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MTI **MINETA TRANSPORTATION INSTITUTE**

L&D On-ramps and Off-ramps for the Mobility Workforce: A Blueprint for Knowledge Ecosystem Formation in the Fourth Industrial Revolution

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CSUTC **California State University Transportation Consortium**

CALIFORNIA STATE UNIVERSITY **LONG BEACH**

MINETA TRANSPORTATION INSTITUTE

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November 2024

TECHNICAL REPORT
DOCUMENTATION PAGE

1. Report No. 24-36	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle L&D On-ramps and Off-ramps for the Mobility Workforce: A Blueprint for Knowledge Ecosystem Formation in the Fourth Industrial Revolution		**5. Report Date** November 2024
		6. Performing Organization Code
7. Authors Tyler Reeb: ORCID: https://orcid.org/0000-0002-8056-9939 Barbara Taylor: ORCID: https://orcid.org/0000-0003-1635-6194 James Reuter: ORCID: https://orcid.org/0009-0004-8761-6111		**8. Performing Organization Report** CA-MTI-2333
9. Performing Organization Name and Address Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219		**10. Work Unit No.**
		11. Contract or Grant No. ZSB12017-SJAUX
12. Sponsoring Agency Name and Address State of California SB1 2017/2018 Trustees of the California State University Sponsored Programs Administration 401 Golden Shore, 5th Floor Long Beach, CA 90802		**13. Type of Report and Period Covered**
		14. Sponsoring Agency Code

16. Abstract

After a yearlong consensus study, this report presents a blueprint with implementation tools and strategies for CSULB and other CSU campuses to adopt a knowledge ecosystem model in higher education. By conducting talent pipeline pilots for internship preparation activities and related survey and focus group research, the research team found near universal support for pursuing university-industry partnerships. Faculty identified extracurricular activities, experiential learning opportunities, and guidance on further education as their top three priorities when mentoring students in professional development. There was, however, a paradoxical perception among faculty about what universities provide in terms of knowledge, skills, and abilities (KSAs) and what industry values in new employees. This paradox begs the solution of having university faculty and administrators collaborate with industry professionals in the planning and delivery of professional development activities for students. The California State University system has ready homes for such "third space" activities in their colleges of professional and continuing education (PaCE units) and in their centers and institutes.

| **17. Key Words**
Education and training,
Information technology,
Data science,
Human resources management,
Information,
Data,
Knowledge | **18. Distribution Statement**
No restrictions. This document is available to the public through The National Technical Information Service, Springfield, VA 22161. | |
| **19. Security Classif. (of this report)**
Unclassified | **20. Security Classif. (of this page)**
Unclassified | **21. No. of Pages**
124 | **22. Price** |

Form DOT F 1700.7 (8-72)

ACKNOWLEDGMENTS

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Executive Summary

After a yearlong consensus study, this report presents a blueprint with implementation tools and strategies for California State University, Long Beach (CSULB) and other CSU campuses to adopt a knowledge ecosystem model in higher education. By conducting talent pipeline pilots for internship preparation activities and related survey and focus group research, we can offer this assessment of levels of support for university-industry partnerships at CSULB. These partnerships create a "third space" between education and career where collaboration, innovation, and learning address critical challenges facing the California trade and transportation sector and other workforces experiencing the high-velocity changes driven by the Fourth Industrial Revolution (4IR).

The study found near universal support for pursuing university-industry partnerships with 97% of CSULB faculty and staff and external stakeholders supporting the concept. Faculty identified extracurricular activities, experiential learning opportunities, and guidance on further education as their top three priorities when mentoring students in professional development. Despite strong consensus on what topics and approaches are most appropriate for professional development at CSULB, respondents were less sure about the impact of current professional development activities, with 53% of respondents agreeing that students graduating from their department are well-prepared for research or research-oriented careers. Nonetheless, only 21% believe that the knowledge and skills attained or developed by students in their department were adequately appreciated and recognized by industry professionals. Thus, the study identified a paradoxical perception among faculty about what universities provide in terms of knowledge, skills, and abilities (KSAs) and what industry values in new employees. Resolving this paradox requires having university faculty and administrators collaborate with industry professionals in the planning and delivery of professional development activities for students.

The study's talent pipeline pilots were university-industry collaborations on KSA training. A course-based pilot for intelligent transportation systems (ITS) was a collaboration between CSULB's Center for International Trade and Transportation and Gannett Fleming, a global engineering firm. A workshop-based pilot for data science was a collaboration between CSULB's College of Natural Sciences and Mathematics and NASA's Jet Propulsion Laboratory (JPL). Both pilots served as proof-of-concept, as both were well-received by the industry participants who found the programs effective and asserted a desire to replicate talent pipeline activities in the future. For their part, Gannett Fleming plans to implement a pre-internship workshop akin to the one led by JPL. The teams at JPL and Gannett Fleming both found success with internship recipients. Gannett Fleming, however, experienced a lag in productivity despite the talent pipeline's onboarding activities, which resulted from interns not having sufficient familiarity with basic computer programs (e.g., Outlook and the Microsoft Office suite). Thus, the research team recognized an oversight in their provision of basic KSAs. It is worth noting that the talent pipeline

format's bidirectionality and close coordination allows both industry and university partners to quickly implement improvements to future iterations of the pipeline.

By means of surveys, discussions, and piloting of internship preparation activities, the study confirms the high value of building learning and workforce development partnerships that engage community, business, and governmental stakeholders. Challenges and differences in opinion emerge when the discussion shifts to the implementation of new programs that break down college silos and open the university to external stakeholders in new ways. We believe the California State University system has ready homes for such "third space" activities in their colleges of professional and continuing education (PaCE units) and in the centers and institutes within their offices of research and sponsored programs. These units grant industry, government, and non-profits access to the university's research and development resources, in turn allowing the university access to the workplace for its educational activities. Given the nimbleness of PaCE units relative to the academic core of most post-secondary institutions, pipelines provide vehicles for rapid response to critical KSAs needed by emerging, incumbent, and displaced workers. Talent pipelines can take many forms: from workshops or bootcamps to more traditional apprenticeship or internship programs run in parallel to, or embedded in, more traditional undergraduate and graduate degree programs. Additionally, PaCE units can support modular, stackable program offerings (digital badges, micro-credentials, certificates, etc.) that create additional skill development pathways with flexible on and offramps for learners as they navigate the job market or as employers implement training for KSA needs that change over time.

This study confirms the feasibility of university-industry collaborations that create the "third space" needed for workforce-informed, multi-tiered curricula to foster professional and workforce development. The study focuses on the transportation and mobility industry with talent pipeline pilots in intelligent transportation systems and data science, an area of research and a research tool respectively, that reflect the technological advances of the 4IR. The study is not, however, limited to any one labor sector; talent pipelines, the concept of "third space," and the aptness of CSU PaCE units, centers, and institutes to serve these two elements can be generalized to virtually any employment sector.

1. Introduction

When *Inside Higher Ed* released its special report, "On-Ramps and Off-Ramps: Alternative Credentials and Emerging Pathways Between Education and Work" in 2018, the Fourth Industrial Revolution (4IR) was still a nascent concept. The report documented how "a growing number of colleges are partnering with employers—or brokers who make those connections—and noncollege education providers to offer alternative credential pathways." Six years later, after a global pandemic, a recession, and the emergence of a wide range of transformational technologies and related skills gaps, leaders in higher education circles are more amenable to forging partnerships with industry and other outside stakeholders to deliver learning and development (L&D) opportunities for emerging, incumbent, and displaced professionals. That sentiment was validated in a recent survey taken by more than 100 faculty, staff, and campus stakeholders at California State University, Long Beach (CSULB), with 97% of respondents "supporting industry-facing university infrastructure and systems" to address education and training demands. The enclosed report will provide an assessment of support at CSULB for innovative partnerships with industry to address 4IR challenges. After documenting the areas of consensus and discrepancies related to such partnerships, the report will present a blueprint with recommendations and implementation tools for CSULB and other campuses in the CSU system to build knowledge ecosystems.

This project built upon findings from the SB1-funded report, "Trade and Transportation Talent Pipeline Blueprints: Building University-Industry Talent Pipelines in Colleges of Continuing and Professional Education,"[1] by engaging stakeholders through surveys and focus groups in consideration of the University's role in workforce development and career training. It also documents and evaluates the implementation of an Intelligent Transportation Systems (ITS) Engineering Talent Pipeline at CSULB recommended by Reeb and Park (2023)[1]—with pipeline-specific curriculum in the spring semester followed by three internship opportunities at Gannett-Fleming, a global engineering firm. A second talent pipeline pilot involved the NASA Jet Propulsion Laboratory (JPL), a global leader in space exploration and satellite technology that also took place in Spring and Summer of 2023—with a two-day data science workshop led by JPL employees followed by up to 10 summer internships at JPL. By conducting these pilots, one course-based and one workshop-based, and related survey and focus group research, we can offer this assessment of levels of support for university-industry partnerships at CSULB. These partnerships foster knowledge ecosystems where collaboration, innovation, and learning address critical challenges facing the California trade and transportation sector and other workforces experiencing the high-velocity changes driven by the 4IR.

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[1] Tyler D. Reeb and Stacey Park, "Trade and Transportation Talent Pipeline Blueprints: Building University-Industry Talent Pipelines in Colleges of Continuing and Professional Education" (San José, CA: Mineta Transportation Institute, February 2023), https://transweb.sjsu.edu/sites/default/files/2144-Reeb-Trade-Transportation-Talent-Pipeline-Blueprints_0.pdf.

The 4IR is an ongoing transformation of our society and economy by advancements in technology—particularly additive manufacturing, artificial intelligence, biotechnology, the Internet of Things (IoT), quantum computing, and robotics. It builds upon the digital revolution of the 20th century but is distinct in that the digital tools we use to work, play, and interact have moved from steadily evolving to iterative design. The societal changes of the 4IR are comprehensive and profound, but even more striking is the velocity at which they occur. That velocity has compromised our methods of education and workforce training. Current methods inevitably lag behind in providing graduates and frontline professionals with the knowledge, skills, and abilities (KSAs) required for success in fast-changing workplaces.[2]

Simply put, the 4IR is taking us into an era where education, training, work, reskilling, and upskilling are synchronous events in an ecosystem of knowledge. In the new paradigm of higher education, the reciprocal value of student internships and university-community relationships can be dramatically optimized by specific and intentional university-industry partnerships that create a knowledge ecosystem in which needs, goals, and approaches are mutually planned. The authors of this report propose the development of knowledge ecosystems that learners of all ages can access through learning and development (L&D) onramps and offramps (Fig. 1).

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[2] *Regarding the Fourth Industrial Revolution in general, see:* Klaus Schwab, "The Fourth Industrial Revolution: What It Means and How to Respond," *World Economic Forum*, January 14, 2016, https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/; Klaus Schwab, *The Fourth Industrial Revolution* (New York: Crown, 2017). *For specific discussions of the impact of the Fourth Industrial Revolution on education specifically, see:* Bryan Edward Penprase, "Chapter 9: The Fourth Industrial Revolution and Higher Education," in *The Fourth Industrial Revolution and Higher Education*, ed. N.W. Gleason (Singapore: Palgrave Macmillan, 2018), 207–28, https://doi.org/10.1007/978-981-13-0194-0_9; Sanni Yaya, "Harnessing the Full Potential of the Fourth Industrial Revolution in Higher Ed," *University Affairs*, June 13, 2023, https://www.universityaffairs.ca/opinion/from-the-admin-chair/harnessing-the-full-potential-of-the-fourth-industrial-revolution-in-higher-ed/.

Figure 1. The Knowledge Ecosystem

Potential paths for individuals in education, training, and work. Adapted from Syracuse University Professional Studies.

L&D on-ramps and off-ramps are metaphors respectively signifying individuals' entry points for accessing resources tailored to specific in-demand KSAs and exit points connecting them to meaningful career opportunities. On-ramps may include access to various learning resources such as courses, training modules, workshops, webinars, and educational materials. They may also offer features such as tracking progress, personalized learning paths, and assessment tools for enhancing the learning experience. Overall, L&D on-ramps play a vital role in promoting life-long learning, skill-building, and professional growth for individuals affiliated with an organization or educational institution. They are entry points into a new knowledge ecosystem—a concept that is reshaping higher education in the 21st century.

2. Methodology and Results

2.1 Stakeholder Survey

A 14-question survey (Appendix A) was completed by 100 CSULB faculty, staff, and external stakeholders who received first- or second-hand invitations by email. The questions were designed to gather insights that can guide the design and piloting of a reciprocal exchange of assets between CSULB and industry partners with the aim of ultimately empowering students and faculty. Survey responses demonstrated near universal support for pursuing university-industry partnerships, with 97% supporting or strongly supporting the concept (Fig. 2A). Notably, this widespread support reflected a diverse set of viewpoints from within the university. The majority of respondents (90%) were faculty, staff, and administrators from all colleges and the library at CSULB (only 10% of respondents were from outside the university) (Fig. 2B). Time spent at CSULB ranged from less than a year to more than 20 years, and the time respondents had spent in their current role also varied, with 52% having been in their current role for 1–10 years and 32% in their current role for more than 15 years (Fig. 2C).

Figure 2. Key Results from Stakeholder Survey

| A | B | C |
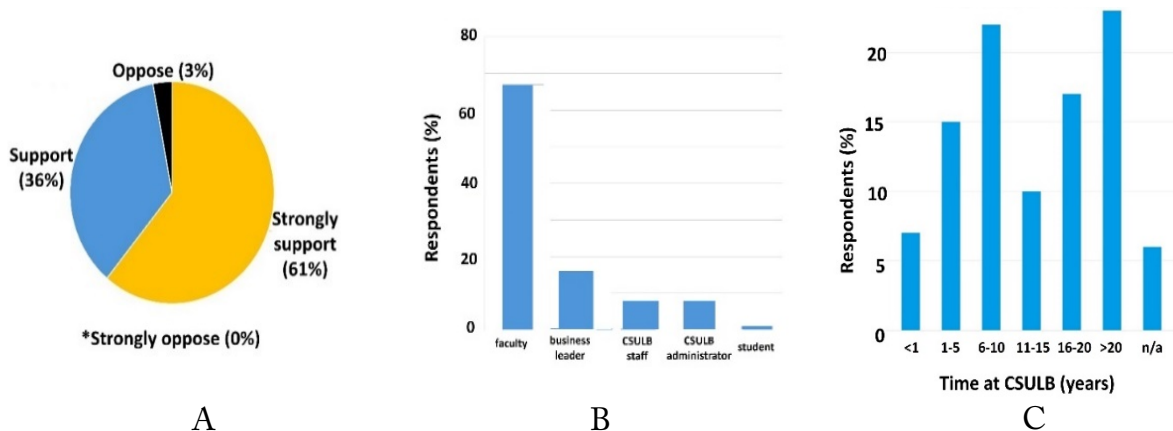
(A) Respondent opinions of university-industry partnerships. (B) The majority of respondents were CSULB faculty; business leaders, CSULB staff and administrators were also well represented. (C) The majority of respondents had been at CSULB for ten or more years.

Stakeholders were asked to identify their own areas of interest and those for which they believed CSULB could make significant contributions to student career development through partnerships with industry. The possible selections did not reflect academic disciplines; they were broad categories or reflected the topics of the two talent pipeline pilots documented in this study. Anticipating a bias toward one's own interests, we parsed the data based on the respondents' reported personal interests. On average, 48% of respondents selected their areas of interest as ones

where CSULB can offer experiential learning and career development activities, and 40% selected topics other than their areas of interest. This suggests that respondents were not unduly influenced by their own interests. Also, 12% of respondents believe their area of interest is not an area for learning and development activities at CSULB. The topics selected most often as an area where CSULB can offer experiential learning and professional development activities, regardless of the respondents' personal interest, were *first principles engineering* (100%) followed by *community health and wellness* (93%), and *transportation and mobility* (90%).

Stakeholders were asked to identify their top three priorities when mentoring students in professional development. Table 1 shows that there was consensus (about 60%) among respondents that the top three priorities are: *over-and-above academic activities/opportunities; promoting experiential learning opportunities;* and *providing guidance concerning further education.*

Table 1. Mentoring Priorities for Professional Development of Faculty Respondents to Stakeholder Survey

%	Mentoring activities
62	Over-and-above academic activities/opportunities (conferences, research assistantships, etc.,)
57	Promoting experiential learning opportunities (such as internships)
57	Providing guidance concerning further education (graduate school, certifications)
44	Providing professional contact information (i.e., contacts with relevant industry professionals, informal meetings with likeminded career professionals, etc.)
37	Formal professionalization (resume, interview coaching etc.)

Figure 3. Responses about Multidisciplinarity of Talent-pipeline Pilots
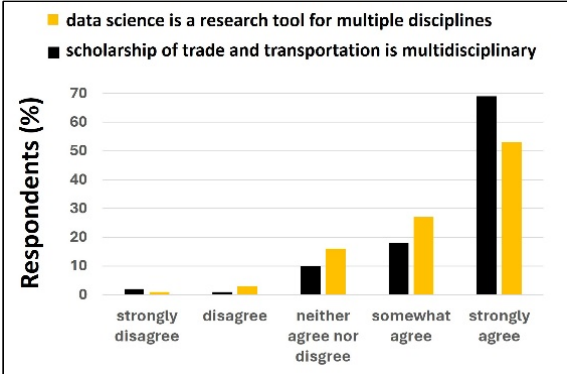
Figure 4. Faculty Opinions Related to Career-Readiness of Students Graduating
from their Department
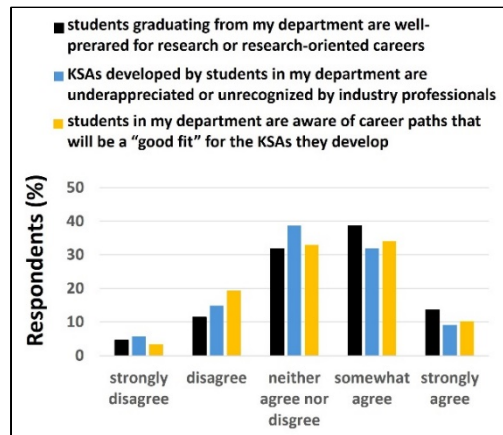
Additionally, 69% of respondents said current open-opportunity, professional guidance events and activities are beneficial for students, and 73% said talent pipeline activities should be open to any student regardless of degree path. The latter opinion reflects the view that multidisciplinary approaches yield the best solutions to challenges in industry and government. Respondents also saw a strong theme of multi-disciplinarity in the talent pipeline pilots documented in this study. Despite strong consensus on what topics and approaches are most appropriate for professional development at CSULB, respondents were less sure about the impact of current professional development activities at the university (Fig. 3) with 53% of respondents agreeing (somewhat or strongly) that students graduating from their department are well-prepared for research or research-oriented careers. While 52% of respondents believe that their students are well-prepared for research or research-oriented careers, only 21% believe that the knowledge and skills attained or developed by students in their department are adequately appreciated and recognized by industry professionals. The majority of faculty believed their students are well prepared for the workforce, but that same majority believes that industry does not share that view (Fig. 4). 41% of respondents agree somewhat or strongly that the knowledge and skills students develop at CSULB are underappreciated or unrecognized. Only 44% of respondents agree (somewhat or strongly) that students in their department are aware of career paths that will be a good fit for KSAs they develop—33% neither agree nor disagree. These survey findings suggest that the majority of personnel believe CSULB students need exposure to experiential learning (research and/or internships) in order to be fully aware of career paths that fit their KSAs. Respondents were also unsure about whether or not CSULB is prepared for demographic changes in the composition of the student body, with a slim majority (38%) believing this to be the case (though 35% of respondents expressed neutrality).

- **Interdisciplinary Collaboration:** Many respondents highlighted the need for stronger interdisciplinary efforts, suggesting that collaboration across different departments and sectors could lead to more comprehensive and effective industry partnerships. Some university departments and sectors often do not perceive that they are valued by or seen as relevant by other departments/sectors in the university, and some faculty members even expressed that they feel completely invisible. The need for a unified, interdisciplinary effort is recognized, but the steps to getting there are not so clear. As one respondent noted, "we all do partnerships individually as we don't know of any other options."

