidance that address the role of operations and how RITSA elements should be mapped to ITS and operations program elements, and vice versa.*
- RITSA should be a consideration for all regional projects, especially those that require coordination between multiple agencies, including Caltrans, MPO/RTPAs and local agencies. There should be better guidance as to when a RITSA's goals or desired outcomes are reviewed



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and considered in the regional planning process. *Update statewide ITS planning guidance to address the relationship between the higher-level vision and the ITS Services to be incorporated within a Regional Architecture, and ultimately with the proposed programs and projects incorporated into the architecture. Provide related training to MPOs and other architecture owners. The Turbo Architecture tool, recently replaced by RAD-IT, was recently enhanced to incorporate planning goals, objectives and performance measures as components in development of regional ITS services.*

- Several existing ITS planning efforts outline proposed ideas and possible joint projects. But may not be clear to stakeholders how to move these ideas forward into projects by stakeholders, and a RITSA could be used as a tool in this regard. *Update RITSA's to reflect proposed ITS programs and projects that have been defined without prior RITSA updates. RITSA should incorporate the goals and objectives of the programs and projects as well as the required services and related information flows that would support these programs and projects. Incorporate this process as part of revisions to the statewide ITS planning guidance.*
- The RITSA should inform and contribute to the development of transportation plans at the regional and sub-regional/corridor levels by identifying projects/strategies and assist in the sequencing of those projects/strategies. *Prioritize programs and projects based on the prioritization of regional goals and objectives as well as knowledge of available funding mechanisms. Reflect this prioritization within a RITSA as part of revisions to the statewide ITS planning guidance.*
- The RITSA should capture all projects found in regional transportation plan (highest level definitions), and then work with project development teams to evolve these into full project delivery architectures by the time a project is listed in the regional TIP. This may require additional “awareness” training of other disciplines on ITS Architecture development, and serious consideration for broadening the ability for phased capture of data (better UI, better reports, far better ability to collaborate across disciplines). *Address relationship of RITSAs to project development and delivery as part of future ITS planning guidance and provide related training to MPO's and other architecture owners. The updated ARC-IT includes a System Engineering Tool for Intelligent Transportation (SET-IT) that enables detailing of projects identified in a RITSA using the Systems Engineering process, including developing Concepts of Operation, system requirements, and interagency agreements and coordination documentation.*

3.2.3 Use of a RITSA as a Tool to Incorporate CAV and Connected Corridors into Regional Planning Activities

Current and future initiatives are underway that are changing the nature of ITS deployments as well as the range of functionality incorporated within a region. The stakeholders and consultant team identified a number of key activities that could enable this, and potential actions are shown in italics:

- RITSA may be the appropriate process for discussing the technological aspects of advanced ITS (including CAV's) however, it cannot just reside there. *RITSAs should identify the desired*



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regional ITS goals and outcomes, along with describing the types of projects that need to be implemented. Consider these projects in the California Statewide Transportation Plan and/or Regional Transportation Plans. If the projects receive funding then they should make their way into the appropriate Transportation Improvement Program.

