



Shane N. White
Telephone: (510) 987-9303
Fax: (510) 763-0309
Email: shane.white@ucop.edu

Chair of the Assembly of the Academic Senate
Faculty Representative to the Regents
University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200

May 9, 2018

**ARTHUR ELLIS, VICE PRESIDENT
RESEARCH AND GRADUATE STUDIES**

Re: Institutes for Transportation Studies Five-Year Review

Dear Art:

At its April 25, 2018 meeting, the Academic Council approved the attached Five-Year Review of the Institutes for Transportation Studies (ITS) Multicampus Research Unit (MRU).

Following procedures outlined in the Compendium, the review was performed by a Joint Senate Review Committee, led by the University Committee on Research Policy (UCORP) with input from the University Committee on Planning and Budget (UCPB) and the Coordinating Committee on Graduate Affairs (CCGA).

The Review Committee's report affirms the unique service the ITS provides to UC's research, graduate education, and public service missions, and recommends continuing the MRU for another five years. The report also offers suggestions for enhancing ITS operations and for strengthening collaboration and coordination, both across the campus branches of the ITS and at non-ITS UC campuses.

The Academic Council appreciates the significant time and effort the Review Committee spent in preparing and writing this report. In particular, I want to recognize the substantial contributions and outstanding leadership of UCORP Chair Jeffrey Richman.

It is also important to note that the recently reestablished process and data templates for MRU review functioned extremely well. We are extremely grateful to the collegial support and expertise provided by the Office of Research and Graduate Studies.

Please do not hesitate to contact me if you have questions.

Sincerely,



Shane N. White, Chair
Academic Council

Encl.

Cc: Academic Council
Senate Director Baxter
Senate Executive Directors



UNIVERSITY COMMITTEE ON RESEARCH POLICY (UCORP)
Jeffrey D. Richman, Chair
Email: jdrichman@ucsb.edu

University of California
Academic Senate
1111 Franklin Street, 12th Fl.
Oakland, California 94607-5200

April 18, 2018

SHANE WHITE
CHAIR, ACADEMIC COUNCIL

Re: UCORP/UCPB/CCGA review of the Institute of Transportation Studies MRU

Dear Shane,

We are pleased to present our review of the UC Institute of Transportation Studies (ITS), a UC Multi-campus Research Unit (MRU) involving four ITS branches centered at the Berkeley, Davis, Irvine, and Los Angeles campuses.

As specified by the *Compendium*, the process of reviewing an MRU is performed by UCORP as the lead committee, with participation by members of UCPB and CCGA, who also consult with their committees. In our review, the interaction between the members of the three committees was very productive and collegial, and the document represents a consensus view.

The review document includes an Executive Summary with a brief version of our recommendations. The final section of the document presents our detailed points in the form of a series of findings and recommendations. We note that the recommendations refer to both the ITS and UCOP.

We would like to thank the staff of the Office of Research and Graduate Studies (ORGS) for their hard work and strong support during the review.

Sincerely,

A handwritten signature in blue ink that reads 'Jeffrey D. Richman'.

Jeffrey D. Richman
Chair, University Committee on Research Policy

cc: Robert May, Academic Council Vice Chair
Hilary Baxter, Academic Senate Director
UCORP members

Review of the University of the California Institutes of Transportation Studies

University Committee on Research Policy (UCORP)
(Lead Committee)

University Committee on Planning and Budget (UCPB)

Coordinating Committee on Graduate Affairs (CCGA)

April 18, 2018

I. Executive Summary

The University of California Institute of Transportation Studies (ITS) is a large, complex, and highly interdisciplinary Multi-campus Research Unit (MRU) that involves four local ITS institutes, or branches, which are centered at the Berkeley, Davis, Irvine, and Los Angeles UC campuses. The broad research programs conducted by the members of these four ITS branches represent a major asset to the University, to the State of California, to the transportation industry, and to the transportation research community. In terms of service to the State, the work performed by the ITS branches represents one of the jewels in the crown of the University of California.

This document presents the findings and recommendations resulting from the five-year review of ITS performed on behalf of the Academic Senate by the University Committee on Research Policy (UCORP), the Committee on Planning and Budget (UCPB), and the Coordinating Committee on Graduate Affairs (CCGA), with UCORP acting as the lead committee. Below, we refer to UCORP, together with participating members from UCPB and CCGA, as the Review Committee.

The main questions to be addressed by the review are specified in *The Compendium: Universitywide Review Processes for Academic Programs, Academic Units, and Research Units*¹, which describes establishment and disestablishment procedures, best practices, reporting requirements, and review procedures for MRUs and other University of California research units. According to *The Compendium*, the report should “provide an objective and balanced critical evaluation of the MRU to be reviewed” and answer two key questions:

1. Does the unit provide a unique service to UC in research, support of graduate education, and public service that would otherwise not be provided in its absence?
2. Should the MRU be continued for another five years?

The consensus of the Review Committee is that the ITS has functioned largely as a network of four separate branches. While there do exist significant collaborative efforts spanning multiple ITS branches, we believe that their powerful individual capabilities have strong potential to function more synergistically, which could greatly enhance the impact of the ITS research program. Although the ITS MRU has existed for many years, progress towards strengthening its collaborative processes and management structures has been made only relatively recently, which was a serious concern for the Review Committee. Thus, we give a qualified “yes” in response to the first question listed above. In response to the second question, we recommend that the MRU be continued for

¹ https://www.ucop.edu/institutional-research-academic-planning/files/compendium_sept2014.pdf

another five years. The new initiatives under development as a result of increased State funding show great promise. In this context, the Review Committee also recommends that the ITS, in consultation with its Advisory Board, carefully formulate a strategy and associated planning processes to strengthen collaboration across the ITS branches. Furthermore, opportunities for collaboration with and support for transportation researchers on other UC campuses should be carefully explored and, if possible, increased. The Conclusions and Recommendations section of this report provides 5 findings and 11 recommendations, which we believe would help increase the impact of the ITS research program, assure that expenditures of State funds are fully documented, and align ITS operations with best practices expected for MRUs.