- **Communication and Transparency:** Effective communication within the university and with industry partners was frequently mentioned as crucial for the success of these initiatives. Respondents suggested creating platforms or systems to facilitate better information sharing and coordination. It was also emphasized that communication and transparency are crucial to achieving legitimate university-wide inclusivity. As one respondent remarked, "Bring in different colleges and departments from the start, not as an afterthought or in a tokenized role."

- **Alignment with Industry Needs:** There was a clear emphasis on aligning university efforts with industry's current and future requirements, ensuring that students gain relevant skills and experiences that are valued in the workforce. At the same time, there is a need to balance this with the needs, expectations, and values of a university. As one respondent noted, "While I am very supportive of increased industry engagement, my experience to date is that it often distorts education. […] Industry tends to focus on the needs of the moment from a 21-year-old student. Students are students first, and it is the responsibility of faculty to ensure that they learn not only what they need in the moment but what they need to grow professionally across their careers and as humans across their lives."

- **Incentivizing Participation:** Some responses pointed to the need for incentives, both for students to engage in experiential learning opportunities and for departments to collaborate and share resources. Relatedly, responses noted that bureaucratic or administrative steps can prove to be a hurdle for industry, with one respondent specifically calling for the streamlining of contracting and procurement processes, especially if a university-industry partnership system is to include smaller actors such as small start-ups.

- **Recognition and Support:** Acknowledging and supporting the efforts of faculty and departments involved in these initiatives was seen as important, with suggestions for recognition systems or support structures to facilitate these partnerships. Multiple faculty members who had embarked on establishing university-industry partnerships within their own departments expressed frustration with a perceived lack of recognition or support from the university-at-large. Recognition and support must be substantive. Significantly, some

attention must be paid to the Retention, Tenure, and Promotion (RTP) process. If a university-industry partnership is to involve faculty—and include *all* faculty members—then there must be a way that such involvement benefits the progress of a faculty member's career. "Offer some infrastructure support that will bring value to individual departments out of the gate, that will encourage and support them to devote the time and energy to the enterprise of forging new relationships with other departments, colleges, and professional industry and reimagine how those relationships best serve our students and mission of the university towards Beach 2030," wrote one faculty member.

2.2 Talent Pipeline Pilots

The two case studies documented in this report concerned the preparation of a cohort of students for two separate pilot pipelines: the first, an ITS cohort preparation for Gannett Fleming and the second, a data science workshop in preparation for an internship with JPL. Students who applied for participation in either pilot hoped to familiarize themselves with the KSAs required for an internship at Gannett Fleming or JPL. These case studies targeted just 25 students for JPL and 3 for Gannett Fleming, and students were made aware that no more than 10% of participants would ultimately receive a paid internship. Flyers (Appendix B) were posted and shared.

While the small size of the cohorts raises questions about the scalability of the talent pipeline pilots, it must be considered that cohort size is dependent on the available number of internships. There is often a limit to the number of internships a single industry participant can offer. To increase the opportunities for student participants, there must be an increased solicitation of industry participants: "Workforce demands will drive industry participation in talent pipelines, but institutions that develop such programs will undoubtedly implement recruiting initiatives—especially as the number of programs increases and competition between programs grows."[3]

Both pilots served as proof-of-concept, as both were well-received by industry participants. The research team maintained close contact with representatives from Gannett Fleming and JPL; both groups found the pilots to be effective and asserted a desire to replicate talent pipeline activities in the future. For their part, Gannett Fleming plans to implement a pre-internship workshop akin to the one led by JPL. The teams at JPL and Gannett Fleming both found success with internship recipients. JPL workshop participants had been provided with sufficient preparation to transition easily into project work in the Earth Science Section of JPL's Science Division. Gannett Fleming, for their part, experienced a lag in productivity despite the talent pipeline's onboarding activities, which resulted from interns not having sufficient familiarity with basic computer programs (e.g., Outlook and the Microsoft Office suite). Thus, the research team recognized an oversight in their

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[3] Tyler Reeb, Barbara Taylor, and Chris Swarat, "Talent Pipelines for the Fourth Industrial Revolution: How California PaCE Units Can Bridge Critical KSA Gaps," *Berkeley Center for Studies in Higer Education Research & Occasional Papers Series* CSHE.SI.2023 (2024).

provision of basic KSAs. It is worth noting that the talent pipeline format's bidirectionality and close coordination allow both industry and university partners to quickly implement improvements to future iterations of the pipeline. For Gannett Fleming, future iterations of the pipeline will accommodate mini-workshops introducing Outlook and Office, so students are better prepared to enter the workforce.

2.2.1 ITS Cohort Preparation for Gannett Fleming

Gannett Fleming, a leading architectural, engineering, and systems design consulting firm with considerable expertise in intelligent transport systems (ITS) and transportation infrastructure projects across the nation, employs a robust team of over 2,800 professionals dispersed across 50+ offices throughout North America. Gannett Fleming has a well-established internship program and expressed interest in participating with researchers at the Center for International Trade and Transportation (CITT).

The inception of the ITS talent pipeline stemmed from a proposal within a Mineta Transportation Institute report, serving as a "proof-of-concept" for such initiatives. Gannett Fleming's endorsement of this pipeline was solidified during a launch meeting held in November 2022 at CSULB with the backing of the College of Professional and Continuing Education (CPaCE) and leadership provided by CITT. During this meeting, Gannett Fleming's leadership affirmed its official support and agreed to offer paid summer internships to CSULB students who successfully completed the initial segment of the talent pipeline program. The firm is committed to closely collaborating with CITT to synchronize talent pipeline activities during the summer internship phase. To ensure effective program implementation, CSULB and Gannett Fleming adhered to the five conditions of collective impact outlined by the Stanford Social Innovation Review. These conditions include establishing a common agenda, utilizing shared measurement mechanisms, fostering mutually reinforcing activities, maintaining continuous communication, and providing backbone support (Table 6, Appendix B). These commitments underscored the company's dedication and investment in the success of the talent pipeline initiative, highlighting that genuine engagement and involvement is a fundamental prerequisite for its efficacy.[4]

The teams from CSULB and Gannett Fleming collaborated with participants in the pipeline to create videos showcasing significant milestones achieved in KSAs. During the university-led phase of the pipeline, members of the pilot cohort produced summary videos highlighting their

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[4] Jason A. Tyszko and Robert G. Sheets, "Building the Talent Pipeline: An Implementation Guide," Talent Pipeline Management (Washington, D.C.: U.S. Chamber of Commerce Foundation, November 11, 2015), https://www.uschamberfoundation.org/reports/building-talent-pipeline-implementation-guide. *See specifically the section "Strategy 1: Organize Employer Collaboratives" (pp. 6–12).*
See also: Jason A. Tyszko, Robert G. Sheets, and Joseph Fuller, "Managing the Talent Pipeline: A New Approach to Closing the Skills Gap" (Washington, DC: U.S. Chamber of Commerce Foundation, 2014), U.S. Chamber of Commerce Foundation TPM Resources, https://www.uschamberfoundation.org/sites/default/files/media-uploads/Managing%20the%20Talent%20Pipeline_0.pdf.

onboarding, presentation prowess, grasp of multidisciplinary teamwork, project management acumen, and familiarity with ITS technologies. Appendix C provides the ITS pilot curriculum and evaluations. At the conclusion of the summer opportunity, interns recorded videos demonstrating their capacity to deliver project briefings to teams.

Through a combination of labor market analysis and input from industry stakeholders, learning objectives for the ITS cohort were identified. These objectives emphasized the development of a general understanding of ITS concepts, engagement with subject matter experts, prioritization of industry-relevant KSAs, and exploration of scalability measures for talent pipeline initiatives:[5]

Gannett Fleming ultimately selected two of the three initial members of the ITS pilot to serve as paid summer interns: "a civil engineering major with a focus on transportation" and "an economics major who made a strong case to be considered for the pipeline despite its engineering focus".[6] The engineering student met the expected learning objectives. Additionally, a computer science graduate student completed the ITS pilot as a paid research assistant on a federally-funded ITS project, serving on a real-world ITS community test-bed project funded by Caltrans and the U.S. Department of Transportation.

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[5] Analyzing the labor market for transformational fields requires a blend of historical labor market analysis from U.S. Bureau of Labor Statistics data (largely derived from census and community survey data) and real-time data. Historical data in some cases does not capture critical occupations and new KSA gaps, but it does provide a way of understanding where the labor market is going. Real-time analysis, using tools like *LightCast*, make it possible to study current job descriptions posted by employers. This real-time snapshot has limitations, too, but provides an alternative perspective to assess changing workforce development challenges.

[6] Tyler Reeb, Barbara Taylor, and Chris Swarat, "Talent Pipelines for the Fourth Industrial Revolution: How California PaCE Units Can Bridge Critical KSA Gaps," *Berkeley Center for Studies in Higer Education Research & Occasional Papers Series* CSHE.SI.2023 (2024).

Table 2. Findings from the ITS talent pipeline partnership with Gannett-Fleming

Recommended Practices	Possible Barriers
To ensure equitable accessibility to participation, the ITS Talent Pipeline was held at CITT on CSULB campus (online and in person). Members of the ITS Cohort were paid $15.50/h for 16–20 h/week.	Paying students will present a problem at institutions that don't allow student stipends or participant incentives for workshop participation. Hiring students through our Research Foundation was a cumbersome way to compensate students for participation.
Use multiple modes of communication to promote the recruitment for cohort members and be sure that social media is one of those modes. Also encourage reposting on social media, especially across platforms.	Inviting employees of outside entities/businesses on campus to interact with students requires Risk Management approval of the workshop leaders and their insurance.
Provide access to a broad range of ITS curriculum and case studies: • Adaptive Signal Control • Data Driven Decisions • Intro to ITS • Automated Bus Rapid Transit • Planning [maybe worth mentioning that this had a smart city data privacy case study) • Travel Time Performance Measures • Changeable Message Signs • Concept of Operations • ITS and Safety Applications • ARC IT	Narrowly defined university policies on internships could impede implementation especially when the university requires a contract with the internship host.

2.2.2 Data Science Workshop for Jet Propulsion Laboratory

JPL is a federally funded research and development center in Pasadena, California, operating as a partnership between the National Aeronautics and Space Administration (NASA) and the California Institute of Technology. The laboratory's core activities include the construction and operation of planetary robotic spacecraft, the execution of Earth-orbit and astronomy missions, and the management of the NASA Deep Space Network. JPL maintains a longstanding internship program.[7]

Following the initiation of the ITS pilot, Earth Science researchers from CSULB and JPL reached out to the authors proposing the implementation of a data science talent pipeline pilot in the spring

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[7] "Student Programs," Federally Funded Research and Development Center funded by NASA and managed by Caltech, Jet Propulsion Laboratory, 2023, https://www.jpl.jobs/students-and-postdocs.

2023. Due to the tight timeframe, a workshop model was adopted. The motivation behind the JPL-CSULB pilot stemmed from a desire to enhance the diversity of JPL internship cohorts by attracting students from backgrounds typically underrepresented in the STEM workforce. CSULB, with 51% of its students hailing from traditionally minoritized racial/ethnic groups, of whom 71% are non-Caucasian, and more than half are eligible for Pell Grants (39%) and/or are first-generation college students (31%), is an ideal partner for this objective.[8]

The data science workshop provided 10 hours of interactive data science training (over a Friday and Saturday in April) held at CSULB but designed and led by JPL researchers. JPL created an online portal for participants to access various data sets of satellite-generated information and a computer sandbox where participants carried out data science activities. The collective pilot team agreed upon the following learning objectives for the workshop:[9]

- a general understanding of satellite-enabled data science and its foundational concepts associated with climate change and sea-level rise;

- linking CSULB to JPL subject matter experts; and

- prioritizing data science KSAs (e.g., coding, statistical analyses, and related ecological knowledge).

The workshop comprised alternating sessions of (1) explanations of sea-level rise and loss of sea ice and (2) data manipulations. In total, 25 CSULB undergraduate and graduate students completed the workshop. Of the participants, two were employed by JPL as 2023 paid summer interns, and five have internship placement for the 2023–24 academic year.

2.2.3 Assessment of Talent Pipeline Pilot Programs

The impact of the CSULB pilots was assessed by surveys completed by workshop participants. Students who participated in the data science workshop for JPL completed pre- and post-participation surveys (see Appendices D and E). To explore broader talent pipeline themes, employees from Gannett Fleming, JPL, and CSULB as well as community advisors for CSULB programs, were invited to complete a stakeholder survey.

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[8] CSULB Institutional Research and Assessment results of fall 2023 census.
[9] Analyzing the labor market for transformational fields requires a blend of historical labor market analysis from U.S. Bureau of Labor Statistics data (largely derived from census and community survey data) and real-time data. Historical data in some cases does not capture critical occupations and new KSA gaps, but it does provide a way of understanding where the labor market is going. Real-time analysis, using tools like *LightCast*, make it possible to study current job descriptions posted by employers. This real-time snapshot has limitations, too, but provides an alternative perspective to assess changing workforce development challenges.

Twenty-nine prospective candidates completed JPL's Data Science Workshop pre-participation survey. Top motivators for student participation were participation in data science and career exploration and preparation. 37% of students enrolled because a faculty member sent them the flyer and encouraged them, 16% enrolled after seeing the flyer posted at CSULB, and 47% enrolled after being encouraged by peers and/or seeing the flyer reposted on various social media platforms (e.g., Discord, Instagram).

Some prospective participants were motivated by a specific interest in data science or a related field, viewing the workshop as an opportunity to gain hands-on experience, enhance their resume, or explore career paths in STEM. Others were drawn by the association with JPL, expressing a desire to learn more about opportunities or applications of their studies in the aerospace industry. All respondents expected to develop KSAs related to data science, with 66% referring to data science in general and 34% identifying specific data science tools and techniques they expected to learn. Additionally, 26% of respondents reported expectations to gain KSAs in networking, teamwork, problem solving, and critical thinking.

Students' definitions of data science included emphasis on programming, data collection, math and statistics, and the application of advanced analytics and machine learning to uncover insights. Common uses for satellite data mentioned by respondents covered environmental monitoring, weather prediction, tracking space objects, and more, showing a basic understanding of its applications. Responses varied in how JPL might use satellite data, with examples including environmental tracking and asteroid monitoring. The benefits and moral concerns of data science research were addressed, with respondents noting the potential for advancements in standards of living and expressing concerns about privacy and ethical implications.

Twenty-five students completed the JPL Data Science Workshop post-participation survey. With respect to KSAs acquired, 52% of workshop participants reported gaining data science KSAs, 30% reported gaining other career-related KSAs, and 18% reported gaining both types of KSAs. 98% of respondents had prior experience with career-development or internship-related workshops, and that group of respondents said the talent pipeline workshop was better than their previous experiences.

Participants appreciated the hands-on and active career guidance opportunities provided by the workshop (Figure 5). One participant mentioned, "This opportunity was more of [a hands-on learning experience] which is really helpful." Students also found the small-group format of the workshops approachable and less intimidating than other career guidance opportunities, with one student describing it as "very personal and welcoming, as opposed to some booths at a job fair" and another claiming that the "JPL reps seemed genuinely interested in all you had to say and wanted to make sure to provide the most help as possible." The workshop's relevance to their academic pursuits was highlighted, with comments such as "I feel that this workshop was very useful for my studies" and another finding that they were "surprised to receive encouragement [from] JPL scientists on pursuing a PhD in the future and a career in research." Some responses suggested that

the workshop offered insights and skills beneficial for future professional endeavors, as one respondent noted it as "one of the best, most relevant, and most equitable opportunities." One student came to the conclusion that coding is much more work than they had previously believed, while another seemed relieved to discover that "I can learn coding without needed a degree in math, computer science and/or physics."

In terms of learning outcomes, students' survey responses can be grouped into the following categories:

- **Technical skills**: Participants mentioned developing technical skills, particularly with tools such as MATLAB and Python, which are crucial for data analysis and scientific computation.

- **Analytical skills:** Some participants noted that the workshop helped them in analyzing data, indicating an enhancement in their analytical and critical thinking skills.

- **Research skills**: One respondent expressed a desire to engage in research, suggesting that the workshop may have sparked interest or provided skills relevant to conducting research.

- **Application of Knowledge:** Participants appreciated the practical application of the knowledge they gained, which likely made the learning experience more impactful and memorable.

Figure 5. Excerpted slide from May 2023 presentation to CSULB Deans Council (left) and photograph (right) taken during the workshop.
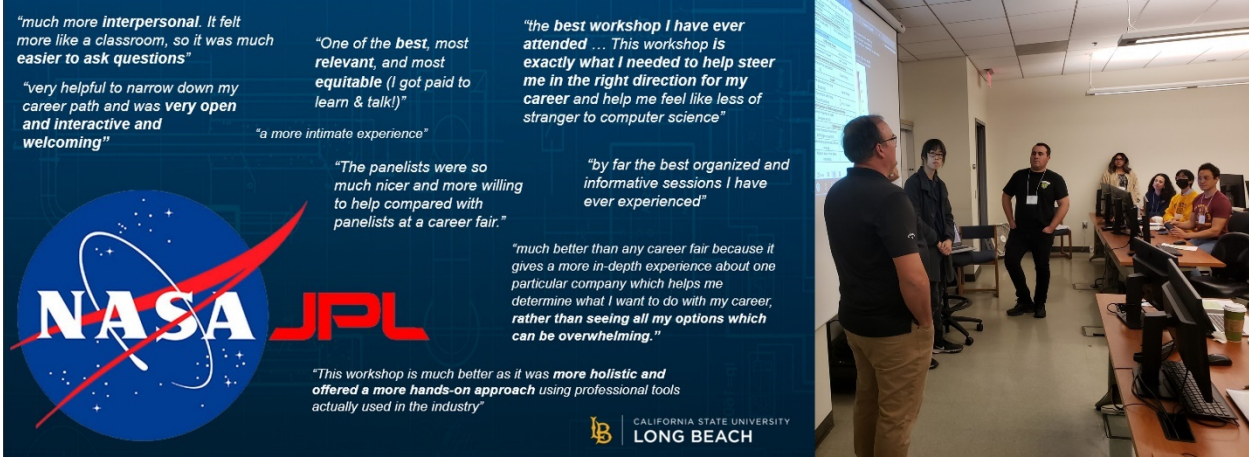
Table 3. Findings from the Data Science Talent Pipeline Partnership with JPL

Recommended Practices	Possible Barriers
To ensure equitable accessibility to participation, the workshop was held on the CSULB campus, and each participant received $200 to offset any loss in pay experienced by devoting two days to the workshop.	Paying students will present a problem at institutions that don't allow student stipends or participant incentives for workshop participation. Hiring students through our Research Foundation was a cumbersome way to compensate students for participation.
Use multiple modes of communication to promote the workshop and be sure that social media is one of those modes. Also encourage reposting on social media, especially across platforms.	Inviting employees of outside entities/businesses on campus to interact with students requires Risk Management approval of the workshop leaders and their insurance.
Provide all materials needed to participate in the workshop. We held the workshop in a computer lab, JPL arranged remote access to Jupyter notebook on their computing network. We also provided food throughout the entire workshop.	Narrowly defined university policies on internships could impede implementation especially when the university requires a contract with the internship host.

3. Next Steps for Scaling Talent Pipelines Statewide

During the November 2022 launch for the ITS pilot, the National Operations Center of Excellence committed to work with CSULB and Gannett Fleming to "connect students to a wide range of ITS career opportunities and trainings" and support expansion of the "single-employer talent pipeline pilot into a coalition-led model." This method of transitioning from single-employer to coalition-led talent pipelines could be applied to a wide range of industries by building upon the organizational framework of the center's annual Transportation Technology Tournament,[10] where student teams work with departments of transportation, municipal planning organizations, or transit agencies to define a problem. The teams of students, guided by an academic advisor, hone their KSAs while developing solutions to the team-identified problem. The tournament concludes with teams presenting solutions to a panel of judges who select the annual tournament's winner. The tournament occurred annually from 2018 to 2023, with 121 graduate and 120 undergraduate students from 31 universities in 16 states participating. After reviewing the goals and outcomes of this event, we believe that statewide competitions for transportation and mobility, as well as other industries, will be a viable means for statewide scaling of talent pipelines.