- The development of a Statewide ITS Architecture (SWITSA) should also address these considerations for statewide ITS functions that connect regions and support intercity corridor operations. *Statewide planning efforts and the SHOPP should leverage RITSA components that support projects directly impacting Caltrans facilities and requiring Caltrans involvement. CAV standards, V2I infrastructure, electric charging stations, electronic toll collection, and road user charging are examples of elements that would need to be made uniform on a statewide (and in many cases, national) basis. A guidance framework should define the relationship between SWITSA and RITSAs.*
- Architectures would need to take into consideration not just agency needs, but also private sector and OEM interfaces with these agencies (since CAV relies so heavily on private data and applications as well as operators). *CAV standards, V2I and V2V, and electric charging stations may largely be deployed by private sector entities, although the framework for implementation may involve public policy decisions. Future SWITSA and RITSA activities should include development of statewide guidance for both Caltrans and MPO's and other architecture owners on how the private sector is engaged. It is imperative that such engagements are coordinated across the state in lieu of duplicate efforts as this may affect the willingness of private sector entities to serve as partners.*
- Broader regional policy issues need to be addressed in addition to, and in coordination with, the RITSA process. *Applications with statewide significance or that will require uniform statewide or national standards, such as V2V and V2I standards, electronic payment, etc., require consideration with or without a SWITSA, but implementation of a SWITSA would involve incorporating these applications and standards, and such applications and standards would also need to be adopted at the RITSA level. As discussed above, a guidance framework should define the relationship between SWITSA and RITSAs.*
- RITSA should serve as a centralized repository for all ITS work. *The new ARC-IT national architecture reference facilitates the use of RITSAs to document assets, which is important for Autonomous Vehicles, both from the standpoint of data collection as well as infrastructure such as electric charging stations, e.g., providing a Center-to-Center interface to update inventories from existing Data Hubs. ARC-IT and its related development tool (RAD-IT, formerly Turbo Architecture) is presently the only industry tool for collecting the architectural elements and their associated requirements in a centralized inventory and associated data flow environment. The companion tool for project architecture, SET-IT, allows for systems engineering development through concepts of operation, requirements, and interface definitions, providing greater*



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relevance to system developers, providing improved data constructs and reference checks so that industry can access and innovate.¹

3.2.4 Enhancement of Staffing and Resources to Develop, Use and Maintain RITSAs

One of the keys to greater use of RITSAs is greater understanding of the architectures by planning staff, not just engineers and operations professionals. Below, stakeholders comments are provided relative to enhancing staffing, resources, and technical expertise. Potential actions are shown in italics.

- Many planners do not have an understanding on what it takes to adequately operate and maintain ITS and related systems. Budget constraints and lack of training for ITS resources have often resulted in less than successful implementations, and this may drive planners' perceptions. The ability to demonstrate RITSA effectiveness in other regions may be useful in helping refine the process so it is more useful in California, achieves the appropriate agency planning objectives, and becomes more worthy of resources and staffing. *The SAC Workshops under this study should provide some examples of where RITSA could support development of maintainable ITS programs and projects (notably including definition of roles and responsibilities). Prioritization of programs and projects should take into consideration the ability of the owning agencies to operate and maintain the systems. While these involve decisions that needs to be addressed outside the RITSA development effort, those decisions should be reflected in the roles and responsibilities defined in RITSA, as well as in the project priority.*
- Support from consultants and other entities in preparing and supporting a RITSA should be accompanied by dedicated agency staff support and knowledge so that there is effective regional and agency ownership of the RITSA. *Statewide ITS planning guidance should provide specific resource recommendations on how MPO's and other architecture owners should maintain the architectures, identifying specific roles and responsibilities in updating architectures, including development of a "generic" or "model" architecture maintenance plan, as well as providing background on the level of resources that should be set aside to support these activities.*
- If an agency's ITS program is being driven by TSMO + Connected Vehicle + Cybersecurity objectives for statewide architectural conformance, then that requires far more rigor than is currently involved in developing and maintaining the RITSA. It will also require more training than may be currently provided to agency staffs as well as opportunities to obtain this training, although there is currently some degree of specialty training provided. *As discussed previously, the relationship between SWITSA and RITSA activities with respect to statewide conformance needs to be addressed as part of statewide ITS planning guidance activities and appropriate training provided.*

¹ The National ITS Architecture was integrated in Spring 2017 with the Connected Vehicle Reference Implementation Architecture, or CVRIA, into the Architecture Referenced for Cooperative and Intelligent Transportation (ARC-IT), built upon revised multi-dimensional views of applications and interfaces.