A recent development with major implications for the continued success of ITS is the passage of California Senate Bill 1 (SB 1) in 2017, which provides an augmentation in State funding of \$5 million/year, expected for many years, to the University of California for transportation research. This long-term funding should enable many new transportation research initiatives, which will in turn provide significant opportunities for graduate student training. The Review Committee commends UCOP for its critical role in helping the ITS to secure this funding.

The outline of this document largely follows the format for five-year MRU reviews specified in *The Compendium*. The information is presented as follows: Executive Summary (Section I), Introduction (Section II), Evidence of Accomplishment (Section III), Budget (Section IV), Administration and Governance (Section V), Advisory Committees (Section VI), Comparison with Other Units (Section VII), and Conclusions and Recommendations (Section VIII).

II. Introduction

(a) History

The ITS was founded in 1947 with headquarters at UC Berkeley and a branch at UCLA. Starting from that time, the ITS has been funded by UCOP at roughly \$1 million/year using earmarked funds allocated from the California State Legislature's Public Transportation Account (PTA). In 1974, the UCLA branch of the ITS was locally dissolved, and its program was moved to UC Irvine. In 1991, ITS expanded to include UC Davis, and in 2016, UCLA was formally added as an ITS branch, although it had been active in transportation research for many years.

The character of the ITS as an MRU has evolved over time, both as the University has developed the MRU concept and as the ITS itself has changed. According to the University's *Compendium*, MRUs are required to submit annual reports to UCOP and to undergo a review every five years. The ITS last submitted a five-year report in 2004, in the form of three separate reports from the three participating campuses at the time. The ITS was also reviewed by UCOP's Portfolio Review Group in 2013–2014, as discussed later in this section.

Starting in 2009, UCOP changed its primary approach to funding multi-campus research projects to a competitive model and introduced the Multicampus Research Programs and Initiatives (MRPI) program. The ITS branches received MRPI funding for the period 2009–2015. With much of the available UCOP central funding shifted to the MRPI program, the incentives for multi-campus efforts to remain as MRUs were significantly reduced. The ITS branches also receive ongoing funding from many public and private sources.

In this evolving framework, the collaborative aspects of the ITS appear to have been for the most part secondary to the campus-based priorities and identities of the separate institute branches, which refer to themselves as ITS institutes in and of themselves. In 2012, UCOP convened a Portfolio Review Group (PRG)² to assess UC's systemwide research portfolio. The ITS was reviewed in 2013 as part of "Cycle 2" of these reviews. The *Report of the Portfolio Review Group* (Feb. 6, 2014) concluded that ITS MRU was aligned with systemwide research and investment principles. The main considerations used to evaluate this alignment are stated in Appendix 2 of this report (italics added):

- 1) *Act as one system of multiple campuses to enhance UC's research capacity, influence and advantage.*
- 2) *Promote efficient inter-campus collaborations and systemwide economies of scale.*
- 3) *Serve the State and citizens of California.*

The PRG found good alignment Principles 1 and 3. However, it also stated (italics added):

Currently, the program partially aligns with Principle 2 (facilitating multicampus engagement and efficiency). Although there is some collaboration as evidenced by the successful MRPI project, the four campus institutes operate with considerable autonomy. The committee received four separate reports from the four campus ITS offices, as opposed to a single integrated one, indicative of the level of program integration. The committee found that there is potential for a more integrated multicampus/systemwide program not realized in the current operating and oversight structure. The impact of the program could be greater by broadening campus participation and collaboration as well as by extending multidisciplinary initiatives and activities beyond traditional disciplines affiliated with the program. The program should consider a strategic initiative, perhaps facilitated by an advisory board, to address:

- *Strategic opportunities to increase multicampus engagement in the Institutes, wherever possible and appropriate, including UC campuses that do not currently have ITS centers.*
- *Areas of overlapping research interests and projects between Institutes and strategies for more closely aligning cross Institute research initiatives in the future.*
- *Areas of duplication in the management of the Institutes and how that may evolve over time to a more combined administration.*
- *Apparent inequities across the campuses that might be addressed by modifications to the governance structure.*

Following the PRG review, an effort was initiated within UCOP to foster a more collaborative approach among the four ITS campus institutes with the goal of producing a compelling proposal for a substantial augmentation in State funding for ITS. The annual ITS State funding level, which was \$920,000 in 1947, had stagnated, reaching just \$980,000 in 2015. After extensive and careful preparation, the initiative eventually led to joint proposal from the four ITS branches. This proposal states that the funding augmentation will be used to "actively support the state in developing policies, rules, and strategies that are grounded in science, and that help address five critical state goals in priority areas identified by the Legislature and the Governor." These five areas are climate change, urban sustainability and air quality, infrastructure and energy,

² <https://www.ucop.edu/research-graduate-studies/programs-and-initiatives/research-initiatives/systemwide-research.html>

transportation system performance, and taxation and finance.

This proposal led to a one-time funding augmentation of \$3 M in 2016 and to an ongoing allocation of \$5 M/year, as authorized in Senate Bill 1 (SB 1), the Road Repair and Accountability Act of 2017, “for the purpose of conducting transportation research.” This major success in strengthening State support for ITS shows the power of a joint approach by ITS, as envisioned and encouraged by UCOP. The Review Committee commends UCOP’s vision and efforts in enabling ITS to secure the augmentation in State funding. The success of this vision establishes that a coherent, multi-campus approach can yield major benefits to all stakeholders, and it creates a strong incentive and need for further collaboration and coordination among the ITS branches.

In March 2016, a memorandum of understanding (MOU) was prepared by the four ITS Directors, and subsequently updated in September 2017. The MOU, which was endorsed by UCOP, specifies the governance mechanisms, funding principles, and funding allocations related to state-funded (PTA and SB 1) activities. Further aspects of this MOU are discussed in the sections on Budget (Section IV) and Governance (Section V).