3.1 PaCE Units as Facilitators of Talent Pipelines

Historically, Professional and Continuing Education (PaCE) units have played an important role in preparing learners to respond to the challenges created by the first three industrial revolutions. Educators and policymakers worked to support the design, development, implementation, and evaluation of programs associated with *extended*, *continuing*, *professional*, and *career-and-technical education* and have revised these categories in response to changing workforce challenges and related KSA gaps:

> The Smith-Hughes Act of 1917 demonstrated a federal recognition that the Second Industrial Revolution—with its booms in mass production, infrastructure, electricity, gas, water, telegraph, and roads—required a new era of PaCE programs to develop a skilled labor force. In service of this new federal PaCE priority, the Smith-Hughes Act supported programs to train teachers to teach vocational programs.[11]

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[10] "Transportation Technology Tournament," National Operations Center of Excellence, August 23, 2023, https://transportationops.org/transportation-technology-tournament.

[11] Ann Y. Kim, Tyler Reeb, Jaylee Jordan, and Youngjin Song, "Curriculum Evaluation of the Academy of Global Logistics Program: Connections STEM Education" (San José, CA: Mineta Transportation Institute, June 2023): https://rosap.ntl.bts.gov/view/dot/68036.

Hoke Smith and D.M. Hughes, Vocational Education Act of 1917 (or Smith-Hughes Act of 1917), Pub. L. No. 64–347, § 703, U.S.C. 929 (1917): https://uscode.house.gov/statviewer.htm?volume=39&page=929.

The Carl D. Perkins Vocation Education Act of 2019 signaled another redefinition of educational priorities in response to the 4IR by prioritizing technical skills and industry-recognized certificates and credentials within a broad context and supporting increased access to post-secondary degrees. The legislation called for new education and training priorities to help learners develop the KSAs needed to succeed at entry-, mid-, and senior-level.[12] Throughout the 20th century, vocational training increasingly became associated with fields referred to as "trades". Legislation now calls for blending vocational skills-based education and academic training associated with post-secondary degree opportunities, acknowledging that 4IR workforce challenges call for new hybrid KSAs.

In higher education, keeping pace with the velocity of the 4IR is not compatible with traditional timetables for curricular and programmatic development even when faced with government calls for higher education to meet workforce demands. Traditional degree programs are often incompatible with the schedules of working professionals seeking new KSAs to remain competitive in the workplace. Stackable micro-degrees, credentials, micro-credentials, and badges have been proposed to address these demands; however, they too have incompatibilities with the traditional academic structure of higher education.[13] Talent pipeline programs are a means for subject-matter experts in industry, government, and education to collaboratively address workforce and research development disconnects. PaCE units are uniquely positioned to serve as a workforce intermediary, directly addressing workforce and employer needs.[14] PaCE units help universities serve as connectors to facilitate learner access to education that is responsive to industry skill demands.[15] Talent pipelines are one type of connector; they are intentionally developed in partnership with industry and government to address specific, industry-wide, and inter-industry needs.

With regard to implementing new programming, PaCE units are more nimble than traditional academic colleges in most post-secondary institutions. Talent pipelines can take many forms, including workshops, bootcamps, long-term, project-based competitions, etc., as well as more traditional apprenticeship or internship programs. All can run in parallel or be integrated with traditional undergraduate and graduate degree programs. Additionally, PaCE units can support modular, stackable program offerings that create additional skill-development pathways with

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For more information on Career and Technical Education, see: Jay Stratte Plasman, Michael A. Gottfried, and Ethan L. Hutt. "Then and Now: Depicting a Changing National Profile of STEM Career and Technical Education Course Takers." *Teachers Colleges Record* 122, no. 2 (February 2020): 1–67. https://doi.org/10.1177/016146812012200209.

For more information on the Smith–Hughes Act, see: David Carleton, "The Smith–Hughes Act (February 23, 1917)" in *Landmark Congressional Laws on Education*, 63–76 (Westport, Connecticut: Greenwood Press, 2002): https://books.google.com/books?id=DraaG0UyOdIC&pg=PA63#v=onepage&q&f=false.

[12] Strengthening Career and Technical Education for the 21st Century Act, Pub. L. No. 115–224, U.S.C. (2018). https://www.congress.gov/bill/115th-congress/house-bill/2353.

[13] Sean Gallagher, *The Future of University Credentials: New Developments at the Intersection of Higher Education and Hiring*, Cambridge, Massachusetts: Harvard Education Press, 2016.

[14] *On post–secondary institutions as workforce intermediaries see, for example:* Nichola Lowe, *Putting Skill to Work: How to Create Good Jobs in Uncertain Times*, Cambridge, MA: The MIT Press, 2023.

[15] Peter Wiseman and Mia Juritzen, "University as Connector" How Universities Can Align Industry Needs and Student Demand Using Data," Nous Group, May 2023, https://nousgroup.com/insights/university-as-connector/.

flexible on- and off-ramps for learners as they navigate the job market or as employers implement training for KSA needs that change over time.

Industry and government leaders can partner with PaCE educators to design and deploy pilot programs that allow educational institutions to test the efficacy of their programs before large-scale implementation, ensuring optimization of possible outcomes for students and establishing "proof-of-concept" to share across higher education. Traditional post-secondary programs are built with the intention of serving generations to come, whereas developing talent pipelines with PaCE units allows for the adaptation of the programs as industry's and post-secondary education's needs change. Furthermore, with Credit for Prior Learning, which continues to gain acceptance, many of these programs can translate to additional credentialing via credit transfer and address degree completion. The "some college, no degree" population of California (~7 million people) and the U.S. (>40 million) represent an important target audience for talent pipeline programs. In Los Angeles County alone, over 2 million people over 24 years plan to pursue post-secondary education. Thus, there is growing need to serve recent high school graduates as well as meet the needs for professional and continuing education challenges facing incumbent and displaced workers. Talent pipelines provide a targeted way for higher education leaders to respond to anticipated declines in traditional enrollment due to declining birth rates during the Great Recession.

4. Future of Education and Workforce Development

We believe the relationship between undergraduate curriculum and workforce development is undergoing change that is driven, in part, by the 4IR. Undergraduate curricula have always been dynamic, but most people assume that advancement in knowledge is the driver. Undergraduate curriculum also reflects shifts in government policies, sociopolitical priorities, labor market forces, and institutional missions.[16] The impact of these cultural elements depends somewhat on how we define the undergraduate curriculum. Arthur Levine, in his 1981 *Handbook of Undergraduate Curriculum*, defined it as the "body of courses that present knowledge, principles, values, and skills that are the intended consequences of formal education," but that definition changed as universities took a more holistic approach to serving students.[17] Amy Tsui, Pro-Vice-Chancellor and Vice-President at The University of Hong Kong, offered a redefinition of curriculum as "the total student learning experience."[18] British sociologist of education Basil Bernstein proposed that the curriculum can be viewed through four lenses: intended curriculum as stated in course documentation; delivered curriculum, reflecting planned curriculum's translation into lectures and activities; received curriculum, what students experience; and the shadow curriculum containing dimensions that are not formally a part of the curriculum, but that are nonetheless communicated through educational content, symbols, and processes.[19] All knowledge imparted by a person's undergraduate experience is their education, and that cumulative information is what students take with them when they enter the workforce. For this discussion, we will remove Bernstein's four distinctions and consider curriculum holistically.

Curricular change often reflects geopolitical, ideological, and socioeconomic shifts; but underlying all these is the 4IR and its impact. Edgar Morin coined the term "supercomplexity" to describe a world of increasing interconnectedness and unpredictability, where society is characterized by an unprecedented level of complexity, ambiguity, and uncertainty across politics, economics, culture, and technology—changes that are driven by the 4IR. In 2000, Ronald Barnett posited that all curricula will change at increasingly rapid rates, no definite pattern of change will be detectable, and the dominant external factors influencing change will be the student market, the labor market, and industry requirements.[20] Almost two decades later in 2018, Barnett used an ecosystem metaphor to describe the reciprocity of change that exists due to the interconnectedness of

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[16] Kerri-Lee D. Krause, "Vectors of Change in Higher Education Curricula," *Journal of Curriculum Studies* 54, no. 1 (January 2, 2022): 38–52, https://doi.org/10.1080/00220272.2020.1764627.

[17] Arthur Levine, *Handbook on Undergraduate Curriculum*, 2nd ed., Carnegie Council (San Francisco, CA: Jossey-Bass, 1981) p. 3.

[18] Amy Tsui, "Reimagining Undergraduate Education" (Keynote presentation, Higher Education Conference, Glasgow, June 13, 2013), https://www.youtube.com/watch?v=JalJGBrEAfY.A

[19] Basil Bernstein, *Towards a Theory of Educational Transmissions*, vol. 3, Class, Codes and Control (London: Routledge and Kegan Paul, 1975); Basil Bernstein, *Pedgogy, Symbolic Control and Identity: Theory, Research, Critique*, 2nd ed. (Lanham, Maryland: Roman & Littlefield, 2000).

[20] Ronald Barnett, "Supercomplexity and the Curriculum," *Studies in Higher Education* 25, no. 3 (October 1, 2000): 255–65, https://doi.org/10.1080/713696156.

universities and society.[21] Collaborations with industry on talent pipeline and workforce development is part of the mission of community colleges that receive the majority of funding for those programs, especially in California. Students at four-year comprehensive universities need and deserve the same talent pipeline and workforce development opportunities. Thus, universities should facilitate knowledge ecosystems between leaders of industry, government, and education to pilot, refine, adapt, and scale talent pipelines and research and development collaborations to optimize society's response to the unprecedented changes of the 4IR.

Technology both disrupts and enables education.[22] Curricula can be offered online, albeit without the hands-on experiences necessary for some degrees. Online offerings such as Massive Open Online Courses (MOOCs), skills-based bootcamps, and self-paced learning platforms (Udacity, Udemy, Skillshare, Teachable, etc.) have contributed to a repackaging of curricula as credentials, micro-credentials, nanodegrees, and digital badges. Universities are facing the challenges of similarly repackaging their curricula. At present, there is a desire but not an imperative to offer online degrees across disciplines because universities have a monopoly on granting globally recognized qualifications. Blockchain technology, however, could break this monopoly with its ability to validate the accuracy of educational records. Information technology was the catalyst for "internet-based universal access" to higher education.[23] The 4IR enables, and may drive, a shift from mass to universal higher education. National policies, such as the US's imperative to increase the number of graduates with STEM degrees and to make higher education accessible to historically minoritized populations, also reinforces the massification of higher education. Education, especially online, of life-long learners is currently regarded as higher education's parachute as society nears the edge of the demographic cliff. Together, technological disruptions and enablements increase the dynamic quality of knowledge ecosystems.

Curricular change is intended to benefit students. Curricular change is expected and accepted as it meets social purposes such as developing intercultural capabilities and grappling with ethical issues of artificial intelligence, cyber security, and personalized medicine. Also accepted are a shift from discipline-specific to interdisciplinary learning and a recognition that the division between research and education is unnecessary—even counter-productive.[24] Universities are also emphasizing innovation and entrepreneurship, though not equally across all disciplines. These changes are intended to make students more employable, but some academics stop short of believing that curricula should be responsive to industry needs. There is a risk in curricula being tailored to meet current industry needs but it is not the risk of turning universities into vocational schools, rather,

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[21] Ronald Barnett, *The Ecological University: A Feasible Utopia* (New York, NY: Routledge, 2018).

[22] Kerri-Lee D. Krause, "Vectors of Change in Higher Education Curricula," *Journal of Curriculum Studies* 54, no. 1 (January 2, 2022): 38–52, https://doi.org/10.1080/00220272.2020.1764627.

[23] Martin Trow, "From Mass Higher Education To Universal Access: The American Advantage," *University of California Berkeley CSHE Research and Occasional Papers Series (ROPS)* CSHE.1.00 (March 1, 2000), https://cshe.berkeley.edu/sites/default/files/publications/pp.trow.masshe.1.00.pdf.

[24] Dilly Fung, *A Connected Curriculum for Higher Education*, Spotlight (University College London Press, 2017), https://doi.org/10.14324/111.9781911576358.

it is the risk that industry needs will change faster than the pace of curricular change. To combat this risk, a university education should teach resilience, adaptability, innovative problem solving, and social justice in addition to skills of critical thinking, communication, and collaboration. Nonetheless, industry-driven models of higher education are emerging. In the UK, rising student fees and concern over the value of an education have pushed universities to work more closely with industry and demonstrate student employability outcomes in universities, and Australia has implemented Degree Apprenticeship programs that combine paid, on-the-job training with higher education.[25] The employability agenda, the imperative to prepare employable graduates, is shaping undergraduate curricula around the globe.[26]

The disruptive influences of 4IR technology portend changes in the design and delivery of curricula, perhaps even in its core nature. Is a curriculum a mechanism for conveying disciplinary knowledge? Is it a means for institutions to manage themselves strategically in a market-oriented society? We argue that it can and must be both. This duality already exists in higher education— or, more correctly, in the "third space." Whitchurch (2008) introduced the concept of blended professionals who work across internal and external institutional boundaries and straddle professional and academic domains.[27] Borrowing a term from social theory (Oldenburg 1989), Whitchurch designated the domain of these blended professionals as a third space, a domain that is rife with paradoxes.[28] While we agree with Whitchurch that her version of third space exists, we disagree "that such environments do not sit easily in formal organizational structures." We believe the CSU system has ready homes for third space activities in their Colleges of Professional and Continuing Education and in the centers and institutes within their Offices of Research and Sponsored Programs. These units grant industry, government, and non-profits access to the university's research and development resources and grant the university access to the workplace for its educational activities.

At its outset, this project was a consensus study titled: Talent Pipelines and a Research and Development Gateway at The Beach (CSULB). The focus was on the transportation and mobility industry with talent pipeline pilots in intelligent transportation systems and data science, an area of research and a research tool that reflect the technological advances of the 4IR. We took inspiration from the CSULB strategic plan (2020), which emphasizes being a "future-ready university" with a goal to "advance partnerships for the public good."[29] As we progressed through

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[25] Philip Powell and Anita Walsh, "Whose Curriculum Is It Anyway? Stakeholder Salience in the Context of Degree Apprenticeships," *Higher Education Quarterly* 72, no. 2 (November 27, 2017): 90–106, https://doi.org/10.1111/hequ.12149.

[26] Paul Blackmore and Camille B. Kandiko, *Strategic Curriculum Change in Universities: Global Trends*, Research into Higher Education (London: Taylor and Francis, 2012).

[27] Celia Whitchurch, "Shifting Identities and Blurring Boundaries: The Emergence of Third Space Professionals in UK Higher Education," *Higher Education Quarterly* 62, no. 4 (2008): 377–96, https://doi.org/10.1111/j.1468-2273.2008.00387.x.;

[28] Ray Oldenburg, *The Great Good Place* (De Capo, 1989).

[29] "Beach 2030 Action Plans" (California State University Long Beach, 2020), https://www.csulb.edu/sites/default/files/document/beach_2030_action_plans.pdf.

the project, research and development and talent pipelines merged into learning and development, and we saw the bigger picture of educational institutions, industry, government, and non-profits co-existing in one knowledge ecosystem, not separated by fences and not needing gateways to interact with each other.

5. Summary & Conclusion

Promoting "future-ready" universities is increasingly becoming a strategic and ethical priority for leaders in higher education. Never-before-seen rates of socioeconomic and technological change associated with the 4IR are transforming the way people in communities, workplaces, and institutions of learning are communicating, working, upskilling, and navigating careers. To address 4IR challenges and the skills gaps they create, leaders in higher education will need to use evidence-based approaches to evaluate learning and workforce development solutions to technological disruption and related socioeconomic changes. Those solutions will require leaders in education, industry, and government to strategically collaborate to address *future*, not past and present, challenges.

> "When we design for the present, we often hold onto the mindsets that replicate the same system and ways of being that we desperately want to get rid of," asserts futurist educator Laura McBain. "In visiting the future, we create prototypes that could live in that future. These prototypes give us an opportunity to interrogate the biases we're bringing to the future."[30]

McBain's commentary encapsulates many of the lessons learned throughout the yearlong consensus study documented in this report. The study sought to gauge the willingness of CSULB faculty and staff to work with external community, government, and industry stakeholders to promote learning and workforce development opportunities for CSULB students. The authors of this report initially used the term "research and development gateway" to characterize the way in which a university such as CSULB could connect with external stakeholders. After evaluating findings from a campus-wide survey and a range of focus groups with university leadership and external stakeholders, the authors conclude with a revised metaphor: a knowledge ecosystem.

The knowledge ecosystem metaphor defines the fluid and interconnected nature of education, learning, industry, and workforce development; it defines these components in an intricate web where they interweave seamlessly, mirroring the complexity and interconnectedness of a natural ecosystem. In this dynamic environment, educational institutions serve as the fertile ground from which knowledge sprouts, while continuous learning acts as the ever-flowing streams that nourish growth. Research functions as the pollinators, spreading new insights and innovations that industries, akin to thriving flora, utilize to adapt and flourish. Workforce development programs decompose and recycle outdated skills, transforming them into relevant competencies that align with evolving industry demands. This ecosystem is devoid of fences and gateways, symbolizing the unrestricted flow of information and opportunities, fostering inclusivity and accessibility. By

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[30] Laura McBain and Lisa Kay Solomon, "Educators as Futurists: A Conversation with Stanford d.school Leaders," *Education Reimagined* (blog), March 24, 2021, https://education-reimagined.org/educators-as-futurists-a-conversation-with-stanford-d-school-leaders/.

eliminating artificial barriers, the knowledge ecosystem ensures that every participant—students, educators, researchers, professionals, and industries—can interact, collaborate, and evolve collectively, driving growth and innovation.

Gateways, however many we might build, are insufficient to meet the needs of a university such as CSULB or any other CSU campus. The survey confirmed that CSULB faculty, staff, administrators, and external stakeholders are nearly unanimously in favor of building learning and workforce development partnerships that engage community, business, and governmental stakeholders; in that respect, the consensus is clear. The challenges and differences in opinion emerge when the discussion shifts to how to implement new programs that break down college silos and open the university to external stakeholders in new ways. Every college on the CSULB campus has unique policy requirements, which are often incompatible with other academic units and centers. In the long-term, leadership will need to address and redefine policies and protocols to empower CSULB colleges and centers to build their own gateways or entry points to the learning and development ecosystems of the future. Again, McBain provides instructive commentary about anticipating and addressing 4IR challenges:

> Traveling to the future is a team sport. It is important to invite other people to travel to the future with you. If we don't do the work of thinking about and interrogating what's possible, we will stay stuck in the same place of incremental growth without having the capacity to radically change the system.

In this respect, urban designer Jan Gehl provides useful guidance to support knowledge ecosystems of the future: "First life, then spaces, then buildings. The other way around only works sometimes."[31] If CSULB faculty and staff start with people, (meaning building partnerships built on frameworks of trust), then identify empowered spaces (that may or may not be on campus or in a formal classroom), they will ensure that people working in empowered spaces are a top priority By prioritizing people and empowered spaces, the use of campus buildings and infrastructure will reflect the values of the diversity, equity, inclusivity, and accessibility (DEIA) movement. [32]

Sixteen years ago, in the middle of a research career focused on academic and professional roles and the future of higher education in locally and globally engaged institutions, Celia Whitchurch of University College London introduced the concept of third space as an emergent territory

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[31] Jan Gehl, *Life Between Buildings: Using Public Space*, Sixth Edition, (Washington, DC: Island Press, 2011).
[32] Committee on Diversity Equity Inclusion Access Culture and Climate Committee (DEIA-CCC), "Policy Statement 24-08" (California State University, Long Beach, April 16, 2024), https://www.csulb.edu/sites/default/files/2024/documents/PS%2024-08%20-%20Committee%20on%20Diversity%20Equity%20Inclusion%20Access%20Culture%20and%20Climate%20Committee%20%28DEIA-CCC%29.pdf;
"President's Commission on the Status of Women | California State University Long Beach," October 17, 2019, https://www.csulb.edu/presidents-commission-the-status-of-women; "President's Equity & Change Commission | California State University Long Beach," March 2, 2021, https://www.csulb.edu/presidents-equity-change-commission.

between academic and professional domains. Prioritizing people and empowered spaces, the use of campus buildings and infrastructure will reflect the values of the diversity, equity, inclusivity, and accessibility (DEIA) movement.[33] In this way, knowledge ecosystems of the future support Whitchurch's concept of blended professionals who work across internal and external institutional boundaries and straddle professional and academic domains. The ecosystem model reflects the previously mentioned notion that the CSU system has ready homes for third space activities in their colleges of professional and continuing education and in the centers and institutes within their offices of research and sponsored programs. These units are a node for connecting industry, government, and non-profits to the university's research and development resources and connecting the university to the workplace for its educational activities.