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- When updating the RITSA, include development of documentation for architecture maintenance to account for future turnover in staff. *As discussed above, guidance on development of Architecture Maintenance Plans should be provided as part of the Statewide ITS Planning Guidance, along with identification of expected requirements for providing staff for such support activities, and related training both for developing the maintenance plans as well as providing the actual architecture maintenance and update activities.*
- A "one-stop-shop" for information on RITSAs, SWITSA and National ITS Architecture activities would be useful, including regular updates from federal agencies to all DOTs, MPO and RTPAs. *The ITS System Builder tool is a natural clearinghouse for the SWITSA and RITSAs, but is one element as part of a larger effort (perhaps accomplished through statewide RITSA User Groups). This larger effort would involve providing similar information to all RITSA owners on updates to the National Architecture and related tools (whether Turbo Architecture or successor architecture development tools).*
- Another possibility is establishment of a multi-agency partnership between regional agency and specific stakeholders (i.e., Caltrans District Planning), with rotating responsibility for maintenance coordination. *This input could be considered on a region by region basis where needed (a) to assure RITSAs are being maintained, and (b) to encourage cooperation and coordination by further engaging various architecture stakeholders in the RITSA development, use and maintenance process by vesting them with shared or rotated responsibility for successfully maintaining the architecture.*

Staff retraining will be required as users implement ARC-IT as the basis for future RITSAs.



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APPENDIX A

Regional ITS Architecture Barriers and Opportunities Questionnaire



Architecture Applicability

The purpose of the following questions is to determine the RITSA owner and stakeholder's perceived applicability of the RITSA to their ITS activities during planning and implementation, and to understand how a RITSA may be made more relevant.

1. Is there a clear understanding (by management and staff) of the value of the RITSA during development, design, and implementation?

Yes

No

Don't Know

How could the Architecture's value be better demonstrated (e.g. through examples, best practices, detailed guidance)?

Click or tap here to enter text.

2. Is the RITSA process clear when compared to other planning efforts?

Yes

No

Don't Know

Should the RITSA process integrate with other regional transportation planning activities?

Click or tap here to enter text.

3. Is the RITSA the appropriate process for integrating advanced ITS, such as connected and autonomous vehicles, into regional planning?

Yes

No

Don't Know

If not, what is / are the appropriate regional transportation planning process (es)?

Click or tap here to enter text.



STAFF RESOURCES AND TRAINING

The purpose of the following questions is to assess the RITSA owners perceived level of resources and training required to properly support a RITSA, and whether that requirement is a valuable use of resources.

4. Is there a clear understanding of the level of staff and other resources required to maintain the RITSA and support stakeholders in using it?

Yes No Don't Know

Have adequate resources been dedicated to maintenance and support?

Yes No Don't Know

Please explain your responses.

Click or tap here to enter text.

5. Are the owner and stakeholders adequately prepared for their roles in maintaining, supporting and using the RITSA?

Yes No Don't Know

Please explain your response.

Click or tap here to enter text.

6. Is there a defined transition plan in case staff assigned to the RITSA maintenance and support left those roles?

Yes No Don't Know

Has that plan been followed, including the appropriate training of staff new to the roles?

Yes No Don't Know

Please explain your responses.

Click or tap here to enter text.



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7. Are the federal support and training opportunities perceived to be adequate?

- Yes No Don't Know

Has the training received been useful?

- Yes No Don't Know

Please explain your responses.

Click or tap here to enter text.

8. Has initial and / or ongoing training been identified as part of the Architecture maintenance / use plan?

- Yes No Don't Know

If so, has the appropriate staff received training?

- Yes No Don't Know

Please explain your responses.

Click or tap here to enter text.



FEDERAL, STATE AND LOCAL RESOURCES

The purpose of the following questions is to identify potential resources to support RITSA owners and stakeholders in RITSA maintenance and use.

9. Would your agency's RITSA activities benefit from a statewide or regional "user's group" to support developing and using the RITSA?

Yes

No

Don't Know

If so, what formats would work best (e.g. web group, occasional webinars, conferences)?

Click or tap here to enter text.

10. Would your RITSA benefit from access to other RITSA developers to serve as liaisons or experts during development?

Yes

No

Don't Know

Please explain your response.

Click or tap here to enter text.

11. As a RITSA owner or stakeholder, would you use an archive or library that provided examples, other RITSAs, best practices and detailed guidance?

Yes

No

Don't Know

Please explain your responses.

Click or tap here to enter text.



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12. As a RITSA owner, would you benefit from technical support provided at the state level?

Yes

No

Don't Know

If so, what forms of support would benefit you (e.g. hands-on guidance, reference documents, Training)?

Click or tap here to enter text.