(b) Mission and Scope

The ITS mission, as stated in its five-year report, is “to be the premier university-based transportation research center in the world, to advance the state of the art in transportation engineering and planning, to serve as a source for information to the state, regional and local transportation agencies, and to provide technology transfer and continuous education to practicing transportation engineers and planners in California.” ITS has advanced laboratory capabilities at facilities such as the Richmond Field Station (UC Berkeley), the UC Pavement Research Center (UC Berkeley and UC Davis), and the Advanced Highway Maintenance and Construction Technology Research Center (UC Davis). However, many of its activities are analytical or policy oriented rather than laboratory based.

In its five-year report, ITS states that “Individually or collectively, the campuses provide research competence related to transportation planning for people and freight, finance and policy, transport infrastructure design and management, construction management, vehicle and highway technology, traffic safety, energy conservation, air transportation, public transit planning and operations, traffic engineering and operations, the environmental impacts of transportation, and innovative mobility and travel demand management. “

While the individual ITS branches are certainly impressive on their own, the collection of all four represents one of the world’s preeminent university-based research enterprises dedicated to transportation studies.

(c) Service to the University and to the State

California, by virtue of its advanced economy, sophisticated high-tech industry, and demanding transportation requirements, is clearly a natural location for a major transportation research center.

As noted in Section II(a), the relationship between ITS and the State has been strengthened in recent years. The urgency of California’s transportation challenges has motivated ITS to try to provide comprehensive analyses and solutions to State policy makers on the time scale of roughly one year, as embodied in the ITS State Policy Rapid Response Program. One year is a short time scale in which to undertake such complex

studies, and this program represents an ambitious effort to engage with the State on key transportation issues. Service to the State includes research and resources directed in the following areas:

- Connected and automated transportation
- Data-enabled decision and policy making
- Greenhouse gas and oil reduction
- Infrastructure resilience: disaster management and cyber security
- Mobility and the sharing economy
- Public transit
- Sustainable goods movement
- Sustainable transportation funding
- Transportation equity and environmental justice
- Vehicle travel and land use integration.

As an MRU, the ITS clearly has strong interactions and visibility with the State because it interacts with the legislature, Caltrans, and other state agencies as a single unit. The ITS branches have numerous partners in the public sector, including Caltrans, the California Air Resources Board, the US Department of Transportation, the California Strategic Growth Council, the South Coast Air Quality District, the State of California Energy Commission, the Los Angeles County Metropolitan Transportation Authority, the Fresno Council of Governments, the Bay Area Air Quality Management District, the City of Anaheim, and the City of Sacramento. ITS branches also participate in various consortia that include both private and public sector partners. Examples are the ITS-Davis Sustainable Energy Pathways Consortium and the ITS-Berkeley DeepDrive Industry Consortium, which is investigating computer vision and machine learning for automotive applications.

These efforts have had an important impact in helping the State to address its transportation-related challenges. For example, the UC Pavement Research Center has helped Caltrans to save \$80 million/year through the use of its pavement management system, save 10%/year through the use of improved software to design pavements, and save about \$19 million/year through the use of recycled asphalt.

The ITS branches provide a highly impressive range of professional development training courses. The ITS documentation states that more than 100 training events are offered each year and are attended by more than 3700 transportation professionals. For example, ITS-Berkeley has a Technology Transfer unit that offers such courses regularly.³ The branches also offer a series of public policy forums, conferences, and symposia that are strongly attended by members of the transportation community.

Because graduate students and postdocs perform much of the research, the ITS MRU as an umbrella organization helps provide a wealth of educational and training opportunities across a broad range of postgraduate programs. Additional service to the University includes providing an interdisciplinary center to train the next generation of leaders in transportation studies. This effort extends beyond traditional undergraduate students, graduate students, and research fellows and includes visiting scholars and international collaborators that increase the stature and visibility of the University. Further discussion of the contributions of the ITS to the University is included in Section III (Accomplishments).

³ <https://its.berkeley.edu/TechTransfer>

(d) Visibility

There are several different contexts relevant to visibility for ITS, including visibility in State agencies that are connected with transportation, visibility in the academic community, both nationally and internationally, and visibility in the transportation community.

The extensive interactions between the ITS and State, regional, and local government agencies are discussed in Section II(c). A major development in the relationship between ITS and the state is the appointment of a UC ITS Assistant Director, who will be based in Sacramento. This position is discussed in Section V(c).

From an academic perspective, the individual ITS branches have high visibility, and the research efforts within their scope attract a large number of graduate students. However, the ITS regarded as an MRU does not appear in the standard rankings, which are focused on academic programs at individual university campuses. For example, in the Academic Ranking of World Universities (“Shanghai Ranking”) in the category Transportation Science and Technology, UC Berkeley ranks #3 in the world, UC Davis #30, and UC Irvine #48.⁴ The Review Committee believes that the mission and scope of the ITS are not encompassed in any standard ranking.

The Review Committee does not feel that the lack of academic visibility of the ITS *as an MRU* is of concern, because the main visibility is associated with the four individual ITS branches. The academic impact of the ITS branches is considerable and is discussed in detail in Section III (Evidence of Accomplishment). However, as discussed in Sections III and IV, the Review Committee believes that the productivity and impact of the ITS can be enhanced with a stronger collaborative approach.

An examination of the web sites of each of the four ITS branches shows that, for the most part, they do not reference each other or provide permanent links to each other’s web sites. We found a news item on the UCLA ITS web site that does reference the other campuses. But in general, the individual ITS branches have very strong individual identities that seem to far outweigh any systemwide notion of an MRU, which we have never seen explicitly mentioned on these sites. The only mention of an MRU entity is at the web site maintained by UCOP, where the MRU is referred to as “The Institutes for/of Transportation Studies” (in different places), whereas the ITS documentation supplied for the review refers to the MRU as “The Institute of Transportation Studies.” The name(s) used by UCOP may be more accurate, at least currently, because the MRU is effectively a network of separate institutes.