This project was a consensus study focused on the transportation and mobility industry with talent pipeline pilots in intelligent transportation systems and data science, an area of research and a research tool respectively, that reflect the technological advances of the 4IR. After disseminating and evaluating a campus survey and after a wide range of focus groups with faculty, staff, administrative leadership, and external stakeholders, the authors had begun to cultivate partnerships and were invited to join the $1.2 Billion U.S. Department of Energy-funded ARCHES Hydrogen Hub project to contribute workforce development expertise. This invitation was a validation of the pilot ecosystem model that the authors tested in this project. The authors are now members of a CSU5 team focused on workforce development strategies for the future hydrogen workforce. (CSU5 campuses: Long Beach, Dominguez Hills, Los Angeles, Northridge, and CalPoly Pomona).

Findings from this report and subsequent involvement with the ARCHES project, informed the authors' proposal for the development of a "Hydrogen Hub Blueprint" that will be implemented in partnership with faculty and career/workforce development leadership at CSU5 campuses and leading trade and transportation employers. Developing this learning and workforce development partnership within our knowledge ecosystem will support the primary goals of the ARCHES project. The ecosystem will demonstrate the ability to not only collaborate across CSULB colleges but also in partnership with other CSU campuses.

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[33] Committee on Diversity Equity Inclusion Access Culture and Climate Committee (DEIA-CCC), "Policy Statement 24-08" (California State University, Long Beach, April 16, 2024), https://www.csulb.edu/sites/default/files/2024/documents/PS%2024-08%20-%20Committee%20on%20Diversity%20Equity%20Inclusion%20Access%20Culture%20and%20Climate%20Committee%20%28DEIA-CCC%29.pdf;
"President's Commission on the Status of Women | California State University Long Beach," October 17, 2019, https://www.csulb.edu/presidents-commission-the-status-of-women;
"President's Equity & Change Commission | California State University Long Beach," March 2, 2021, https://www.csulb.edu/presidents-equity-change-commission.

These transformational trends in zero-emission passenger and freight transport technology are ramping up just as the trade and transportation sector faces a current and projected shortage of labor for a range of reasons, including:

- a lack of new entrants;

- a lack of awareness about careers in transportation and international trade fields;

- an aging and retiring incumbent workforce;

- an incoming generation of professionals that is smaller due to declining birthrates during the Great Recession; and

- transformational 4IR technologies.

This wide range of factors is redefining the necessary skills for newcomers and creating skills gaps when unaddressed. Reports from the U.S. Department of Transportation, 2015, state that more than 50% of workers in warehousing and transportation would be eligible for retirement over the next 10 years, with trends of high retirement rates expected to continue throughout 2031.[34] The answer to the many KSA and occupational gaps in the trade and transportation workforce is to develop learning and workforce development ecosystems that engage and empower the entire continuum of potential professionals from every learning population and related demographic.

The global transition toward sustainable and clean energy sources has propelled the hydrogen fuel industry into the spotlight and the need for a learning and workforce development ecosystem to support it. As governments, industries, and consumers alike recognize the potential of hydrogen as a clean energy carrier, the demand for skilled professionals in the hydrogen fuel sector is on the rise. Workforce development plays a pivotal role in shaping a sustainable and efficient hydrogen economy, ensuring that the industry can meet its potential while addressing the challenges associated with the energy transition.

The authors' next blueprint project in support of the nascent hydrogen economy will provide recommendations for statewide CSU inter-campus partnerships to launch new talent pipelines and develop non-degree certifications to help incumbent and displaced workers rapidly add skills to compete for in-demand trade and transportation occupations. Those recommendations would include suggested strategic partnerships between industry leaders, CSU colleges of professional and continuing education, community colleges, and organized labor. The blueprint will include a curricular plan for an online introductory module to promote fluency in the basic understandings

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[34] Marissa McFadden, Hannah Ullman, and Glenn McRae, "'I See Myself in That Career': Exploring Methods to Attract the Next Generation Transportation Workforce" (University of California, Davis: National Center for Sustainable Transportation, December 1, 2019), https://ncst.ucdavis.edu/research-product/i-see-myself-career-

of how and why hydrogen-powered locomotives and heavy trucks could create cleaner supply chains throughout the world.

The blueprint report and recommended pilot module will provide operational fluency in hydrogen-powered supply-chain systems. The curriculum will provide critical knowledge and technology transfer for professionals in industries essential to developing the hydrogen hubs of the future. The recommended curriculum will incorporate best practices from successful professional development and stackable-credential programs that address critical energy and supply-chain KSA gaps. Thus, the authors' next project will address both the labor shortage in the trade and transportation sector, as well as the changing workforce demands of 4IR.

The *MIT Sloan Review* published an article entitled "The Future of Work Is Through Workforce Ecosystems," which is the culmination of two years of research, including two global executive surveys and interviews with leaders and academic experts.[35] The authors, Altman, Kron, Schwartz, and Jones make the case that cultivating workforce ecosystems empowers leaders to better address socioeconomic and technological change.

We contend that the "workforce ecosystem" of Altman et al. is equivalent to our "knowledge ecosystem," meaning a structure that consists of interdependent actors, from within the organizations and beyond, working to pursue both individual and collective goals. The goals of the *MIT Sloan Review* article—to introduce the concept of workforce ecosystems to the business world—align with the goals of the authors of this report. Toward that end, the authors drew from findings in this report in a peer-reviewed article published by UC Berkeley's Center for Studies in Higher Education. Entitled "Talent Pipelines for the Fourth Industrial Revolution," the article presents

> a rationale for using professional and continuing education (PaCE) units at post-secondary institutions throughout California to design and implement talent-pipelines, research and development collaborations, and other knowledge ecosystems where emerging and returning professionals can acquire the knowledge, skills, and abilities as well as the experience, they need to address the challenges of the Fourth Industrial Revolution (4IR).

The article, which was coauthored with Chris Swarat, Dean of CSULB's College of Professional and Continuing Education, "provides an analysis of the reasons why PaCE units are uniquely positioned to address the needs of industry and job seekers, and on a timetable that keeps pace with 4IR velocity."[36]

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[35] Elizabeth J. Altman et al., "The Future of Work Is Through Workforce Ecosystems," SSRN Scholarly Paper (Rochester, NY, January 14, 2021), https://papers.ssrn.com/abstract=3801121.

[36] Tyler Reeb, Barbara Taylor, and Chris Swarat, "Talent Pipelines for the Fourth Industrial Revolution: How California PaCE Units Can Bridge Critical KSA Gaps," *Berkeley Center for Studies in Higer Education Research & Occasional Papers Series* CSHE.SI.2023 (2024).

The authors look forward to completing the forthcoming Hydrogen Hub Workforce Blueprint to instantiate the workforce ecosystem insights from this yearlong campus engagement.

Appendix A: Stakeholder Survey Responses

for advance partnerships for the public good, the need for more robust industry engagement has been identified by leaders in every college. This increased emphasis on industry partnerships is evident in the top priorities established by the Office of Research and Economic Development (ORED), Institute for Innovation and Entrepreneurship (IIE), and campus leadership.

A recently awarded SB1 grant addresses the need for more industry-facing university infrastructure and systems to catalyze a new era of research and workforce development at The Beach. What follows is a series of questions that will gather insights and determine priorities from CSULB to build a Research and Development (R&D) Gateway to:

1. Establish a process for determining strategic areas of expertise that CSULB faculty and researchers can provide for industry and community partners;
2. Design and pilot a scalable R&D Gateway that will solicit targeted research and development needs from industry and community partners;
3. Develop research initiatives and talent pipelines to address community and industry needs; and
4. Work with ORED, IIE, and industry partners to secure public- and private-sector funding to support related research and talent-pipeline programs.

These insights can be a guide for the design and piloting of a reciprocal exchange of assets between CSULB and industry partners that ultimately empowers students and faculty.

Question 1: I _____ university-industry partnerships.

Field		Choice Count
Strongly oppose	0%	0
Oppose	3%	3
Support	36%	36
Strongly support	61%	61
Total		100

Question 2: How long have you been part of the CSULB community?

Field		Choice Count
Less than 1 year	7%	7
1-5 years	15%	15
5-10 years	22%	22
10-15 years	10%	10
15-20 years	17%	17
More than 20 years	23%	23
Nonapplicable: I am not a member of the CSULB community	6%	6
Total		100

Question 3: How long have you been in your current role at CSULB?

Field		Choice Count
Less than 1 year	13%	12
1-5 years	28%	26
5-10 years	24%	23
10-15 years	14%	13
15-20 years	12%	11
More than 20 years	10%	9
Total		94

Question 4: What are your current areas of interest? Select as many as are applicable

Field	Choice Count	
Transportation & Mobility	16%	37
First Principles Engineering	3%	6
Data Science	16%	39
Community Health & Wellness	15%	35
Sustainable & Resilient Ecosystems	15%	35
Art & Innovation	13%	31
Designing Cultures of Continuous Improvement	11%	25
Other (please describe)	12%	29
Total		237

Question 4: What are your current areas of interest? [Text Entry]

Other (please describe) - Text

Physical Sciences

Economic Development

Cities and urban innovation, digital rights, privacy and community engagement

1. Transformation esp Digital Transformation 2. Transformative Teams as a building block for transformation

Filmmaking

Workforce Development-Urban Planning

Earth Science

Technology policy

basic biomedical research

Information Literacy

Spatial Thinking

Basic science

Policy

Translation Studies

Community Engagement, Global Engagement

Financial Literacy

GIS applications to all areas of research. Our department specializes in geospatial techniques including GIS, Remote Sensing and Cartographic Visualization. We are excited to see you are partnered as GEOG manages CSULBs software and licensing.

User Experience Research/Qualitative Research in Industry

Information sharing such as journalism.

Philanthropic Studies

Science

Organic Chemistry Methods - Photochemistry

Chemistry and Materials Science

hydrology, environmental science

Are those really the only areas you could think of?

civic engagement and political participation

Engineering disciplines

AI Safety

Combinatorics

Question 6: In which of the following areas do you believe CSULB has the most to offer Research and Workforce Development? Select as many as you would like - Selected Choice

Field	Choice Count	
Transportation & Mobility	17%	50
First Principles Engineering	9%	27
Data Science	16%	47
Community Health & Wellness	17%	50
Sustainable & Resilient Ecosystems	14%	42
Art & Innovation	12%	37
Designing Cultures of Continuous Improvement	10%	29
Other (please describe)	7%	21
Total		303

Question 5: In which of the following areas do you believe CSULB has the most to offer Research and Workforce Development? [Text Entry]

Other (please describe) - Text
Physical Sciences
Economic Development
Cities and urban innovation, digital rights, privacy and community engagement
1. Transformation esp Digital Transformation 2. Transformative Teams as a building block for transformation
Filmmaking
Workforce Development-Urban Planning
Earth Science
Technology policy
basic biomedical research
Information Literacy
Spatial Thinking
Basic science
Policy

Translation Studies

Community Engagement, Global Engagement

Financial Literacy

GIS applications to all areas of research. Our department specializes in geospatial techniques including GIS, Remote Sensing and Cartographic Visualization. We are excited to see you are partnered as GEOG manages CSULBs software and licensing.

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Philanthropic Studies

Science

Organic Chemistry Methods - Photochemistry

Chemistry and Materials Science

hydrology, environmental science

Are those really the only areas you could think of?

civic engagement and political participation

Engineering disciplines

AI Safety

Combinatorics

Question 6: What are your top three priorities when mentoring undergraduate and/or graduate students regarding professional development? - Selected Choice

Field		Choice Count
Formal Professionalization (resume or interview coaching, etc.)	13%	36
Promoting Experiential Learning Opportunities (such as Internships)	21%	55
Over-and-Above Academic Activities/Opportunities (Conferences, Research Assistantships, etc.)	22%	60
Providing Guidance Concerning Further Education (Graduate School, Certifications).	21%	55
Providing Professional Contact Information (i.e., contacts with relevant industry professionals, informal meetings with likeminded career professionals, etc.)	16%	43
Other (please describe)	5%	13
I do not have experience mentoring students	2%	6
Total		268

Question 6: What are your top three priorities when mentoring undergraduate and/or graduate students regarding profession development? [Text Entry]

Other (please describe) - Text

Physical Sciences

Economic Research

unsure

Outside of my department, I don't know what CSULB has to offer. I do know in my dicipline, film editorial and post-production, our students are desperately in need of professional workforce training and first-time employment or internship opportunities

Urban Planning

I dont know

Labor Studies

don't know

pharmaceutical industry

Basic science

no opinion

Language Services

Global Engagement

unknown

Financial Literacy

Geography, community engaged spatial analysis

Qualitative Research in Industry/User Experience in Tech

Research Training

AI Safety

Question 7: Students graduating from my department are well-prepared for research or research-oriented careers.

Field		Choice Count
Strongly disagree	5%	4
disagree	11%	10
Neither agree nor disagree	32%	28
Somewhat agree	39%	34
Strongly agree	14%	12
Total		88

Question 8: The knowledge and skills attained/developed by students who major or minor in my department are underappreciated or unrecognized by industry professionals.

Field	Choice Count	
Strongly disagree	6%	5
disagree	15%	13
Neither agree nor disagree	39%	34
Somewhat agree	32%	28
Strongly agree	9%	8
Total		88

Question 9: CSULB is prepared for demographic changes in the composition of the student body (i.e., increasing number returning students without a degree, first-time students who work full-time, etc.).

Field	Choice Count	
Strongly disagree	5%	4
disagree	22%	19
Neither agree nor disagree	35%	31
Somewhat agree	28%	25
Strongly agree	10%	9
Total		88

Question 10: Students in my department are aware of career paths that will be a "good fit" for the knowledge, skills, and abilities they develop.

Field	Choice Count	
Strongly disagree	3.41%	3
disagree	19.32%	17
Neither agree nor disagree	32.95%	29
Somewhat agree	34.09%	30
Strongly agree	10.23%	9
Total		88

Question 8_5 - Current open-opportunity professional guidance events and activities – such as guest speakers or career fairs – are beneficial for CSULB students.

Field	Choice Count	
Strongly disagree	1%	1
disagree	5%	4
Neither agree nor disagree	24%	21
Somewhat agree	25%	22
Strongly agree	45%	40
Total		88

Question 12: How do you believe a Research & Development Gateway might best benefit your students? Select as many options as you would like

Field		Choice Count
Career Exploration	19%	63
Professional Development (developing connections with professionals in field of choice)	20%	67
Supplementing traditional classroom education (providing "real world" context unavailable in a classroom, etc.)	18%	60
Complimenting traditional classroom education (i.e., enhancing classroom participation)	11%	38
Research Experience	17%	56
Career Motivation	14%	47
None of these options. I do not believe that a Research & Development Gateway would benefit my students. (Please explain your reasoning in the dropdown box below)	2%	6
Total		337

Question 12: None of these options. I do not believe that a Research & Development Gateway would benefit my students. (Please explain your reasoning in the dropdown box below) [Text Entry]

None of these options. I do not believe that a Research & Development Gateway would benefit my students. (Please explain your reasoning in the dropdown box below) - Text

N/A

Im sure I understand what this will provide our students and whether it will be relevant to student in my field.

no opinion

Collaborative Online International Learning (COIL) to assist in learning how to to apply global knowledge to the global workforce

depends what "Research & Development Gateway" is offering!

If we could find partnerships, but we would need an infrastructure committed to that

Question 13: Industry Talent Pipeline "bootcamps" or training sessions ought to be open to any student, regardless of degree path. For example, a Fine Arts student ought to have an equal opportunity to enroll in a funded coding language program.

Field		Choice Count
Strongly disagree	1%	1
Somewhat disagree	7%	7
Neither agree nor disagree	17%	16
Somewhat agree	29%	27
Strongly agree	46%	43
Total		94

Question 14: Data Science, the study of data to extract meaningful insights, is a research tool used across disciplines. For example, Data Science can be deployed by researchers in the fields of biology, healthcare, marketing, and many others.

Field		Choice Count
Strongly disagree	1%	1
Somewhat disagree	0%	0
Neither agree nor disagree	10%	9
Somewhat agree	17%	16
Strongly agree	72%	68
Total		94

Question 15: The scholarship of trade and transportation is multidisciplinary, in that it benefits from the contributions of researchers with backgrounds in a variety of fields (including science, technology, engineering, mathematics, liberal arts, and more).

Field		Choice Count
Strongly disagree	0%	0
Somewhat disagree	2%	2
Neither agree nor disagree	17%	16
Somewhat agree	30%	28
Strongly agree	51%	48
Total		94

Question 16: As colleges and universities work to better partner with industry, the approach is often fragmented between different departments and sectors of the institution. How could CSULB best ensure that efforts are complementary rather than competitive?

Seek input from external partners through non-college specific advisory groups

By providing an overall framework where we can all learn from each other. We all do partnerships individually as we don't know of any other options

Reward interdisciplinary endeavors.

We must learn how to communicate to each other that is open with no barriers. There's so much good taking place across campus, but it appears to be very siloed.

Hiring Ricki Burgener as Director, University Partnerships and Civic Engagement is a good start. More generally, we need a single entry point for interested industry partners and a database of collaboration opportunities. For example, our media relations office has a database of subject matter experts for press inquiries. We need a similar set of resources for industry partnerships inquiries.

Showcase / open-house events where industry is invited to network with other CSULB partners.

The university may create a center to regularize and encourage internal collaboration and facilitate external partnerships.

Have student initiatives/exercises/etc. that crosscut multiple programs to introduce students to new fields.

Conduct and cross-department events to help introduce students to different fields. Where applicable bring in industry to connect with students at these events.

An office at the university level that is coordinating industry collaboration between departments would be helpful.

Align timelines and deliverable expectations better

A co-ordinating body focused on using collaborative tools and platforms

Comprehensive transparency -- detailed information on who is doing what to avoid duplication and to provide an opportunity for faculty from different departments to contribute.

Leveling of the playing field -- opportunities to lead or make substantive contributions to industry partnering, workforce training, mentorship of students is often reserved for full-time, if not tenured faculty -- especially for any compensation or offset to teach load. When in reality, it is often the adjunct or part-time faculty that has a broader industry base, often still working in the industry, often connected with like programs at other schools, often with more relevant industry skills, even certifications to teach industry accepted/industry sought competencies, often teaching relevant industry skills to working professionals outside of their work at CSULB.

Develop off campus work/study programs in Long Beach business communities like urban planning in Bixby Knolls

Faculty from different disciplines need to work together towards a common goal/goals. Knowledge and development should be a shared venture.

Create strategic goal within the BEACH 2030 framework about how this gets measured and managed.

There is still fear about getting the credit and social connection stolen if industry partnership is shared with multiple departments / colleges. Often, this effort for 'centralization' upsets people because the credit is not owned by the person who initiate the idea. To make this efforts complementary than competitive, there should be more opportunities to encourage multidisciplinary projects and partnership.

Build a one-stop-shop to coordinate external and internal communications. Ensure the "hub" is non-partisan and effectively communicates to all stakeholders the strengths offered by all campus constitutents.

Industry-academic collaborations in research are mutually beneficial; internship programs are mutually beneficial; and industry can serve an advisory role for department updating curriculum and planning certificates, minors, etc.

NA

Develop a mechanism to support programs that are integrative and complementary even if they are extra-curricular and outside a department or college. This may be self-serving but the Institute does not get any resources from the university to support the development of industry partnerships and integrating students into various entrepreneurial opportunities with internships and career knowledge that is outside the traditional 'go to work for a big company'.

sharing of partnerships and contacts across departments would be helpful. Also, providing context from different departments strengthen solutions in the industry. For example, community health in transportation can be areas of collaboration between both departments.

Quick learning methods on career opportunities will help - for example, modern careers in running the transportation system require a ton of communications and management skills. NEed tools to quickly explain that to Comms/management students.

Increase the focus on Labor Studies within the University by establishing a a Labor Studies Department and having that organization interact with CITT.

Competing for

You need government engaged as well to complete the triple helix

CSULB should do much better outreach to labor. They are missing out on understanding operational expertise. If you are going to work with industry, work with all the stakeholders.

The OSCM and CITT groups are starting to collaborate. There would be a benefit to events where students of both degree and non-degree programs could meet and compare notes.

It would be great to have a single connection point with coordination with the various schools within CSULB

encourage multidisciplinary collaborations

As a leader in COTA, I do not think upper administration considers strongly enough how our college contributes to the strength of this campus or the creative ecosystem on a campus and in the region.

No answer.

(Surveys should really be designed to allow the option of not answering)

Hold students to a higher standard. Set greater expectations for them in the classroom, since that is what industry is expecting of them. Actually tell students they will need to work hard in order to be competitive in the work place.

make it a two way street where the faculty receive some kind of compensation/funds for their efforts or research/mentoring of students that go into the program.

Things could all be centralized, likely in ORED, but that may be politically untenable. There may also be capacity issues in that approach as well.

If things remain decentralized, there should be clear rules about baseline expectations that all departments/programs/colleges agree to so that industry can set their expectations accordingly.

Create partnerships that are available to a variety of disciplines, perhaps concurrently. Industry partners could take on a student from a variety of colleges (no matter the discipline focus of the partner). If a student is majoring in Comp Sci or Literature but wants to do an aerospace internship, let them both go. The students can meet to share their insights.

I think the library is a great resource for different departments and sectors to come together because the librarians can enable and support research and investigation in ways that students and faculty can influence. Librarians have suggestions to make and they have the ability to explain resources and get new ones. It's a great place for people to join together in to talk about the connections between content and experience. And we can easily accommodate outreach and workshops at the library.

As a professional in the geospatial industry (I serve as GIO for the County of Los Angeles) and recognizing that everything happens someplace, I believe that the value and importance of Geography and the Geospatial Programs/Courses they offer are vastly underutilized. Seeing that Esri is noted as one of the industry partners for this initiative, I would encourage a deeper engagement with the Geography Dept. and exploring opportunities to build data science and spatial thinking into programs cross the campus and curriculum. In the County of Los Angeles, spatial thinking and geospatial methods and data analysis are used and impact essentially every department and discipline.

comprehensive program - mimic USC

Have disciplinary-focused training and alumni opportunities that are relevant to students in particular majors.

increase funding for interdisciplinary work WITHOUT increasing workload

Good question. You must create a win-win. Initially, maybe a small pilot program?

In the case of the Center I run on Translation Studies, we could benefit from greater visibility of the training we provide in a College of Liberal Arts and how it connects with the work done in other colleges, especially Health and Human Services and Business. Instead, there are barriers. We teach localization, for example, very useful in many disciplines and colleges, but it is very hard to connect students across colleges for the kind of training we provide that relates to all disciplines and colleges for multilingual students.

This is hard to answer because the framing in the previous sections is quite narrow both in terms of educational areas and in terms of professional areas/workforce in southern California. Top needs areas for workforce skills consistently focus on "soft skill" areas such as critical thinking, working in teams, analyzing and interpreting data, ability to demonstrate complex problemsolving
skills, ability to communicate through writing, and global learning experience that included exposure to diverse experiences and perspectives and application of learning to their major and their own life (AAC&U employer survey 2021). If we want to partner with industry across our different departments and sectors then we need to focus on core areas where we educate students of importance to workforce and the high-impact practices (internships, international experiences, community engagement, theses, research experiences, etc) that help them grow as thinkers and learn to apply what they have learned in their professions. This would require reframing the narrow categories on the previous pages.

During the past 6 years, I have actively hosted many extra-curricular workshops (mostly during the weekend as an optional choice for students and always open to all CSULB students) and invited many guest speakers to my classes. Also, I have helped several students in my classes to land professional internships and career paths. I am grateful to the CSULB support, although I wish some setup could help facilitate the process and reduce the back-and-forth paperwork. Also, I wish my efforts would be recognized as an interdisciplinary effort to bridge between Psychology, Art, and Engineering to pave the path for future activities.

Poll faculty for meaning for industry partners that provide direct access to career opportunities. Ensure sites are co reacted and have "skin in the game" so the sites are motivated and up to standard.

well rounded, open requirements.

By seeking the advice of mentors, instead of researchers. Better if the mentors are interdisciplinary themselves. Also, it will be important to be inclusive, which will require people with DEI advocacy training.

Pay faculty for the additional work that they do, and appreciate faculty who have work experience but not a terminal degree. Work experience is important in teaching concepts.

If there are grants, some of that money should be given to the community partners, working with the university, for students' stipends. Students don't want to engage in experiental learning without incentives -- grades and knowledge are no longer considered incentives when they have a job or a family on top of school. Students don't even come to office hours, unless there is some sort of a need. Students prefer online classes for its time flexibility, driving to a site for outside class experience is not greatly appreciate, unless there is a stipend or scholarship for those students who are interested in an internship and/or service learning.

Work in partnership, share knowledge as you lead the way, create spaces to hear from those involved or who will benefit, in all phases.

Research from the outside - in (workplace to University) what the current and future requirements in their respective fields are crucial and insist that these are imbedded in the curriculum of every student at the Beach.

Find collaborative connections among departments and draw upon their contacts in the professional industry to discover overlap of interests, career paths, contacts, and build new relations and bring value to those departments and their students. This would require an infrastructure of curiosity followed by a strategy of actions - with institutional support all the way. So this would not be a 'top down' driven enterprise, but rather an 'inside out' driven one, and forming interdisciplinary teams around that idea. Do a series of 'design thinking' workshops and events around this to draw out collaborative creative possibilities.

Faculty learning communities, better communication across colleges.

By partnering together across disciplines.

Do 'homework' on campus to understand what departments are already doing and who we are partnering with, and skills available among faculty. Assist departments to obtain more exposure with potential community partners. Internships are problematic in that the learning is "farmed out" and not uniform across experiences. Also, many students cannot afford an unpaid experience so there are equity gaps. This 'gateway' approach should make sure that experiences are accessible, and can be assessed. What are the incentives for community partners? Will the University provide funding to incentivize participants in this type of engagement?

Open, transparent communication, especially across colleges. For example, in the College of Liberal Arts, the Geography Department teaches data science classes focused on geographic information science (GIS) and partners heavily with ESRI and other regional GIS industry partners. It is interesting (and perhaps troubling) that ESRI is one of the key partners mentioned in the email communication about this program, but the Geography department and M.S. in Geographic Information Science (MSGISci) program faculty and department chair were not aware of this initiative even though our students, faculty and staff have very close ties to ESRI and we already have an industry pipeline with many students working for ESRI.

Do not underestimate or reproduce false stereotypes of colleges and departments that are research-active or working with industry vs those that are not. This is often a huge problem at CSULB, where certain colleges, such as CLA are undervalued and underappreciated in this regard.

There could be better networking and coordination across activities. However, efforts need to stay diversified and decentralized to ensure multiple access points for participation. Perhaps a central webpage or service that keeps a calendar and repository of resources and events.

I'm not sure, but supporting dialogues across colleges would be a good starting point to compare best practices.

Build a culture of trust by maintaining decentralized partnering.

It will be difficult

N/A

CSULB could best ensure that efforts are complementary rather than competitive by creating an inter-collegiate, inter-disciplinary team in which research and industry opportunities are vetted, shared, and marketed to a variety of campus and community stakeholders. Faculty team members could collaborate with staff in order to design forums, calls for research/internships, or other synergistic activities to promote campus-industry engagements.

University departments and sectors should value other departments/sectors in the University and see them as relevant.

Stop thinking of a four year degree as a direct one-to-one correlation to a specific career. Four year degrees offer a comprehensive set of skills that can be translated and adapted to a variety of careers. For example: When different colleges try to bring all GE requirements 'in house' they undermine the value of the other colleges and the interdisciplinary potential of learning, research, etc...

Not sure....

Organized communications between departments and sectors

-Elect/create a committee composed of Faculty and/or administrators (Deans, etc.) from diverse Colleges/Depts. that select partnerships with industry.

Have an office on campus that maintains and manages partnerships.

funding for mentors

This is a real challenge in my book because the best collaborations are usually maintained at a personal level among PIs. However, a database that lists ongoing collaboration (similar to internship or Center for Community Engagement databases) might at least let administration know what is going on.

We need to focus on career readiness and skills competency across the board. Cultural change must begin with the faculty. Our institutional expectations and rewards must measure our student's competency in applying skills and then apply this to evaluating faculty and programs.

We need to support faculty scholarly and creative activities in applied areas to make more direct connections to the needs of our community partners. This will also better serve our first-generation and UR students who will be better able to relate their activity to the challenges of the larger community.

First compile a list and description of all current activities that do this, then have people know where to go to find these and have a moderator so that when new programs/opportunities get proposed they can say, 'hey this already exists, perhaps you don't have to re-do it but instead you can collaborate'

Something like the current scholarship site for all students to access information about internships.

There needs to be more pathways and opportunities for student/faculty innovation, that is a cultural change that need a centralized focus. Unfortunately in our campus focus is not on innovation, research rather on teaching loads for faculty and passing classes for students, this is not a good recipe for promoting innovation and solving problems which can lead to start-up and tech level problem solving.

Ensuring that there is communication across units from the planning phase through execution.

Promote cross-discipline skills such as data science, statistics, project management.

Demonstrate the opportunities to all of CSULB, and give us a way to come together and find partners

Someone at the college and campus level should lead the effort.

A more accessible internship program, one that also works to alleviate the financial hardships that frequently work as a barrier to participation among our students.

Perhaps a requirement of co-mentorship across colleges or working group/s consisting of a faculty representative from all colleges

Have more events to help newer faculty in different departments meet each other, provide food and don't have an associate dean breathing down our necks.

N/A

Create pathways based on function rather than discipline. Encourage multidisciplinary partnerships and degrees.

I think that organizing a conference/workshop with faculty that are already doing this work would be necessary. Faculty may be unaware that there are others working in the same industry.

Inter-disciplinary incentives.

Hi, Barbara and Tyler. I have a strong interest in University/Industry partnership as an information professional with a particular interest in Engineering. I have networked with many librarians in the corporate engineering sector. I would be happy to be part of any initiatives.

I don't know

I don't have views about this.

Targeted invitations?

It seems like there needs to be a mechanism or person in place who reviews initiatives undertaken across the university to identify overlaps and place relevant departments/faculty in conversation.

Many industry HR people don't properly appreciate what sciences and mathematicians can do in their area. We need to find a way to manage that situation.

Industry partnership is discipline specific. It would be hard to centralize this process. Developing partnership take time and should be beneficial to both, industry and the university entity. Making internship class an elective in the required curriculum is the key.

Question 17: What problems faced by the community of Long Beach could be addressed by University-Industry innovations?

Need for early career awareness opportunities and development of apprenticeships

I don't think our problems can be addressed in this way

Housing, transportation, healthcare

Everything. From economic development, workforce development. Being the lead as the City embarks on the Space Beach initiative. What other organization/institution can lead this better from a non-partisan industry perspective but CSULB. We can certainly assist, support, create in every facet of the City but there's not an appropriate department, software or conduit in which to show our value to the city of Long Beach as well as the communities around campus.

Growth and Economic Development strategies for the City and Region. Healthcare Access. Basic Needs assessment. Aligning workforce development efforts with industry needs, including upskilling (non-degree) opportunities.

The current NSF Planning Grant to explore a digital rights platform led by Gwen Shaffer and Tyler Reed is an example of how an academic research program is already partnering with a social impact start up (Helpful Places) to solve a priority problem for the community of Long Beach

Mobility and transportation is one of them.

Transportation challenges in safety, mobility, equity, and climate.

Digital rights protection.

Workforce job readiness; Data privacy

Sustainable supply chains are a unique opportunity for this community to take advantage of University-Industry innovations.

First time employment, high-level (professional) competencies (additional training), access to professional organizations within an industry sector. Mentorship program -- support of faculty research, initiatives, projects that are "outside" the University -- especially the work of part-time/adjunct faculty.

Creation of University led - professional work/projects, designed specifically for student lead initiatives, but fully mentored, supported (at least in part) by the University.

Developing work/study programs to prepare students for careers in fields such as urban planning.

N/A

Creative thinking around the unhoused problem, cleaner air and water in LB, mental health support

Drug abuse

Economic Blueprint 2.o priorities.

providing resources, attracting external grant funding

health disparities

At some level, all of them! University-Industry partnerships can help to address economic development, job creation, re-entry opportunities, health-wellness, and so many more. We are doing programs to support all of these areas but with no support from the university.

Community and raising awareness of different career paths to K-12.

Environmental impact of freeway

Equity issues cause by transportation infrastructure

Housing policies as they related to transportation and environment

Changes in population

Improving the compensation rates and career opportunities of low paying segments within the transportation trades.

Faculty ought to be getting physically involved in the community and industries

Unsure

If the university reached out to labor, they could solve the freight mobility issues that plaque the Westside.

The Port of LB and LB Airport and the most likely areas for the supply chain programs.

Efficient logistic and transport systems

funding for faculty and students for research training (and not just to complete funded projects)

Housing concerns, most certainly.

Funding and oversight.

do not know

I'm sure there are many but I can't think of any right now.

Silos occur in every workplace, this sets the precedent of looking outside the box for insight.

Well, any problems and opportunities the City has could be investigated by our students. Urban Planning, the environment, the developing literature, fine art, graphic design, and performing arts scenes, large-scale and small-scale marketing campaigns. The development of industry and shipping. All of these things could lead to partnerships between CSULB students and our city.

I am not privy to specific examples in the City, but countywide, issues of equity, public health, sustainability, sustainable development, geodesign and many others provide countless opportunities to address problems faced by SoCal communities.

poor education

Innovative approaches to housing concerns and the connection to community health and wellbeing

sustainability (ecologically and culturally)

It's difficult for me to answer this because I am not very familiar with the Long Beach community to know what problems they face. However, what community would not benefit from Unverity-Industry innovations?

Multilingual communication at the community level, offering cultural information and content in multiple languages, at the Aquarium of the Pacific, for example.

If we focus on what students have learned (core skills) and how they learn to grow and apply them (high impact practices) then the possibilities are endless. CSU-Water, for example, does a good job of this sort of engagement across the CSU system. BUILD research experiences, Global Fellows, and other funded engagement opportunities both pre-selects students and provides them additional research and engagement training and faculty mentorships. This could be grown for every sector - community associations, testing and sampling for coastal management, support for budget or economic models, social media/content development, research on the history of different policy efforts, research on how particular problems are addressed in other comparable cities, business management support, etc etc. 59% of residents in LA county speak a language other than English at home (more than 200 languages) , and Long Beach is one of the most culturally diverse cities in the world. Our students can also conduct research on cultural adaptation, bridge cultural differences, translation services, etc.

I prefer to discuss this in a town hall or through a private setup.

More innovated workforce. Deeper collaborations, employment opportunities, expanded reach.

unknown

Inequality and lack of inclusion decided the mayoral race. Sustainability is also a mayor concern.

The industry can provide PAID internships for our students and provide entry-level positons for our students.

as previously said -- stipends for students' projects offered by the community partners!

appropriate infrastructure in departments to support the demands

Homelessness, food instability, small business economy, clean air and water.

Would provide a more direct connection to our Long Beach community and potentially expand curricular offerings to include non traditional students. University-Industry innovations could be put to practical use (Design, Engineering, Fine Arts) in service oriented applications in the community and in such urgent areas as housing insecurity, food insecurity, sustainable energy and environmental issues in our community. These are areas that require innovation and creativity and broader collaboration, therefore, among Engineers, Environmental Science, Design, Fine Arts, Computer Science, Data Science, Business Entrepreneurship.

Less siloed approach to learning. SJSU has their Honors X program which promotes cross disciplinary experiences, for instance.

Homelessness, Mental Health, Career Advancement, Literacy

There are so many and it depends on the skills and expertise needed and available. Identify stakeholders to 'pitch' projects to the University. There are so many applications. LA City (pre-pandemic) supported a Data Science Federation where City entities pitched projects and the Federation "matched" with participating universities.

Climate change adaptation and resilience building, transportation planning and innovation, homelessness and community services, extreme heat adaptation, sea level rise planning and adaptation

Clear career pathways for students that allow for local employment.

Civic Tech could be supported through user research.

Workforce Pipeline.
Health and Wellness.
Innovation across Disciplines.
Community Impact.
City Services.

Local press, public transport

Affordable health care and housing.

Environmental concerns; sustaining/maintaining green spaces, community gardens; transportation and logistics; affordable housing.

Not sure

Housing, infrastructure, homelessness, clean energy, waste management, ocean stewardship...

Not sure...

Not familiar with the problems in the community of Long Beach

- Greater # of students joining the workforce in their area of expertise after graduation.
- Increased visibility of a CSULB education as a driver of future employment.
- Increased funding to CSULB faculty and staff via grants and/or private donations by industry partnerships or the community.

No comment.

Expectation gap between university and industry skills.

Environmental justice and climate justice issues that cross many sectors (Transportation, ecology, sustainability, etc.)

Environment and climate change-related topics including ocean and potable water, recycling and reclamation, developing new materials and energy resources, transportation options, ensuring quality healthcare and educational resources for all.

Advancing technologies of regional industries with an eye on sustainability

housing, food security, science literacy, environmental impacts both social and physical

Not sure

Pollution, poverty, art promotion, education, work force development...

Pollution, Public Health, Infrastructure

Students have motivation to enter the workforce but many have little idea what careers look like and what it takes to be successful. Without early traning they tend to take the path of least resistance and drift away from STEM.

Most of our student are very weak (low GPA) in their chosen STEM field, but having more University-Industry connections would allow students to see different paths forward.

homelessness, housing affordability, sustainable energy development and affordability. Financial and mentorship support of low-income students.

Environmental awareness, remediation, and resilience. We have departments in Engineering, Biology, Geology, Economics and many others that can offer solutions to these problems, if a collaborative system between these groups can be established.

I think the list is endless. It could range from work with environmental consulting firms to social service offices such as foster care, homelessness or veterans care.

Beach pollution, biodiversity protection, probably something involving the port supply chain

N/A

Housing & the unhoused, sustainable eco-system, best-in-class child care, standard of living supporting new grads.

Any problem that Long Beach faces can be addressed through partnership. The challenge is how best to leverage the partnership, so that both parties derive benefits

Retention and recruitment crises.

Have to think about it!

Congestion and pollution

I don't have views about this.

Unsure

Environmental issues. City planning. Preservation of cultural heritage.

Not sure

Goods movement and logistics, talent pipeline, climate change and environmental impacts, public health, housing.

Question 18: As colleges and universities across the country work to better partner with industry, the approach is often fragmented which leads to counterproductive "turf wars" between different departments and sectors of the university. How could CSULB best ensure that efforts are complementary rather than competitive?

Identify funding sponsors where interdisciplinary teams are encouraged or required and form response teams for when funding opportunities reveal themselves. Maybe a role for URAC?

Already answered this

Reward interdisciplinary endeavors.

Create a database system that will be accessible to everyone, but, there needs to be levels at which the information could and should be accessible (depending on project, the position the person(s) have on campus i.e. Dean, VP, Center Chair, Program Chair, Faculty/Staff, etc.

Please see my answer to the previous, similar question.

Provide mechanisms for potential partnerships to be visible to other depts and sectors and provide opportunity for other researchers to learn and engage with the PI in question

Regularize and encourage internal collaboration and external partnerships.