The visibility of the individual ITS campus institutes is therefore high in the relevant communities, but the visibility of the systemwide MRU appears to be much lower. It is not clear that this represents a major problem, but it represents the actual situation of the ITS.

(e) Internal and External Interactions with related units

Transportation studies in the UC system are not confined to the programs within the ITS branches. For example UC Riverside has recently received funding for its Center For Environmental Research and Technology, which is part of a new Department of Transportation University Transportation Center. UCR is also part of The Center for

⁴ <http://www.shanghairanking.com/Shanghairanking-Subject-Rankings/transportation-science-technology.html>

Advancing Research in Transportation Emissions, Energy and Health. Other UC campuses also have significant efforts in transportation research.

In the past, all four ITS branches participated in a US Department of Transportation (DOT) University Transportation Center (UTC) that was headquartered at Berkeley. However, the most recently awarded UTC for the California region, referred to as the Pacific Southwest University Transportation Center, is led by USC and involves UC Davis, UC Irvine, and UCLA, without participation by UC Berkeley. This change illustrates the way in which ITS branches have flexibility to operate differently in different contexts.

A modest part of the SB 1 funds is used to fund transportation research at non-ITS UC campuses. This funding is discussed in Section IV (Budget).

III. Evidence of Accomplishment

(a) Research

The group of scientists, engineers, and other scholars associated with ITS have demonstrated extremely strong research productivity over the course of the review period. Investigator-initiated programs of research, seeking to understand and improve many aspects of modern transportation systems, have resulted in many peer-reviewed publications. ITS members also respond to the needs of governmental and commercial organizations. The importance of the work of these researchers can be seen in the extensive research funding that they receive from both public and private sources. Through a combination of these endeavors, ITS has been a font of discovery, innovation, and impact.

The field of transportation studies is profoundly multi-disciplinary and encompasses the natural sciences, engineering, social sciences, and management. Examples of such research areas include transportation planning for people and freight, finance and policy, transport infrastructure design and management, construction management, vehicle and highway technology, traffic safety, energy conservation, air transportation, public transit planning and operations, traffic engineering and operations, the environmental and health impacts of transportation, and innovative mobility and travel demand management. The multi-disciplinary nature of the field allows researchers to make original and significant research contributions both within the disciplines of their training and across disciplinary boundaries to address complex transportation problems.

ITS reports that, during the period 2012–2017, its members published 1116 journal articles, produced 459 conference papers, 209 reports, 36 books, and 54 book chapters, as well as other magazine articles, web pages, etc. This is a very significant output.

We have also considered a list of 20 top-cited research papers published in 2015–2017 provided to us by the ITS. The mean number of Google citations for the 20 top-cited research papers published in 2015–2017 is 44.75. In most cases, the authors of these papers do not identify themselves as members of the ITS or even as a member of the ITS on any given UC campus. This shows the character of ITS as an umbrella organization encompassing many academic departments and collaborative research units on the four campuses.

Transportation research results are often disseminated in the form of technical reports, white papers, books, and similar independent publications. Thus, the research productivity of the membership of ITS can also be seen in the publicly available reports

appearing from the ITS membership each year, often commissioned by commercial or governmental organizations. ITS researchers are sought out to offer their expertise to investigate pressing transportation questions raised by groups like Caltrans, the US Department of Transportation, the California Air Resources Board, and the California Energy Commission. Disseminating research results in this way introduces some issues of archiving and access, which ITS addresses, in part, by supporting the Harmer E. Davis Transportation Library at UC Berkeley.

The ITS has been able to obtain funding from a broad range of sources described in the Section IV (Budget).

The synergistic assembly of transportation researchers under ITS has also been recognized by the funding of various research centers. In the past, the UC Berkeley ITS led the University of California Transportation Center (UCTC) and the UC Center on Economic Competitiveness in Transportation (UCCONNECT). Currently, ITS-UC Davis leads the National Center for Sustainable Transportation (NCST), which is one of five national transportation centers arising from the University Transportation Centers program.

The ITS campuses have recently begun a variety of major research initiatives. At UC Davis, the “3 Revolutions Future Mobility Program” aims to provide a strong research foundation for policy. At UC Berkeley, the industry funded “Berkeley DeepDrive” pursues innovative uses of artificial intelligence in automobiles. At UC Irvine, the “Transformational Mobility Living Laboratory” promises the development of real-world testbeds for new transportation technologies.

In 2008, the UC Office of the President awarded five years of Multi-campus Research Program and Initiative (MRPI) funds to ITS. The resulting research effort focused on alternative fuels and vehicle technology, system and infrastructure management, and land use and mobility. It incorporated researchers from UC Berkeley, UC Davis, UC Irvine, and UC Los Angeles, along with collaborators at UC Riverside and UC Santa Barbara. This research program generated hundreds of publications, supported a large number of graduate students, and helped to attract several million dollars annually in additional extramural funding.

The ITS branches have initiated several cross-campus collaborations, including the development of a low-carbon fuel standard for California (UC Davis and UC Berkeley), operation of the UC Pavement Research Center (UC Davis and UC Berkeley), and a project on habitat mitigation as part of transportation planning (UC Davis and UC Los Angeles). It is not clear whether the ITS MRU was critical for the initiation and operation of these collaborations. The Review Committee believes that achievements on a larger scale could result from closer collaboration between the four ITS branches.

(b) Undergraduate and Graduate Education

Although ITS is primarily a research unit (and not an education unit), it engages with faculty in a number of undergraduate and graduate programs across diverse fields ranging from Business to Engineering, Law, Environmental Design, Social Ecology, Political Science, Urban Planning, Public Health, Public Policy to Social Ecology across the four branches. UC Davis has MS and PhD degrees in Transportation Technology and Policy. UCI offers MS and PhD degrees in Transportation Science. UC Berkeley offers interdisciplinary Transportation Engineering degrees in its Department of Civil and Environmental Engineering. UCLA offers a Transportation Policy and Planning PhD program in Urban Planning. A significant number of graduate students conduct ITS-

related research. For example, students were involved in the research on switching to electric buses in California. There are undergraduate and graduate research, internship and fellowship opportunities at various ITS campus units.

Students are involved in ITS conferences, seminars and lectures aimed at government and industry leaders. ITS facilitates student-led annual conferences involving all four campuses. The annual transportation conference in Washington DC also involves students. ITS assists students with access to academia, industry, and government leaders. In 2015, about a third of transportation faculty at transportation planning programs in the US had received their PhDs from UCLA and UC Berkeley. Graduates of the component degree programs that participate in ITS find work in influential positions in industry (including startups) and government in California, the US, and elsewhere around the world.

The ITS is also involved in public sector professional development and training through its technology transfer initiatives among others that serve public sector employees. Its community outreach initiatives targeting K-12 students aim to increase participation of women and underrepresented minorities in transportation studies.

(c) Recognition of Excellence beyond UC

Because of their size and many accomplishments the ITS branches are widely recognized in the transportation community. This topic is discussed in more detail in Sections II(c) and II(d).

(d) Public Service and Outreach

ITS interactions with State agencies are extensively described in the Section II(c).

Outreach programs mostly emanate from specific branches of ITS. Examples include the UCLA Lake Arrowhead Symposium on the Transportation-Land Use-Environment Connection, a three-day event, held since 1991, that facilitates cooperation between the four ITS branches, elected officials, and senior public and private sector officials. Similarly, the UC Davis Asilomar Conference on Transportation and Energy Policy has been held biennially since 1988. The Technology Transfer Program, housed at UC Berkeley, offers conferences and training sessions for professionals interested in the latest developments in transportation engineering, urban planning, infrastructure design, public safety, and policy and planning. The collective efforts of the four branches of ITS in outreach might be more usefully clustered under the umbrella of the MRU.

IV. Budget

The Review Committee used three main sources of information in its analysis of the ITS budget:

1. Budget tables included in the ITS five-year report in Appendix 1,
2. Responses provided by ITS to written questions from the Review Committee, and
3. The Memorandum of Understanding (MOU) between UCOP and ITS, originally prepared on March 30, 2016 and updated on September 30, 2017.⁵

⁵ https://www.ucop.edu/research-graduate-studies/files/research/documents/Final_ITS%20MOU_30March2016.pdf

Budget information was provided in Appendix 1 of the ITS five-year report in the form of several tables, which list:

- MRU Revenue: FY 2012/2013 through FY 2016/2017 and MRU Expenditures: FY 2012/2103 through FY 2016/2017,
- Expenditures by Campus for FY 2016/2017,
- Expenditures by Fund Type for FY 2016/2017, and
- Expenditures by MRU Sub-Grant & Contract for FY 2016/2017.

The budget tables report that the four ITS branches had a combined budget of roughly \$50 million in revenue, excluding carry-forward funds, during FY 2016/2017. Broken down by campus, the expenditures were about \$27 million at UCB, \$15 million at UCD, \$4.4 million at UCI, and \$3.9 million at UCLA. The Review Committee noted the existence of some large and inconsistently reported carry-forward amounts in the budget tables. In its written responses to questions from the Review Committee, the ITS explained that these funds arise from a range of issues but did not indicate any significant concerns.

The MOU involving the four ITS branches and UCOP specifies the governance mechanisms, funding principles, and funding allocations related to state-funded (PTA and SB 1) activities: “this MOU encompasses both the nearly \$1 million annual allocation of funding from the state Public Transportation Account (PTA) as well as the \$5 million annual allocation from California Senate Bill 1 (SB 1), known as the Road Repair and Accountability Act of 2017, to the University of California for transportation research.”

The MOU includes a set of funding principles and describes the agreed-upon procedure for future funding allocations. One of the funding principles states (*italics added*),

Five percent (5%) of total state funding (current plus augmented funding) in excess of \$2 million per year will be set aside to support transportation research and outreach activities on non-ITS UC campuses and multi-campus initiatives among two or more ITS campuses. These 5% funds will be administered by the Council of Directors. Priority will be given to supporting non-ITS UC campuses and to collaboration among campuses.

The 5% allocation for collaboration across ITS branches and for non-ITS UC campuses is discussed below in Section V(d).

Section 5 of the MOU addresses the disproportionate funding to the different campuses in its plan for distribution of increased state funds: “When UCLA, UC Davis, and UC Irvine have achieved funding equal to half of UC Berkeley’s allocation (\$352,858.50 in 2016 dollars), every additional dollar of state funding will be allocated equally among all four ITS locations,” apart from the 5% set aside described above.

The Review Committee’s analysis and interpretation of ITS budget information was complicated by the fact that the four branches do not maintain a common accounting system, and so it has been difficult for the Review Committee to obtain a complete picture of the way in which these new funds are being used. The ITS was able to provide the budget information for the five-year report only with great effort and with a number of inconsistencies. In response to the Review Committee’s request for a budget presentation, the ITS replied that “The ITS MRU does not operate as one financial entity. Each campus has entirely separate funding and financial systems. A number of the issues raised below [by the Review Committee] are a result of each of the campuses

interpreting the tables differently, and reporting within the limitations [of] their financial system. For instance, Berkeley pulled financial numbers for expenditures from eight different units across campus.” Although these difficulties were not anticipated by the Review Committee, they are perhaps not surprising given that the four ITS branches operate largely independently, with most of the funding obtained through extramural grants that go to a large number of different investigators spread across multiple departments and centers. Perhaps more importantly, one can argue that a relatively small amount of centralized State support provided through UCOP is being leveraged to obtain a much larger level of extramural funding.