Cross department programs and initiatives including collaborative hands-on activities projects that bring in students from multiple departments.

Perhaps including tracks under a major that encourage students to take courses from another department - for example a track in transportation that encourages students to take data classes, etc. And vice versa.

NA

Align expectations, timeline, and funding so all parties have skin in the game.

A "neutral" facilitating gateway that has a service led mission would likely be welcomed and could help reduce the (natural) competitive aspects.

I believe this question has already been addressed in a previous question, at least, inter-departmentally.

Turf wars are unavoidable. However, if we are seeking the most effective solutions/programs/opportunities for students -- who wins in the turf war should perhaps be decided on based more on industry standards, capitalistic benchmarks of the most qualified, rather than on academic entitlement standards.

Perhaps a 3rd-party vendor/provider. Aligned with the University, but outside of employment at the University, an alliance/cooperative or consortium of some nature, with a specific mandate, who would then solicit ideas, information, proposals from departments or sectors within the University (perhaps within the CSU system at large); determine best use of resources, and select the most qualified candidates with the University (faculty, staff, even students) for leadership of and participation in special programs. A body that has no specific alliance with any one department, and is not bound by the rules of the academic senate, tenure, entitlements, etc.

Their will still be competition, but one could argue that it is more "FAIR", more reflective of industry than academia.

Concentrate on objective of urban planning and develop focus groups in Business Improvement Districts with Council Offices, Business Owners & Residents

If seeking grants, a competitive grant would be better served by having more collaboration rather than individual approaches.

Have a centralized lead on approach and that lead would create a clearing house of information that could be used by all campus entities.

Please refer to my answer to Q11.

As mentioned above, build a non-partisan, one-stop shop to coordinate these efforts.

I answered this in a previous question.

Unfortunately, I dont have enough experience to have an insight or feedback.
I think long term partnerships with specific organization thru alumni or university/organization leaderships can be a good approach for sustained engagement.
Additionally, the university may choose to make a financial commitment towards an engagement at the start to demonstrate the value.
Non-profit organizations can also be good partners.

The number one thing that could change is the incentive structure for folks in development. As long as they are evaluated on 'funds raised' that can be attributed to them, these walls will be difficult to break down. I'm not sure about all the factors that are involved in the evaluation process for development employees, but it seems they are primarily evaluated based on funds raised for their unit.

Identify approaches that allow for better communication that can match diverse companies in industries. For example our firm is multidisciplinary within engineering, and to be able to coordinate activities across multiple disciplines would be very beneficial.

N/A

Put the students first.

create a network of CSU schools that industry can engage with

First, you need to understand the industry and work with all the stakeholders before you avoid your turf wars. The University doesn't understand the entire shipping industry.

A regular connection and collaboration would benefit all parties. Top management at the Provost level would be necessary to set goals and ensure all sides benefit. Funding is a key piece of this equation.

A single connection point

encourage and promote multidisciplinary collaborations

Better coordination within colleges and dept at the Univ level, before engaging with industry.

industry sucks off of the goodwill of academia all the time without giving back. if they are associated with our program give money/funds to support the program and not some paltry offering that does not properly support the research/mentoring efforts of the academics involved. Furthe, make sure it gets to the academics that are actually mentoring the students in the pipeline.

Centralization of communication, information, and the formal approval process.

Create a team environment rather than an individual one, that includes research. Solitary research is praised in higher ed, flip the thinking. It is more difficult to work in a group than alone.

I think the opportunities need to be expanded past high-money-making sectors. I don't know that you will get away from competitive situations if you keep to just the fields that make the most money. I feel that if every department had some relationship with parts of the city that would benefit from fresh, thoughtful student input and work, the experience would be more equitable.

Establish broad-based curriculum that is not duplicative in different Depts. (e.g., not everyone needs their own stats class, etc.) Allow students to delve deeper into real world and experiential learning.

no opinion

Include the faculty and departments in the efforts and ensure that you seriously include their expertise in planning and programming. Ensure that there are interdisciplinary and multi topical issues and training that are available to all students, regardless of major. For example, while a student may be in Sociology, there a Sociology of health students who want some training in health sciences and other STEM fields.

see earlier response

Counterpoductive turf wars are deeply imbeded in all sectors of education and usually tied to funding. There needs to be a benefit for collaboration that is greater than protecting ones island. Also, trust will be a factor, so a level of confidence in the project will influence success.

In the case of translation studies, where the need is extremely high in so many areas (I have many statistics) it is more a question of invisibility in the institution rather than competition or turf war. What we do is good for all industries and we need to be visible as the only translation and interpretation studies program in the State of California that addresses all facets of the industry of language services.

I refer back to may answer that focuses on the ways in which we use developed student core skills and high impact practicdes as opposed to colleges, departments, programs, and majors.

By setting up a framework for such activities. Allocating the budget which is the key factor in all the efforts and recognizing faculty who go above and beyond to bring the best into their classroom and conduct interdisciplinary research/teaching activities. By recognizing "Art" as a potential hub for innovation among all disciplines.

Contracting should be appropriate and collaborative. Have a lead from each college/dept that can highlight strengths. Ensure there is a key decision maker overall.

common sense requirements. essay requirements, marketing.

By working with interdisciplinary mentors and making sure that there is DEI. That will also help grants.

Make sure that every department is treated equally. Faculty to student ratio should be the same in all departments. When students are working in clinical-based courses, make sure that the student-to-faculty ratio is realistic.

Interdisciplinary research -- this way each department takes a piece of the pie.

Allow everyone to apply, let the funder make the selection.

Focus on the students and live the motto "student success!" This is not about navel gazing - it's about fulfilling our mission as an institution

Refer back to other answer about developing an infrastructure built on curiosity, listening, discovery (from individual departments) and adopting an inside out or bottom up driven mentality first of all. Then follow up with a realistic action plan that has university resources devoted to it that will support departments and colleges financially and offer research support to develop innovative collaborations and projects.

More opportunities for departments and faculty from different colleges to communicate

Common goals and strong partnerships

Break down the silos. e.g. CS is starting a degree in Data Science. Geogrpahy/Geographers do spatial data analytics. We could partner in curriculum, create mini certificates to prepare students to engage in specific industry projects (for example take a selected CS course, GEOG course and Business Course and be prepared to work for industry A, B or C. Identify core key competencies, determine where they are already being taught.

Open, transparent communication is key! Multi-disciplinary initiatives that are inclusive of students and programs from across different colleges and value the skills and talents that students from different departments and colleges bring to industry. Soft skills are highly important in industry and are often undervalued - such as critical thinking skills. Bring in different colleges and departments from the start, not as an afterthought or in a tokenized role.

Specific to CSULB, our CPaCE program traditionally has been competitive, rather than complementary to, college programs. At this point many colleges are attempting to organize programs 'stateside' rather than go through the hassle of extended ed. From the perspective of MHRM, our extended ed runs programs in HRM and in supply chain that are in direct competition, and do so without any input or oversight from faculty. They have made it clear that they would prefer to remain autonomous, rather than act as an 'extension' of the actual college programs.

I haven't experienced this at CSULB. What kind of resources would faculty be competing for?

The university will need to attract new partners. There has been a long history of faculty feeling their personal and professional contacts - that they've developed over years - are poached by the university and the resources from those contacts are diverted.

Communication is key

N/A

I already answered this.

Different sectors/departments should value other sectors/departments.

See question 11.

Not sure...

Share the information between the departments and universities (without sharing sensitive info)

- As mentioned before, elect or create a committee composed of diverse faculty and staff from Different Departments/Colleges. Open communication will facilitate working together.

No comment.

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Already answered.

Adopt an administrative rule that, If you can't work or play well with others you don't get to play at all.

We must have a student centered mindset, if the students benefit from the opportunity / experience then it should not be a competition. The turf wars come up when different departments don't get the credit for the efforts they are putting in or the students they are benefitting, so the college/university can also do a better job of giving that credit/recognition and allocating resources and advertising more equitably.

Reward complementary efforts

It should be a centralized hub for these activities that welcomes new people, the goal should be promoting innovation and student success.

Communicate and invite stakeholders from across the campus to participate.

I thought we answered this... focus on cross-disciplinary skills

Already answered this, let us form collaborative efforts. Turf wars will occur unless better benefits can be shown for everyone to work together

A taskforce with administers, faculty, and students should be developed. It should develop strategic goals and objectives and recruit the appropriate people to work toward meeting these goals and objectives.

Allow for meaningful compensation of collaborative work among the different groups. Reward collaboration and ignore competition.

Collaboration

Keep our focus on the city of Long Beach

N/A

Each area of focus needs someone who can be the conduit of information and partnerships.

Turf is only defended when resources are scarce. Rethinking how tenure and release time is awarded may help to reduce turf wars.

?

We could look at other successful models across the country.

More transparency across departments and colleges, especially when it comes to sharing grant money.

Not sure

unsure

Need someone who reviews partnerships and identify ways for all efforts to align effectively. I'm not sure how best to do this but it seems like reviewing service learning paperwork, internships, and research proposals to identify overlaps and then focus on encouraging collaboration.

This is a difficult question.

While most industries are discipline-specific, however, coordination could identify areas of common interest to make the efforts more productive. I think the key element is establishment of multidisciplinary centers and institutes that could be the primary for engaging the industry. This initiative requires university and colleges supports and should be coordinated from the top.

Question 19: Are there any other questions you would like to ask or comments you would like to provide?

N/A

If we agree that industry partnerships are valuable then let's have a Provost-driven effort to unite these across the board.

No

Nothing at this time.

Building industry partnerships takes time and resources. The university is often too slow to invest in building those partnerships, and too quick to claim credit for partnerships built on donated time.

Contracting and procurement processes could be streamlined and terms developed that support industry-academic partnerships in particular with small start-ups which are unlikely to be able to meet the same insurance/liability etc terms as established global industry orgs. This is an important issue that challenges innovation not just in academia.

Not at this time

None at thsi time.

NA

No

Not at this point - looking to understand before advising ...

I think it is a wonderful initiative. After nearly 3 decades in professional/industry education and higher education, what our students want most and need most is jobs -- access to industry. Programs and initiatives that do not just confer a degree, but rather prepare them for a career and position them for immediate access to industry -- a hybrid of classical undergraduate education and professional workforce training or a classical undergraduate/graduate education -- with extended professional certifications, internships, mentorship that is supported by the University, for which they can apply Federal and State Financial Aide.

This is incredibly important. Our graduates often find that they are "sort of prepared"; sort of trained to enter the workforce but there are hundred's of hours of workforce or professional training or internships that they would like to pursue after graduation -- but they can NOT afford it; they are scrambling for any first job (in any field, even at Starbucks) to begin to payoff their educational debt.

If some of this additional professional education was available to them within their degree program or as an "add-on" upon graduation, many would pursue rather than wait 3-10 years when they feel they can afford it. And/or a restructure of degree programs that were less broad-stroke, and job-focused for those who are clear on their career path would make all the difference. Or a program for declared majors who meet certain GPA requirements that allowed for some of their classes to be "outsourced" to professional training.

CSLUB should consider off campus infrastructure to develop ongoing work/study programs.

no

Not yet. Thanks for offering the survey.

N/A

N/A

I think for faculty, more than often the rate limiting step is time. I think commitment from university to provide faculty with runway to engage with outside university entities could benefit the campus and students.

Is this program focused on establishing industry-academic relationships? If so, how does this fit into the RTP process - should I spend time doing this or writing a paper? Does this count as service or are there other rewards?

No other questions.

N/A

No

No

Why don't the university working to mitigate the impacts of automation in the shipping industry and create a template to use with other industries? There is a blind eye to what is coming. The future isn't going to be pretty and the university should understand the responsibility they have to the community.

Not at this time. Thank you.

None

Ideas are always great, but there needs to be support for them. Often faculty are asked to do this work without compensation or even support for students.

I think this has potential, but will require that we increase the expectations for our students, so they can truly benefit from these opportunities. After 25 years of teaching and training students, I have see the lowest level of overall commitment and willingness to work in the last 8 years. My industry collaborators (most are CSULB alums) tell me they are disappointed with the training level and work ethic of students coming from CSULB now, which is quite disheartening because we have had a reputation for generating well trained and motivated students for so many years.

Is this more work with no rewards???

I hope that any policies that get put into place will make space for the arts and humanities and not be STEM-centric. Please run drafts past people in COTA/CLA/etc.

n/a

I wish the campus would value the capabilities of the University Library and its librarians and staff more. I would like to see the millions of dollars of research we have available be used more effectively when considering student development and their progress in their own connection with industry and their local community. We specialize in information and digital literacy - it is our job to help students and faculty understand how to evaluate information and its value to any project. This is a skillset that I believe all of our students would benefit from when partnering with industry during their time at CSULB and in their future, when they are on their own without access to our resources.

No, thank you.

The students are not prepared when arriving at the university. The seem to expect to be "spoon fed"

no

no

No. Good luck--sounds like a great project.

It would behoove those working on this project to think about the many professionalizing opportunities for students in translation and interpretation. I would welcome a conversation with someone.

While I am very supportive of increased industry engagement, my experience to date is that it often distorts education. Industry tends to focus on the needs of the moment from a 21-year-old student. When we train to that we end up educating students into permanent low-level jobs. As a university that focuses on low-income, first-generation, and minority students, we often contribute to the very barriers we are trying to break down. We, therefore, need to make sure that ALL industry opportunities for ALL students ALWAYS are matched to the intended learning outcomes set by the faculty in a given field of enquiry to support their learning and provide them as a resource (not the other way around). Students are students first, and it is the responsibility of faculty to ensure that they learn not only what they need in the moment but what they need to grow professionally across their careers and as humans across their lives.

When are we going to hear from the "Research & Development Gateway" plans and how can we access the result of this survey?

I would like to be part of providing suggestions for industry partners.

Thanks

Many more, but I do not have time to do this because it is the week before finals

N/A

Not at the moment.

Please come in with some benchmarks as to what others are doing - this should not be a clean sheet initiative, as others have undoubtedly tackled this!

I think at the outset of this project, it will be important for you to be sure you are not appearing to pile on, or actually pile on, more work at the local department/Chair level. Offer some infrastructure support that will bring value to individual departments out of the gate, that will encourage and support them to devote the time and energy to the enterprise of forging new relationships with other departments, colleges, and professional industry and reimagine how those relationships best serve our students and mission of the university towards Beach 2030.

No

No-

What is esri's role? Pleas reach out to Geography, we would like to learn more.
█████████r@csulb.edu

I would really like to remain part of the discussion! Thank you.

The other 'turf war' when dealing with industry has to do with alumni. University Relations and Development has a stranglehold on alumni outreach, and does little to collaborate or share. This hampers colleges attempts to maintain and develop industry contacts with our recent alumni, who often have better ties to their specific colleges than any university office. Is there a way to restructure Development to be more decentralized and supportive at the college level?

I hope that the College of Liberal Arts will also be able to take advantage of this program -- our students would really benefit from this.

The university is an institution and should focus on institutional-level partnerships.

No

N/A

No.

No

No

No

None

No.

No comment.

.

This type of partnership especially if we are making it as inclusive of a changing student body as possible will require funding and support for both faculty and students.

No.

No

Not at this time.

This seems interesting and I hope it will lead to better career guidance and outcomes for STEM majors who often find our general campus career fairs, options to focus on areas they don't find relevant.

The CSULB Dean's leadership academy is an useful model. Students are recruited based on merit and have potential internships waiting for them at Aerospace Corp. I think this model could work across a range of disciplines and would not necessary be for one company. Several companies could join so long as they guarantee mentorship and the availability of X number of internships per year.

https://www.csulb.edu/college-of-engineering/the-aerospace-corporation-deans-leadership-academy

This is an excellent idea and needs to be implemented quickly and with resources for us to work towards success.

NA

Well there be significant resources available to achieve these goals, or well the CSULB community be expected to work for free in order to obtain meaningful results?

The approach needs to benefit both academic and industry partners. Academic faculty have career requirements and goals that should not be overshadowed by the wants of the partners. It needs to be a collaboration.

I get the impression that whoever wrote this survey has never worked with students or done research and the whole thing is kind of creepy, like they're fishing for the best slogans to sell our students as cheap labor to a mining conglomerate.

N/A

Remember to engage ancillary organizations such as the Long Beach Area Chamber of Commerce which can provide linkages.

No

No

I am very excited about this initiative - about time!

No

No

no

Not at the moment.

no

Should one of the major goals of the university be research, innovation, development, and technology transfer? If so, how should the university meet this goal?

Appendix B: Flyers, Tables, and Figures

Paid Summer Internship at Gannett Fleming:

Are you interested in the future of Intelligent Transportation Systems (ITS)?

Develop KSAs for a Game-Changing Industry

The implementation of ITS smart mobility infrastructure in communities across the country is driving demand for engineering graduates with the knowledge, skills, and abilities (KSAs) associated with these transformational technologies. The ITS Engineering Talent Pipeline at California State University, Long Beach gives interns a rare opportunity to work with ITS experts on a range of innovative projects and real-world test beds.

About the ITS Engineering Talent Pipeline

Selected CSULB engineering junior and senior students will participate in talent-pipeline activities that will prepare them for a paid summer internship at Gannett Fleming's Irvine offices. Gannett Fleming is a pioneer of architectural, engineering, and construction innovations that support resiliency and sustainability in our rapidly changing world.

Requirements

- ☑ Must be a CSULB Engineering Student in your third or fourth year of undergraduate studies or pursuing a graduate degree at CSULB
- ☑ Strong critical thinking and qualitative/quantitative skills
- ☑ Interest in pursuing a career in ITS
- ☑ Aptitude and willingness to learn about transformational technologies

About Gannet Fleming   **About CITT**   **Apply Now**

The ITS Engineering Talent Pipeline is led by CITT and Gannett Fleming, in partnership with CSULB's Colleges of Engineering, Continuing and Professional Education, and the Undergraduate Research Opportunity Program.

Summer Internship at JPL:

Are you interested in the future of data science and satellite technology?

Develop KSAs for a Game-Changing Industry

Breakthroughs in satellite technology and data science are driving demand for college graduates with knowledge, skills, and abilities (KSAs) associated with computer coding, data analysis, and quantitative reasoning. The Data Science Talent Pipeline at California State University, Long Beach gives students a rare opportunity to work with JPL scientists on a range of innovative projects using satellite data.

About the Data Science Talent Pipeline

CSULB students from any major will participate in a workshop that, for some, might lead to a summer (2023) internship at JPL. Students who participate in both days of the on-campus workshop scheduled on April 7-8 will earn $200.

Requirements

- ☑ Must be a CSULB student eligible to work in the U.S. and willing to work onsite at the Jet Propulsion Laboratory in Pasadena
- ☑ Strong critical thinking and qualitative/quantitative skills
- ☑ Interest in data science and coding
- ☑ Aptitude and willingness to learn about transformational technologies

About JPL Internships

About CITT

Apply Now

The Data Science Talent Pipeline is led by the CSULB College of Natural Sciences and Mathematics in partnership with CITT and the Jet Propulsion Laboratory.

Table 4. Collaboration between CSUs and Local Industry Partners

Common Agenda:	Strategic networks of CPaCEs on CSU campuses, industry partners, and government agencies establish common agendas to implement talent pipeline strategies in the form of short-term programming, certification programs, etc. as a solution for targeting transformational skills building in the face of a rapidly changing work landscape.
Shared Measurement:	All partners involved agree to collect data and share results across all stages of talent pipeline planning and implementation to assess the effectiveness of the programming and each partners' involvement.
Mutually Reinforcing Activities:	All partners agree to play a distinct role in talent pipeline planning. CSU partners agree to be the backbone support and facilitate educational/training programs; industry partners agree to provide experts and consultants who can lead the conversation on in-demand KSAs, cast the vision for the selected programming/work of the talent pipelines, and refer instructors for the CSUs; government agencies can provide economic support and resources.
Continuous Communication:	All partners agree to scheduled meetings and a schedule of events/actions/etc. that are required for successful cross-sector collaboration and planned execution.
Backbone Support:	CSU partners will serve as the facilitators and managers of this collective impact and will primarily be responsible for convening partners to initiate and coordinate participation from all other partners

Appendix C: Pipeline Participant Responses

Students who participated in the Gannett Fleming pipeline were asked to briefly reflect on their professional interests and the ITS modules they studied. Slight modifications to formatting were made to anonymize students. Minor typos or other grammatical errors were corrected.