According to the ITS written responses to questions from the Review Committee, the recent increase in the level of state funding from SB 1 is expected to have a “transformative effect” on the UCLA branch, which did not receive any state funding prior to 2016–2017. The increase will also provide significant help for the other three ITS branches, with a large share of the funding for graduate students. Another major benefit of the SB 1 funding is that it allows more flexibility in the research program than is typical from other funding sources, which are more focused on the near-term needs and interests of the sponsors. The Review Committee strongly encourages the ITS to use this flexibility to enable more collaboration between its four branches, as well as between the ITS and non-ITS UC campuses.

The SB 1 funds have enabled the ITS to create a new UC ITS Assistant Director position, which has already been filled with the hire of Laura Podolsky. The role of the Assistant Director and recommendations of the Review Committee with regard to this position are discussed in Section V.

The Review Committee concluded that, for the purposes of budget analysis, it is more appropriate to regard the most relevant “MRU funding” as consisting of two parts: the \$980,000/year from the Public Transportation Account and the \$5 million/year allocated in SB 1, both of which go to UCOP and are then distributed to the ITS branches. The Review Committee recommends that, in future reports, such as the upcoming annual report, the ITS MRU budget reporting should focus on expenditures associated with these funding sources. It is important to carefully track these expenditures and to fully document their use. The Review Committee recommends that UCOP work with ITS to devise a budget reporting scheme that would support a straightforward analysis of the PTA and SB 1 budgets by UCOP.

The Review Committee notes that the algorithm for future funding distributions between ITS campuses detailed in the MOU is not based on clear programmatic considerations, and could not determine the basis for these distributions.

The Review Committee is concerned about the small amount of funds specified in the MOU for non-ITS UC campuses and for collaborative research across ITS branches. This amount, which we estimate would currently correspond to about \$200,000 (5% of total state funding in excess of \$2 million, which at the current funding level of \$6 million would be 5% of \$4 million), is small on the scale of potential needs. Furthermore, these funds would be divided between two separate areas, each of which the Review Committee would like to see strengthened. The Review Committee recommends that the ITS, with input from the SB 1 Advisory Board, carefully formulate a broader strategy to (1) encourage and help support transportation research conducted at key non-ITS UC campuses and (2) develop ways in which collaborative efforts across the four ITS branches can be strengthened. The Review Committee does not want to prescribe any specific targets or goals, but it is skeptical that the 5% allocation associated with the sum of these two areas is optimal for overall research productivity and impact

The ITS states as a goal the leveraging of SB 1 funding to increase overall ITS funding, above all for two programs: a multi-campus collaboration on innovative mobility and a “rapid response” research program. We commend these initiatives and encourage ITS to formulate a set of priorities to guide requests for increased funding as well as expenditure of SB 1 funds.

In its presentation to the Review Committee, the ITS Directors expressed the hope that UCOP would work to expedite the rapid transmission of state funds from UCOP to the ITS branches.

V. Administration and Governance

(a) Director

As noted in the Introduction (Section II), the ITS functions both as a set of four largely independent institutes (branches), each with its own Director, and as a network that operates within the UC MRU framework. The SB 1 funding led to the need to formalize the governance and coordination for this part of the ITS effort. The resulting agreements are described in the MOU discussed in Section IV between UCOP and the four ITS branches, first prepared in 2016 and updated in September 2017.

The ITS MRU is governed by a Council of Directors, which consists of the Directors of the four ITS branches. Decisions are made by unanimous consensus. One of the ITS Directors serves as Chair of the Council of Directors (CCD), a position that rotates annually among the Directors. The four ITS Directors are currently Professor Alexander Bayen (UCB), who is on sabbatical leave and was represented at the review by Acting Director Professor Joan Walker (UCB), Professor Dan Sperling (UCD), Professor Stephen Ritchie (UCI), and Professor Brian Taylor (UCLA). Each of the four Directors is highly qualified, with many decades of experience in the various fields of transportation-related research. Professor Stephen Ritchie (UCI) is the current CCD (2017/2018). The Directors meet frequently and regularly, and this administrative model appears to be functioning well. It was not clear to the Review Committee that this leadership structure is optimal, particularly the short term of the CCD.

To the knowledge of the Review Committee, the ITS MRU does not have any written bylaws. The Review Committee recommends that the ITS follow the best practices guidance provided by UCOP’s Office of Research and Graduate Studies⁶ and write a set of bylaws and procedures to govern its formal operations. The bylaws could better formalize the roles and responsibilities of the SB 1 Board of Advisors, the mechanisms for the accounting and reporting of the use of State PTA and SB 1 funds to UCOP, the role of the Assistant Director, and the mechanism(s) for coordination and communication with UCOP over matters related to interactions with the State government. The bylaws would also provide for a formal process for the potential inclusion of additional UC campuses into the ITS.

(b) Space and Resources

Each ITS branch has its own campus-specific research space, which in some cases includes specialized laboratory facilities. The only space issue that arose during the review was the ITS request for UCOP to provide office space in Sacramento for the ITS Assistant Director, as discussed in Section V(c) below.

⁶ <https://www.ucop.edu/research-initiatives/programs/mru/other-guidance.html>

(c) Personnel

The SB 1 funds have enabled ITS to create a new UC ITS Assistant Director position, which has been filled with the hire of Laura Podolsky. The Assistant Director reports directly to the ITS Directors; serves as a liaison with the Legislature and the Administration; and facilitates system-wide coordination of research, communication, and engagement activities. The Assistant Director is based in Sacramento, and ITS is requesting that UCOP provide space in downtown Sacramento for the Assistant Director and central staff members. The Review Committee recommends that UCOP consider this request.