Student A: B.A. in Business Economics with minor in Comparative World Literature

For the Gannett Fleming summer internship, I would like to focus on the development and implementation of autonomous vehicles. When reviewing the ITS modules, this topic stood out as the most fascinating of the bunch to me. The third module, titled "Automation in Bus Rapid Transit", was the one that specifically piqued my interest. Previously, I was not aware of the implementation of autonomy in rapid transit bus systems, so it was very interesting to learn about. The benefits of autonomous vehicles, whether being used for transit systems or personal vehicles, could be revolutionary given the potential to reduce congestion and improve safety. Higher adoption of autonomous vehicles would lead to a safer, more efficient future, and for that reason I would love to contribute to the emerging field.

Additionally, I am interested in city planning and environmental damage prevention. Transportation and city planning go hand-in-hand, relying on each other to create an efficient community. I would like to help increase this efficiency through the use of my economic and writing-based skill set, researching problems and solutions and conducting relevant analysis. As for my interest in the environmental field, I believe it is an extremely important factor that needs to be properly thought out before going through with any future projects. To me, it is important to find the balance between solutions that are cost-effective and environmentally-friendly, combining the two to yield the most efficient outcome.

I am excited to be on an ITS team and contribute to the problem-solving tasks to the best of my abilities. I believe I have what it takes to help solve issues related to privacy rights, local and state regulation, and raising capital for projects. My unique skill set, combined with the skill sets of others on my team, can help clear a path for the future of ITS.

Student B: B.S. in Civil Engineering with a focus on transportation systems

We are living in a world where things are changing rapidly. To keep up with the arising innovations such as AI and data collection, I believe we need to have a goal that keeps us motivated. My goal is to understand a little bit more about ITS, get familiar with the new technologies, new organization terms, be able to identify which technologies are going to stay, and how we can utilize them to improve our transportation system.

Again, during my internship, I want to focus on exploring and understanding different technologies and strategies that can be applied to new ITS implementation. One area of ITS that

interests me is the concept of smart cities. As you may know, traffic congestion and inefficient transportation systems are major challenges faced by modern cities. These problems are caused by increasing population density and [an increasing reliance] on private vehicles. Smart cities are all about using new technologies and data to tackle these issues. It helps reduce traffic congestion, and create more sustainable, efficient, and smart modern cities.

Another area that has caught my attention is automated bus rapid transit (ABRT). Traditional bus rapid transit (BRT) systems face limitations in terms of operational efficiency, reliability, limited flexibility in route planning and scheduling, and passenger experience. ABRT solves most of these problems by using smart sensors, artificial intelligence, and connectivity to create a faster and more efficient public transportation system. I believe that by adopting smart city principles and ABRT, we can address some of the challenges we face today, such as traffic congestion, carbon emission, pollution, and inadequate infrastructure.

In addition to building my technical skills, I also want to enhance my communication skills. Effective communication is essential in any professional setting, and I want to improve my ability to articulate ideas, collaborate with team members, and present my work clearly and confidently.

At the end of my internship, I am hoping to find my capabilities and potential within the field of intelligent transportation systems and gain valuable experience.

Student C: M.S. in Computer Science, particular interest in artificial intelligence and machine learning

Objective: As a part of the main objective of the case study, I was supposed to go through the ITS PCB modules and undergo the pre and post surveys to understand what I gain from the modules vs what I already knew.

Key Elements: Key elements being the data received under transportation and the challenge about how the ITS can contribute to improved transportation and trade systems.

Summary:

- The introductory module has been explained very well with examples and testimonies at various place to serve as [evidence for the claims made]

- The inclusion of a video and real data is great but some words need to be rephrased

- For the planning module, there were certain grammatical errors. Great visuals were included but captions and explanation needs to be given in order to make those visuals clear

- I loved the inclusion of Bus Rapid Transit in the modules as it is one of the best examples to show the advancement in transportation. [However,] I feel a couple of other example

modules like autonomous driving or connected and communicating vehicles could be equally interesting and intriguing

- For the travel time module, there was much statistical information and formulae, which was necessary but a few example questions could have made the topics clearer

- I felt that data driven decisions module was the most effective and important one as it holds a great importance in the analysis and decision making for any intelligent systems

- I loved the visuals and explanations on the CMS module

- The ITS architecture module was the least effective in terms of deliverables for me as the architecture was mentioned but just with the diagram and was not clearly explained with steps.

- The architecture of any system is an integral part for its proper undertaking but it is not clearly [explained by] the module which can be improved

Suggestions for future iterations of the ITS module:

- In addition to the existing module, I feel that including one about sustainability and environmental impacts [would be justified]. Highlight how ITS can contribute to sustainable transportation practices by reducing congestion, optimizing fuel consumption, and promoting alternative modes of transport.

- I also feel like exploring the latest trends and emerging technologies in ITS, such as 5G connectivity, edge computing, artificial intelligence, and blockchain applications can arise a sense of curiosity in whoever is reading the documents and thus should be included.

Appendix D: JPL Workshop Pre-Survey Results

JPL Pre-Workshop Survey

Question 1 - What or who motivated you to participate in this workshop? How did you hear about this opportunity?

- I heard about this workshop from my Academic Supervisor.

- My passion to my learn. I saw a flyer on the 3rd floor of the Hall of Science.

- My academic advisor, [REDACTED], advised me to participate in this workshop.

- I was made aware of this workshop through a flyer, posted on the math department's bulletin board. I was motivated to attend this workshop to expand my knowledge on job opportunities in STEM.

- [REDACTED] encouraged me to participate in this workshop. I heard about this workshop through the METRIC faculty.

- In my robotics club, [REDACTED]one of my team members sent out an announcement for this workshop. Looking into it I saw there was an opportunity to learn how to code and an opportunity to land an internship at JPL which is only a far dream for so many including me. I jumped at the opportunity and signed up.

- My passion to learn. I saw a flyer on my way to my physical and chemical oceanography class

- I am going to be a new grad soon and I would like to have some hands-on experience and more information.

- regarding how data analytics is applied in the aerospace industry. In addition, I have always had an interest in aerospace and I want to learn how my major (applied mathematics) can be used in the industry, especially since it is an engineer-dominated field. I heard about this opportunity from my peers in my Master's program.

- I heard about it from a flyer sent out on a discord I am in for school. I signed up for the shop because I'm interested in JPL.

- Society of applied statistics, and heard it from [REDACTED].

- Flyer for workshop was on Physics and Astronomy Department Walls.

- I first heard about this opportunity from a friend and he has heard it from the CSULB math instagram account.

- Heard through csulb math/stat Instagram.

- I heard about it through my research advisor. I was always interested in anything NASA related.

- I am currently a SA at G2-lab, I saw the opportunity from my supervisor as well as the flyer was posted outside the G2-lab. Since it was mentioning about internship and resume workshop, I think it is an opportunity to finally sit down with someone to have a better guideline in applying for job and working on my resume.

- I saw this opportunity on CSULBMATHANDSTATISTICS Instagram page. I have always been interested in data gathered from satellites and an eager to learn more about the topic so I decided to apply for participation.

- I learned about the workshop threw the CSULB Applied Statistics Masters program Teams page. I wanted to attend because I am interested in learning about how the JPL is using satellite data.

- What motivated me to apply is my curiosity towards data science. CSULB does not have a data science major so I am looking to gain exposure and experience in the industry. I was introduced to this opportunity by [REDACTED].

- I motivated myself. I would like to pursue a career in data science, when Dr. Pair sent the application out it peaked my interest.

- I heard about this opportunity through the CSULB Math Department social media. I have mainly applied for engineering internships. However, I have never considered data science and was encouraged by professors to explore it as a potential profession.

- I am motivated to participate in this workshop because I am very interested in the field of data science and as an applied math graduate I'd like to learn more about this growing field as it is built upon the foundations of mathematics. I heard about this opportunity through the college of science and mathematics Instagram.

- I learned about this opportunity through my department chair, [REDACTED], but I was motivated to participate in this workshop because I am interested in the Data Science field and its applications. I really want to take the steps to increase my knowledge in the field.

- Explore career paths, learn new skills, and network. One of my geology professors informed me about the opportunity.

- Dr. Balbas told me about the workshop, and a possible internship motivated me to attend.

- I am currently working as an Intern for Research and Data Analytics at [REDACTED]. I spend most of my time working with data, and I fell in love working with data. Hence, I want to make my career in Data Science. Also, I heard about this opportunity from one of my colleague at work.

- I heard about the opportunity through applied statistics master's program announcement board.

- I wanted to gain some knowledge or experience that seemed more hands on so I can get an understanding of what companies are looking for after I graduate.

- I want to participate in this workshop since I have little knowledge of coding and want to improve more. I heard about this opportunity on my CSULB Math Department's Instagram.

- I found out about this opportunity through METRIC leaders and peers.

- My METRIC Scholarship Advisor, Professor [REDACTED] forwarded this opportunity to me. This is due to my interests and future career goal of becoming a data scientist.

- I heard about the workshop from my Statistic professor. I think this workshop would be a great opportunity to learn more about some coding and skills that needed for the summer internship at JPL. It would be a great chance to meet and talk to like-minded friends and people who have had experience in the field.

- Someone is my discord sent out a flyer and I was really interested because I want to work with JPL in the future so I want to get familiar about JPL and what this workshop can provide.

- No one necessarily motivated me to participate. Once I heard about this workshop through the physics department, I thought this might be a great opportunity for me to get some insight and the world after college.

Question 2 - How would you define Data Science?

- Data Science is a discipline where people apply mathematics using computer science.

- Data Science is a discipline that combines computer science, mathematics, and analysis.

- The process of gathering, cleaning, and analyzing data to build predictive models, using statistical and computational methods.

- Data science is the study of large data sets to understand the behavior and meaning of our system.

- The science to manipulate, analyze, and compute large amounts of data.

- The study of data to analyze, define, and diversify the information for various purposes.

- Data Science is the study of analyzing data to find trends, patterns and useful information for a business. Many tools can be used to analyze data such as Excel, coding as well as many other platforms.

- Data science is combines math and statistics, specialized programming, advanced analytic to help with strategic planning and decision making.

- Making predictions and applied machine learning.

- The study of obtaining, processing, analyzing, and presenting data.

- It is a discipline that involves working with data to analyze and to make predictions about the future.

- Cleaning and Analyzing data and drawing conclusions.

- The study for data and the study of what it can describe about the real world.

- Data Science is like a collection of collecting, analyzing, projecting from past and current information or any experience that can help us improve better choice and options for the future purpose in term of education, economic, career or in general.

- I believe data science is the process of gathering data from a wide variety of different sources and using statistics and analytics to make inferences and observations based on data. Furthermore, I see data science as the ability to communicate these observations and inferences to management and aid in decision making.

- Using machine learning algorithms to draw conclusions from large amounts of data where traditional statistical methods are no longer valid.

- A combination of math, computer science, and business. Organizing data to draw conclusions to problems.

- the collection and analysis of data used to optimize various other factors (i.e., minimizing resources used, maximizing profit, etc.).

- Data Science is the process of answering a proposed question by collecting a relevant dataset, and then drawing conclusive answers to the question asked.

- I would define Data Science as a multidisciplinary field that combines computing and statistics to extract insights from data.

- I would define data science as predictive analytics. Though part of data science is just looking at existing data, we are also able to use that data to gauge what future data may look like.

- Analyzing data(statistics, field measurements etc...)in order to obtain important insight or possible solutions to problems.

- The interpretation and processing of large amounts of information.

- In my opinion, Data Science is an interesting field which helps to extract trends and patterns, and also useful insights from the data. It uses Mathematical or statistical knowledge, Domain expertise, and programming knowledge to extract valuable insights.

- Analyzing data and formulating models to answer research questions and make future predictions.

- Studying and analyzing data so that we can draw conclusions from it.

- Data Science consists of different concentrations such as machine learning, data mining, coding/programming or even statistics to analyze and visualize complex data set.

- I would define this as the taking of a collection of measurements on something and transforming that large series of measurements through computation so that patterns and features of the measurements are able to provide a deeper understanding of whatever phenomenon is being measured.

- Data science is the use of statistics, mathematical modeling, and programming to data in order to discover findings or better understanding of said dataset.

- I believe data science is data analysis combining with coding. Using codes to translate and manipulate data to understand what data tells you about a research or survey. From that, we can get meaningful information that can help the business or projects to succeed.

- Data science involves math and statistics, programming, advanced analytics, (AI), and machine learning with specific subject matter expertise to uncover actionable insights hidden in an organization's data.

- I would say the data science is the programming and data collection behind the stats of a certain field whether that be in sports or more science based applications.

Question 3 - What do you think are common uses for the satellite data collected by research organizations like JPL? In other words, what is the value or purpose of the data collected by satellites orbiting the Earth?

- I believe the common uses for satellite data are for checking weather patterns, climate change, and tracking ice sheets.

- The value or purpose of the data collected by satellites orbiting the Earth is helpful towards the planet and the living organisms inside the planet.

- Satellite data collected by JPL has many valuable applications; such scientific research, environmental monitoring, navigation, disaster management and communication.

- It is important to collect the data in order to monitor the Earth in case of potential threats and to understand how our planet will evolve in the next few years in order to adapt to the changes more swiftly.

- The value that data from satellites is incredibly huge, as it can help with the issues of climate change, discovering new planets, or even life on other planets through the data they can collect.

- Climate change and adaptation and resilience. Urban and community development.

- The purpose for satellite data is to discover information about Earth's surface. This includes and it not limited to climate patterns, landforms, possible rising sea levels. Satellite data can also analyze historical data or be for military use.

- The data collected by researchers in JPL is to monitor the asteroids that come close by Earth and make sure that we know which asteroid potentially hit Earth.

- Make good predictions based on regression and machine learning.

- Study of the atmosphere, sea level.

- Some common uses might be to record observations around the Earth and to help scientists in their research.

- Measuring distance of wavelength travel?

- I believe the purpose of data collected by JPL is to analyze and understand what it happening in the real world that we couldn't really see happening from our current vantage point. It also allows for world wide data usage as opposed to simply being data from within a city or coastal area.

- To predict a better future on natural cause, to provide a better convenience for the community like using the map, gps, or predicting the weather.

- I imagine that the data collected by satellites orbiting earth is used to analyze weather/climate patterns, changes in sea levels, and to identify anomalous events that happen on earth.

- You can monitor changes such as the sea level, polar ice caps and large scale weather events such as storms.

- I believe the purpose is to study our planet such as predicting weather and climate change.

- Common satellite data uses could include documenting ocean phenomenons, noticing atmospheric differences, or gauging how the ocean basins and land masses interact.

- Satellite data research could be used for geographic purposes, such as a GPS system. It could also be utilized in climate change analysis, such as with heat maps.

- I think some common uses of the data collected by research organizations such as JPL would be to collect information about the changes of earth's vegetation, monitoring of the climate and following weather patterns, as well as navigation. The value of the data collected by satellites orbiting the earth is huge as the insights it has provided have been a tremendous help in us gaining a better understanding of the planet we live on.

- I think that some common uses for the satellite data include mapping the Earth, environmental monitoring, and weather forecasting. The data collected from satellites is essential for these reasons and many more. Additionally, using satellites, we can collect data about the oceans and other locations as well.

- Satellites can measure the affects of climate change, for example sea level rise. Data on sea level rise in a region is very useful for coastal towns.

- Detect groundwater levels (i.e subsidence) temperature data magnetic data.

- Data collected by satellites orbiting the earth are helpful to us in several ways. 1) This data can be useful for the accurate weather prediction and natural disasters like tsunami, and many more. 2) This data an also be helpful in the field of communications such as internet

access, and phone signals. 3) This data can also be helpful for national security and surveillance.

- I think human population and environmental tracking would be some of the major purposes of data collection by satellites orbiting the Earth.

- I think things like monitoring the environment, ecosystem and keeping track of things that happen around the planet are main reasons.

- I think satellite data collected by JPL can be used in scientific research such as earth's atmosphere, oceans, lands to make decisions on how we can benefit the society.

- I imagine there are a wide array of applications. The obvious one is GPS data which everyone from individual citizens to governments rely on to get themselves and other things where they need to be with extreme precision. Weather patterns can be understood and this informs logistics for everything in every field of life. Climate change understandings such as through measuring the amounts of greenhouse gases in the atmosphere. I could go on.

- The satellite data collected is used for the betterment of the people and the future exploremrent of space discovery. This data gives us a better understanding of the properties of the Earth such as climate change and advances us little by little to explore more of the cosmos.

- The very first purpose I can think of is location/GPS. GPS has been such a great innovation for society. Now people can get to anywhere they want without spending hours looking through a map to find a routes. GPS can detect which route is faster in advance and looking through a map wouldn't give that information. The satellite data can be used in electrical transmission, calls, radio stations, in order for information from the internet to work, they all need to know where to go. That's when satellite coming in to locate and detect. Satellite data is really important in investigations as well. Since satellite information is so important and powerful, it should only be controlled with integrity.

- To track asteroids, space debris, in other word the value/purpose collected by satellites is to understand more about Earth and track objects out in space that can be potential harmful to humanity.

- The satellites can collect lots of data. The first thing that comes to mind is the whether and different environmental aspects such as sea level. This can be valuable in determining the next steps in preserving the environment and more.

Question 4 - Can you tell us some ways (if any) that you might interact with satellite data on a daily basis?

- Some ways that I might interact with satellites on a daily basis is through wifi, GPS, and checking the weather.

- I check the weather forecasts through weather apps daily, which use satellite data to predict weather patterns. I also use Google Maps, which relies on satellite data to provide accurate location information.

- The GPS is one way I directly interact with satellite data to reach a desired location.

- On my daily commute from Pomona here I use GPS and cellular service to find my way here. Along with many other interfaces is how I interact with satellites.

- GIS maps, google earth, research articles.

- I believe checking my weather app daily consists of using satellite data.

- Using GPS, and weather app.

- Using different sorts of data like spatial and GIS.

- iPhone; GPS (navigation).

- I might contribute to helping gps record traffic which can help predict what the traffic would look like in the future.

- Tv, computer, microwave, solar panels, etc.

- You interact with GPS almost everyday. Electronics are filled with data coming from satellites all of the time.

- I use any map products like Apple map, Google map, or any weather map area if I need to travel to somewhere far, or daily weather check of the way going to school or work.

- I realize that cell phone usage is dependent on satellites. This includes apps like Instagram, the ability to make phone calls, checking weather forecasts on your phone, etc. I also know from my uncle, who is a mechanical engineer, that satellite signals are the source that allows us to watch television.

- When I travel and use Google maps to navigate I assume that uses satellite data.

- Checking the weather on my phone and gps.

- Using gps systems like the maps app on my phone interacts with satellite data. I'm sure there are tons of ways that I'm unaware of as of right now.

- Using a GPS system to drive to a destination is the first use that comes to mind. Another usage is through Geotagging photos on social media.

- Some ways that I interact with satellite data on a daily basis would be using my gps to find my way from point a to b, checking the weather forecast on how the day and days ahead will be as well as watching live streams such as sports.

- Some common ways I probably interact with satellite data is when I use Google maps using the satellite version or when I look at weather forecasts.

- I use satellite interactions with my phone on a daily basis when using Google maps when driving. Perhaps in the future I will be using satellite data to study climate, glaciers, fires, or geomorphology.

- GPS satellite images.

- We interact with satellite data in various ways in daily lives. 1) GPS Navigation 2) Weather forecasting 3) Radio and Internet 4) Agriculture uses by farmers.

- The weather channel and the use of directions.

- When I check the temperature/weather.

- I think satellite data that I interact on a daily basis is the Google/Apple maps, weather apps.

- Personally, GPS, internet access, weather reports etc.

- I interact with satellite data on a daily basis whenever I check the weather app in the morning or check my map directions when going to a new location.