The Review Committee regards the creation of the Assistant Director position as a significant development. This position provides an important resource for helping to ensure strong communication with the State legislature and with State agencies related to transportation. From the perspective of the Review Committee, the Assistant Director could also play a key role in helping to coordinate research collaboration across the four ITS branches and with non-ITS UC campuses that are engaged in transportation research. The Review Committee believes that this position, which provides a system-wide point of contact, has great potential to help in both of these areas. However, the Review Committee believes that it is critical that the Assistant Director consults and coordinates with UCOP's State Governmental Relations office to ensure that consistent messages and plans are developed and presented. The Review Committee recommends that the responsibilities of the Assistant Director and procedures for consultation and coordination with UCOP be carefully and unambiguously documented.

(d) Contract and grant administration

The administration of contracts and grants is handled through a large number of separate centers and departments on the four ITS campuses. The absence of centralized accounting is not necessarily problematic, given the variety of different funding sources and the fact that many of the projects are restricted to just one campus. However, as discussed in Section IV (Budget), the Review Committee recommends that UCOP work with ITS to devise a budget reporting scheme that would support a straightforward analysis of the PTA and SB 1 budgets by UCOP.

VI. Advisory Committees

The ITS has a rather complex advisory board structure. Each campus-specific ITS branch has its own designated advisory board. In addition, there are project-specific advisory boards. The advisory board that is most relevant for the ITS as an MRU is the *SB 1 Board of Advisors*, consisting of 19 members from the public and private sectors, together with a set of SB 1 Designated Advisors, which include key members of the State government involved in transportation.

The membership of these diverse advisory committees is overlapping, with members often serving on more than one advisory board. The responsibilities and composition of the SB 1 advisory board are specified in the MOU between UCOP and the four ITS branches as follows:

The Council of Directors will be responsible for appointing an Advisory Board comprised of at least five prominent transportation stakeholders. This Board will include the Vice President for Research and Graduate Studies from the UC Office of the President (UCOP), or his/her designee, as well as representatives, as appropriate, from the Governor's Office; the State Legislature; California State

Transportation Agency, Caltrans; the California Air Resources Board (CARB); the California Energy Commission (CEC); Metropolitan Planning Organizations; local governments; Non-Governmental Organizations (NGOs); and/or the private sector.

It is not clear to what extent the ITS Directors rely on the SB 1 Board's input for decision making and this should be documented clearly and regularly in the future. The SB 1 Board of Advisors represents an excellent communication channel and opportunity through which ITS activities could and should be coordinated and tuned with UCOP and state legislative interests.

VII. Comparison with Other Units

The ITS MRU is one of the largest university-based transportation research centers in the country and is believed by the ITS Directors to be one of the top such research centers in the world. As discussed in Section II(c), the Review Committee was not able to obtain any relevant rankings from standard sources, but we believe that this assessment is broadly correct.

As discussed in Section II(d), transportation-related research in the UC system is also conducted at other non-ITS UC campuses, some of which participate in major US Department of Transportation research centers.

VIII. Conclusions and Recommendations

The ITS Multi-campus Research Unit is a powerful network of four UC campus institutes (branches), each of which makes major contributions in the field of transportation studies. Researchers who operate within the ITS framework are highly recognized in the field of transportation, both nationally and internationally, and they have a high level of productivity. The service contributions of the ITS branches to the State of California are outstanding.

The organizational complexity of the ITS presented a challenge to the Review Committee. In many contexts, the four institutes act independently and have strong separate identities, while in others, the ITS branches collaborate and act more synergistically. This flexibility is in some ways a strength, allowing the ITS institutes to pursue a broad range of opportunities in transportation research, sometimes in competition and sometimes in collaboration. Although the ITS branches can point to many impressive strengths and accomplishments, the Review Committee came away with serious concerns about the collaborative aspects of the ITS and to what extent the ITS as an MRU is functioning in an optimal way. Our findings and recommendations are presented below, followed by our responses to the questions posed in the *Compendium*.

The Review Committee presents the following set of findings:

1. The individual ITS branches (Berkeley, Davis, Irvine, Los Angeles) have highly active and distinguished research programs that have a major impact on the field of transportation studies. These programs influence engineering technologies, practices, and policies in the transportation field.
2. The UC faculty members involved in these research programs obtain numerous research grants from a wide range of public and private sources. This framework provides opportunities and support for the training of a large number of graduate students, many of whom go on to become leaders in the transportation community.

3. The effort and commitment of the ITS branches to multiple service missions is exemplary. The work performed by the ITS branches is important to State, regional, and local transportation agencies, including Caltrans, as well as to industrial partners and transportation professionals. This work has high impact and visibility. The ITS is increasing its focus on providing relevant research results and policy studies on time scales that better fit the urgent needs of State agencies. The ITS also provides important training opportunities to a large number of transportation professionals. The Review Committee commends the ITS branches for their outstanding service to the State of California and for their high level of engagement on a wide range of transportation-related problems.
4. UCOP staff played an instrumental role in initiating and helping to develop a plan in which the ITS branches were encouraged to develop a joint proposal for increased funding from the State for transportation research. This initiative, after a major effort by both UCOP and the ITS branches, resulted in a substantial augmentation in funding, as provided in California Senate Bill 1 (SB 1). Currently, the California state funds provided to UCOP to fund transportation research consist of the SB 1 funds (\$5 million/year) and Public Transportation Account (PTA) funds (about \$1 million/year). The Review Committee commends UCOP staff for their work enabling these accomplishments.
5. The Review Committee notes that the ITS has recently established a broad-based “SB 1 Board of Advisors” and that it has started to implement a collaborative framework for the ITS branches. Matters related to the functioning of the ITS MRU with respect to the SB 1 and PTA funds are formalized in a Memorandum of Understanding between UCOP and the four ITS branches.

The Review Committee presents the following recommendations:

1. The Review Committee recommends that the ITS follow the best practices guidance provided by UCOP’s Office of Research and Graduate Studies and write a set of bylaws and procedures to govern its formal operations. These could better formalize the roles and responsibilities of the SB 1 Board of Advisors, the mechanisms for the accounting and reporting of the use of State PTA and SB 1 funds to UCOP, the role of the Assistant Director, and the mechanism(s) for coordination and communication with UCOP over matters related to interactions with the State government. The bylaws and procedures would also provide for a formal process for the potential inclusion of additional UC campuses into the ITS. The Review Committee also recommends that the ITS consider whether its governance structure, particularly the one-year term of its Chair of the Council of Directors, is optimal.

The Review Committee recognizes that the ITS branches function in two separate ways: first, as independent institutes (in some cases as Organized Research Units) with separate programs and second, as a framework for collaborative efforts across the campuses. Both of these have value, and flexibility is also a significant asset in responding to research and funding opportunities. The program, practices, and capabilities of ITS, regarded not just as four individual branches, but as a true multi-campus research unit with a joint mission and a coherent, collaborative program, are still a work in progress.

2. The Review Committee recommends that the ITS, in consultation with the SB 1 Board of Advisors, carefully formulate a strategy and associated processes, such as workshops, to develop new initiatives to be pursued as collaborative efforts

across the ITS branches. The Review Committee commends the ITS for its progress in this direction but believes that stronger planning processes could enable the ITS to address larger scale problems in a coherent way. This recommendation echoes a similar point made in 2014 by the Portfolio Review Group.

While the four ITS branches have strong transportation research programs, other UC campuses also have significant efforts in the field.

3. The Review Committee recommends that the ITS, in consultation with the SB 1 Board of Advisors, make a renewed and carefully planned effort to engage and support transportation researchers from other non-ITS UC campuses and to provide additional support to them from SB 1 funds. We believe that such an effort is particularly important given the recent increase in State funding allocated to the University of California for transportation research, together with the fact that ITS will have its own representative in Sacramento, a unique situation within the UC transportation research programs that requires particular care and responsibility.

The Review Committee notes the recent appointment of an ITS Assistant Director, who will serve as a statewide coordinator based in Sacramento. Overall, the Review Committee sees this position as a significant development that has a potential for improved communications with State agencies. However, the Review Committee has serious concerns that this communication path could also create problems if there is not careful coordination with UCOP.

4. The Review Committee recommends that the ITS Assistant Director coordinate strongly and regularly with UC's Office of State Governmental Relations and that the Assistant Director should ultimately report to UCOP. A written plan prepared jointly by ITS and UCOP for how this position will function would be highly advisable. The Review Committee recommends that ITS also use the Assistant Director position to strengthen collaborative efforts across UC campuses.
5. The Review Committee recommends that UCOP give careful consideration to the request for office space in Sacramento for the ITS Assistant Director and staff.

The Review Committee is concerned that UCOP does not have adequate information to assess ITS budget expenditures related to PTA and SB 1 funding. The ITS was not able to provide the Review Committee with a clear and consistent statement documenting these expenditures.

6. The Review Committee recommends that the annual reports submitted to the University of California Office of the President focus primarily on MRU-specific aspects of the ITS program. In particular, we recommend that the budget information in these reports focus on providing assurance that expenditures and research progress associated with State funds from the Public Transportation (PTA) account and Senate Bill 1 (SB 1) are carefully monitored and documented. To do this, the ITS will need to implement a systematized and consistent set of accounting practices and principles across the ITS branches for these funds.

The Review Committee could not find any clear programmatic justification for the formulas used to define funding allocations to the ITS branches or to the non-ITS UC campuses as specified in the ITS MOU. It is not clear how these allocations relate to ITS commitments to the State to perform various research studies.

7. The Review Committee recommends that UCOP request an annual written statement from the SB 1 Advisory Board, distinct from the ITS MRU annual report, providing a detailed assessment of (a) how the PTA and SB 1 funds are being used and (b) whether the progress made over the past year and the deliverables provided by the ITS meet the expectations of State agencies.

The ITS leadership has noted that there have been delays in the transmission of State funds from UCOP to the ITS campuses, which vary significantly by campus. These delays can impact the ability of ITS to support graduate students.

8. The Review Committee recommends that UCOP work with ITS to expedite the transmission of State funds to the ITS branches.

The Review Committee observes that the web pages of the individual branches do not make reference to other ITS branches, except possibly in temporary ways associated with news items.

9. The Review Committee recommends that the ITS branches collaborate to create a strong overall identity for the MRU. As examples, we recommend that the ITS branches update their web pages to include permanent links to the web pages of other ITS branches. The Review Committee also notes inconsistency in the name used for the ITS in the ITS review documentation, in the name used in the MOU associated with the ITS/UCOP agreement, and in the two different names on the UCOP web page. The differences are small, but The Review Committee advises the use of consistent naming for the MRU.
10. The Review Committee recommends that the ITS maintain a common web page that would contain links to the individual branch web sites and that would provide a common portal and overview of ITS program for use by State agencies and the public.
11. The Review Committee recommends that progress in implementing the recommendations be reported in the MRU annual report to be submitted by the ITS to UCOP in 2019.

The main questions to be addressed by the review are specified in *The Compendium: Universitywide Review Processes for Academic Programs, Academic Units, and Research Units*. According to *The Compendium*, the report should “provide an objective and balanced critical evaluation of the MRU to be reviewed and answer two key questions.

1. Does the unit provide a unique service to UC in research, support of graduate education, and public service that would otherwise not be provided in its absence?
2. Should the MRU be continued for another five years?”

The Review Committee believes that the ITS MRU has the potential to provide unique services to UC, in the areas specified in the first question, that are far above and beyond the contributions from the individual ITS branches. The Review Committee believes that the ITS MRU is a work in progress, with encouraging signs for the future. Thus, our answer to the first question listed above is a qualified yes, with recommendations for improvements as presented in this section. The Review Committee further recommends that the ITS MRU be continued for another five years and expects that this period will be one of great achievement and progress.