- I use GPS almost every day. Without satellite data, I wouldn't know how to get to places. I am not that good at determining directions either, so GPS has been a great help. I wouldn't be to listen to the radio or watch TV without satellite transmission.

- Using my GPS and weather app.

- The first thing that comes to mind when interacting with satellite data would be through our phones although I don't think we are entirely interacting with the data more so just using the satellite as a means.

Question 5 - Some of the projects and exploratory research carried out by JPL will eventually have applications for commercial, government and military systems. Are there any important benefits that derive from the research conducted by JPL? Are there any moral or ethical concerns that may be raised by the transformational technologies that this research develops?

- There are many important benefits that derive from the research conducted by JPL such as tracking satellites, scanning the ocean and land masses, predicting weather patterns, and studying the solar system.

- Some important benefits are that JPL's work on Earth observation can help inform decisions related to urban planning, disaster management, and natural resource management. The development of communication technologies can connect people in remote areas. However, there are concer *[respondent did not finish this sentence]*.

- I suppose the main concern is whether those technologies were safety checked and that users are aware of all the implications associated with their usage.

- The research conducted by JPL will bring new groundbreaking technologies that will find the secret to issue we face today such as climate change, and the rise of water levels.

- research from JPL is highly interdisciplinary that support the development of various sectors. With data extraction and information can have ethical concerns due privacy concerns and fear of the unknown and the effects uncertainty.

- Some important benefits include warnings of severe climate change, developing further knowledge of space and national security. I believe expanding humanity's technological boundaries is inevitable, necessary and empowering. However, with greater discoveries comes greater choices and decisions to make, which is something that we must continue to be mindful of while continuing this endeavor. As a society, we must remain humble and always recall how privileged we are to be a part of the technology transformation.

- An important benefit that derives from the research conducted by JPL is the monitoring of asteroids. I believe that it is important that we focus on being able to stop asteroid impact on Earth because space has so many asteroids that we cannot account for all of it so we need to be ready to alter their trajectory or destroy them.

- Using AI applied for statistical research.

- Moral/ethical concerns would arise for military use; otherwise there is broad and great potential for technological innovation in commercial and government applications.

- I could see that the benefits could be to improve our technology and improve security. Some concerns may be lack of privacy and consent.

- Maybe.

- There will always be benefits and flaws to conducting research such as discovering new technologies or improving warning signals. If it's for the good of the world then there will be ethical and moral concerns involving the best course of action to take without hurting civilization as a whole.

- Better development on any commercial use would technically leading to better use, better decision making by human.

- The primary benefit I would gain would be to help advance technology in a way that leads to more favorable lifestyles for people across the globe. If any research helps identify predictors that negatively affect the rising sea levels, and there are steps we can take to swiftly aid this problem, it would be an enormous gratification to me. As far as any transformational technologies unsettling ethical stances, I don't foresee anything arising that could possibly raise concerns.

- Yes assuming that the research will be used for applications in the government, commercial and military then there are important benefits that derive from the research conducted by the JPL. Yes whenever something is applied there will be some sort of ethical concerns.

- Research conducted by JPL can have positive impact on these different systems to give more insight on what is happening on Earth. Some moral and ethical concerns my be the lack of privacy.

- Depending on the data gathered there may be ethical concerns about the invasion of people's privacy.

- JPL's research could certainly enhance the standard of living, such as improving accuracy or resource access. For example, GPS technology could help someone find something they are looking for. My moral concern is twofold: how would this affect someone's right to privacy and job availability. Both are complex issues that are not the responsibility of a single company, but I do think they are important to consider.

- There are many important benefits that derive from the research conducted by JPL such as improving how we navigate, gaining a better understanding of the world, and advancing our technology. The moral or ethical concerns that this research develops involves privacy

as the use of satellite data could raise concern about civil liberties, weaponization of technologies that could impact civilians, and the impact on the environment from rocket launches and electronic waste.

- I think that there are many important benefits that derive from the research conducted by JPL. One thing that I think is beneficial is the observation of the Earth to see climate change. I think that this type of research is especially important because it is difficult to see on a smaller scale. I think that my main moral concern about these transformational technologies is that the data would either be hidden to the public or used to aid in warfare.

- I think there are lots of moral concerns in terms of the development of technology in general. People have been questioning whether or not A.I would beneficial or detrimental. However, I think that the data provided by JPL's atmospheric and environmental scientists are extremely beneficial to local governments. For example, sea level data from JPL could save a town who has weak infrastructure or is prone to flooding.

- improved satellite systems, areas can be researched without having to go there no moral or ethical concerns for me personally.

- Definitely. there would be several benefits such as, 1) Space Exploration 2)Technology improvement in GPS and Internet Services 3) Helpful to National security Also, there are moral or ethical concerns such as, 1) Concerns about Privacy 2) Concerns about Military Applications.

- Some important benefits that derive from the research conducted by JPL include technological advancements, positive impacts on the environments, scientific discoveries and so much more. I do believe some of these transformational technologies will raise moral and ethical concerns at that these discoveries will be used for.

- I think the research conducted by JPL helps us understand more about the planet and what's going on in it serves to be very useful information. I think there could be concerns about access to the data and who to entrust it to, an imbalance of power of who's controlling the satellites and the data it gathers and it could potentially be used for the wrong reasons.

- I think one of the significant benefits from the research conducted by JPL is navigation and communication. It leads to the development of GPS systems/ maps or weather apps. And Privacy is the moral and ethical concern that may be raised by the transformational technologies that this research develops. Technologies developed for surveillance purposes may raise concerns about individual privacy.

- Research conducted at JPL and elsewhere always has important ramifications even if the goals of the project fail.

- Knowledge and technology are harnessed for the betterment of all both directly by achieving a milestone in the project or indirectly in a way that another field of science may find some data massively useful in their own research. This has sort of a snowball effect. Naturally there are often times moral and ethical concerns with emergent technologies and so it is imperative to keep ethical progress and pace with technological progress.

- The research conducted from JPL can improve the monitoring of location and events which the government may find useful. Moral or ethical concerns that may be raised is the concept of privacy and understanding if improving research may lead to be an obstruction to an individual's privacy.

- I believe since satellite data is so powerful, it should only be used for security and safety purpose. Personal privacy should always be concerned when using or researching about satellite data.

- I feel like the most important benefit that derive from the research conducted by JPL is the tracking of asteroids that pass by near Earth. Space is filled with so many asteroids and on any day any one of those asteroid can hit us and we must find a way to defend ourselves from these asteroids if we want to survive.

- I think there could be tons of benefits that derive from the research, however, there could also be an equal amount of moral or ethical concerns. I think it more fitting to have research that benefits society at a slower pace than to have research come at a cost greater than money such as negatively impacting the environment and humans.

Question 6 – Who do you think are key stakeholders in the development and deployment of advanced satellite technologies and the data collected by these technologies?

- I think the key stakeholders are government officials, politicians, or government agencies.

- The key stakeholders include government agencies, the private sector, academic, and research organizations.

- Government agencies like NASA, National laboratories, and academia researchers.

- I would say the government would be a key stakeholder in the development and deployment of advanced satellite technologies and data. My reasoning for this is as they are usually the ones who invest in technology with the vision of looking many years into the future.

- Government agencies, private industry, corporations.

- The key stakeholders would be the U.S. Government and military, national laboratories and private companies.

- The government NASA or any other AI advanced technology development.

- Government, military, private sectors (defense).

- I am not sure.

- Military, government research, airplanes.

- I would say there are a lot of stakeholders. You have the top like governments and space agencies. And it would trickle down to manufacturers all the way to daily users be they an individual or a large group of people.

- User's data.

- I anticipate that military, commercial companies dependent on satellites, and the scientific community writ large would be those stakeholders most interested in development of advanced satellite technologies.

- Government, military and private industry

- NASA

- Most likely the military is a key stakeholder. There are also probably a ton of private corporations who are invested (possibly like Elon Musk?).

- From a government perspective, I believe that the military and intelligence organizations are key stakeholders. My understanding is that they have some of the highest budgets in the country, and utilize satellite technologies frequently. On the commercial side, I believe that transportation and agriculture may be the most important industries. They would satellite technology multiple times per day.

- I think there are many key stakeholders in the development and deployment of the advanced satellite technologies and the data collected. Government agencies such as the NOAA, private companies like SpaceX, scientists and researchers, environmental organizations as well as the general public.

- I think some key stakeholders in the development of deployment of advanced satellite technologies and the data are military companies such as Northrop Grumman and Raytheon. Also, I think that data users who frequently need to use satellite data are also some key stakeholders.

- I think lots of people can benefit from satellite technology. Some of which being us/civilians in our phones and guidance systems, scientists who use it for research, and the military for weapons.

- average people, for GPS scientists for large amounts of data take over a large area military for military purposes.

- I believe mainly there are number of key stakeholders such as: 1) Government Bodies --> For national security and military services. 2) Private Companies --> For construction of Satellites 3) Scientific and Academic Institutions --> For advance research and study 4) General Public --> For usage of GPS, Radio, and Internet services.

- Government agencies, private sector, research and education institutions, and the overall public.

- government, NASA, contractors, anyone who works within these companies deploying and data collecting etc.

- I think government, commercial companies, scientists, environmentalists in general are key stakeholders in the development and deployment of advanced satellite technologies and the data collected by these technologies.

- The military tends to be the largest funder of projects in this field and many others and as a result this would likely make them the biggest stakeholders. Though their budgets are so big, if a project fails they won't lose out on much so I would say that those in the tech and data sector have the most invested given their much more limited resources compared to the military.

- Key stakeholders of this data and technology are most definitely federal agencies and science organizations.

- I believe it's the government and they do that for security purposes. Big tech companies as well. Society is on the path to a world where technology will be an irreplaceable part life. Satellite data is so important in that, because without satellite there's no way for information to be transmitted to everywhere in the world.

- The government.

- I am not very familiar with satellite data, but I'd imagine companies such as SpaceX and NASA would be key stakeholders as they are the ones who launch the satellites and would most likely be the ones collecting the data from their satellites.

Question 7 - What knowledge, skills, or abilities do you want to develop by participating in this workshop? What value do you think it offers your education and/or career development?

- I would like to be more familiar with MATLAB and how it applies to helping the world become more safer.

- This workshop offers an opportunity for me to gain experience with data science techniques, through working with [real world] data sets and learning to apply statistical methods to solve problems. This workshop would also expose me to more career opportunities in the STEM field. This workshop would also provide opportunities to network with professionals in STEM, which could lead to career opportunities.

- I believe data science and coding skills are increasingly important nowadays in all areas of research. Along with that, being better informed on how to get involved in internships.

- In this workshop, I want to learn how to code and put it into use. In the past, I have attempted to learn to program on my own yet I haven't been able to apply it practically. This workshop will do just this where I get to apply what I have just learned.

- Understand coding and HOW our analysis translates to actions. This diversifies my professional background and how I can apply to both of my internships. How can I bring this to the high school students and into my internship as an environmental scientist.

- I want to improve my coding skills and machine learning knowledge with this workshop. I also want to learn how my overall mathematical skills can be implemented into real-life industry work. This workshop is very important to me because I have worked on many projects and have been lectured on how many concepts we learn is used in common work, but I have never seen it first hand. Although being an Applied Mathematics major comes with many opportunities, we are rarely exposed to what specific positions we can do. Participating in this workshop will allow me to see the different kinds of fields I can work in and see which interest me since I will be a new grad next month.

- Able to analyze data and understand what that data tells us. Use models and apply what we learn in our studies.

- Applying statistical research and machine learning.

- Low-level programming (assembly?), how satellites are used by JPL to obtain types of data, how this data is stored/processed/analyzed.

- My interest is in data science/software engineering so I believe the workshop will give me new insight into how one particular company uses an embedded system and analyzes such data.

- I want to gain domain knowledge about the aerospace industry, especially in NASA, and I want to improve my skills to be a data scientist.

- Data science, coding I would like to gain some more insight about what JPL does and can do for the greater good of humanity. I would enjoy learning how to code better and what code is being used. I would also like to learn about the specific pipeline that data science is in. I believe that I can gain good technical and on the job experience with this workshop.

- Integrity, team work and passionate about the topic that I would like to do, in this case is data science and coding.

- I hope to learn about the technologies used by NASA—how they are deployed, how they measure, what they measure, and how real data scientists and engineers approach these problems. The opportunity to learn from a company as renowned as NASA, I believe, will be extremely valuable in the long run for a career in data science.

- I would like to gain more skills in general problem solving ability and a introduction to new use cases. I think the workshop will provide an opportunity to learn about new techniques and methods that I am not familiar with.

- I want to develop my computer science skills and gain experience in industry. Likewise, I am also looking forward to surrounding myself with like minded people and learning how to work in a professional setting. I believe this opportunity will allow me navigate to career I am passionate in since it's difficult to know what you enjoy if you haven't been able to experience it (being able to get out of a classroom environment).

- I would like to understand more about the data that satellites can gather. I also want to learn more about different ways that data science can be conducted and how to derive results from the data gathered. This will be beneficial to my career development because it will help establish better foundations in data science, which is the field I hope to pursue after graduation.

- I want to develop my ability to work with large datasets, and optimizing performance speeds. My training at CSULB mainly consists of low-level computer hardware that considers cost more than performance as a restriction. I think I would benefit from approaching technology and problem solving from a different constraint to develop well-rounded skills.

- The knowledge, skills and abilities I would like to develop by participating in this workshop are to gain a better understanding of satellite data and how to analyze the data, develop my computational skills in a real world context, advance my data visualization ability and be able to better communicate the insights gained from data exploration, further my team

working skills with the chance to work and collaborate with a diverse team with different backgrounds. I believe the value it offers for my education and career development is vast as it provides me with the chance to work hands on with real world data and an opportunity to learn and network with experts in the field. The workshop will also be valuable in building my resume and preparing for a future career in data science. Overall this workshop is a valuable resource to build knowledge, skills and experience.

- I want to get insight of what JPL does as well as the data science application. I think that it offers me a learning experience and also some insight of which field I want to go into in data science.

- Skills I would like to learn include basic coding and the quantitative side of geology such as making models. Both of which are skills that not all geologists have and would be valuable for me. I want the experience of working in a geology job before I graduate. I think it will provide me with valuable incite on what type of job I will want.

- I would be able to develop strong Data Analytics and Data Visualization skills through this workshop. Furthermore, I would be able to gain more knowledge in the domain of satellite data. Moreover, I want to utilize my skills and knowledge in the one of the niche area like satellite data. Hence, it would be really important for my future career.

- I am interested in discovering the various projects that JPL data scientists are currently engaged in, particularly how they utilize data science and statistics in space exploration. Acquiring this information will greatly assist me in determining how to combine my educational background and skills to pursue a career in this field.

- I would like to be more fluent in coding, how to approach data analysis and collection, working with data in a real life setting and getting an idea of what a typical data scientist goes through including the motions, tasks etc. I think it offers a ton of value because I'll be able to meet people who have been in the field for a while and get perspective on what I can expect in the future if I want a career in data science.

- Coding is the skill that I want to develop by participating in this workshop. I think I can know more and improve my coding skills, which is extremely helpful for my major and future career.

- I firmly believe data science and machine learning are going to be profoundly important tools for solving enormous challenges now and in the future. I would like to develop the programming and statistical skills necessary to be able to use these tools in an even more effective way. Naturally as a junior scientist, I would like the most powerful tools available at my disposal so I would like to start as early as I can to get a handle on how these technologies work.

- From this workshop, I wish to develop a better understanding of how to handle and extract information from real-life datasets. More specifically, learning of data visualization and relevant programming packages in R or Python and concluding meanigful findings from said data is something I have recently grown interest in, and I believe doing so with this practical experience will offer me knowledge I cannot gain through a classroom setting or self-studying. This will greatly benefit me in my journey of pursuing a career as a data scientist.

- I want to have more coding skill and critical thinking skill. It would be nice to learn more what satellite data is actually used and what is the future for satellite data. I think the workshop would prepare me well for a lot of scientific research opportunities in technology field.

- I want to develop my data analyzing skills, learning how to interpret data such as graphs, charts, tables. Able to use the necessary technologies to be able to track data.

- I want to be able to see how computer science and coding is used in the real world, and not just in the classroom setting. I think this will offer a tremendous amount of value as it will show all the applications of things I have learned in class in a real world setting as well as give me insight into what I could possible want to pursue in my career.

Appendix E: JPL Post-Workshop Survey Results

Question 1 - Is there anything that you learned or experienced during the workshop that surprised you?

- I learned how to code in matlab and how it can be applied to a real world problem.

- I was surprised by how friendly and welcoming the JPL team was. They really cared about the students and wanted to be as much help as possible.

- Yeah I was surprised about how fast the sea levels are rising and was gratified to learn about the machine learning techniques used for image classification.

- What surprised me was the networking I was able to establish from the workshop and learning how to code using Matlab.

- I learned that JPL has a surprising amount of diverse topics they study and work on. I also learned a ton about the internship process and what they do during their research.

- That climate change is really more drastic than I thought.

- Learned [MATLAB] and geology I didn't know.

- I learned that JPL is mainly a research organization, as opposed to other tech industries that shows a more practical approach. I've also learned that JPL is very vast with different departments that focuses on various specialties (such as earth science, water dynamics, etc.).

- I was astonished to discover the far-reaching impact of carbon emissions on our planet, particularly when [JPL STAFF MEMBER] emphasized the potential consequences of melting Arctic ice sheets on the beaches of Southern California. The warming of our planet caused by greenhouse gas emissions is causing rising sea levels, which can lead to devastating consequences for coastal regions around the world. In addition to Southern California, many other areas of the world, including major cities like New York and Miami, are at risk of flooding and displacement due to rising sea levels.

- Most of the hand on work from this workshop is really different with what we learnt in school.

- Up until now I figured that JPLs engineering department was bigger than it's earth science department, and therefore there isnt very many positions for geologists. It was also interesting to learn about new research that's being conducted at JPL.

- I learned so much more about climate change and ice melting on the Earth. There was so much insight as to how climate change worked and it was told by experts so it was really insightful. Also, I learned a lot more of the interfaces that are used by them to map ice sheets.

- The working environment as an employee at JPL, in other words, you can have intellectual freedom while working at JPL.

- I learned many things that surprised me such as how devastating it would be if the sea level rises in a short amount of time. I was also surprised about how many satellites JPL and NASA uses to track ice movement and ice flow.

- here were many things that surprised me, the extent of the impact of the melting ice sheets was beyond my expectations. On another note, I was also surprised to hear that it is almost impossible to get admitted into NASA unless we have some kind of network established with people in NASA.

- The power of machine learning in the context of scientific modeling to make accurate predictions of phenomena that we currently have no means to directly measure was fascinating to me. Very surprising.

- I learned that it doesnt necessarily matter what you major is in order to do research cause every field needs a variety of different backgrounds and experts.

- Yes i learned more about matlab, ice sheets, python and much more

- Yes

- I learned a bit about using the mesh in matlab and python. A lso how to use it for machine learning.

- How much work coding is.

- I was very surprised to learn about machine learning during the workshop. I was also surprised to receive encouragement JPL scientists on pursuing a PhD in the future and a career in research.

- I was surprised to learn about the specific models the JPL scientists use model the ice sheets and coastlines.

- The process of mesh generation and the trade-off between high and low resolution as it relates to sea level mapping.

- How important the work is for all of society that jpl does as well as the plethora of projects being worked on.

- Ice Sheets, Machine Learning, and Coastline Extractions.

- I can learn coding without needed a degree in math, computer science and/or physics.

- the drastic effects of climate change on the ice sheets and how fast we can be affected by it.

- About the applications of machine learning.

Question 2 - How would you define Data Science? Do you think your definition has changed much (if at all) because of this workshop?

- i would say data science is the study of data and how it could be used to tell you something about the real world. I do not think it has changed over the course of the workshop.

- I still believe data science is the study of data, but instead of being applied to mostly corporations, it can be applied to the well-being of the planet and its features.

- the science of using data to classify, quantify, and predict. My definition hasnt changed, but i did find that data science can incorporate many more domains than expected.

- My definition of data science has not changed much from my initial definition. My initial definition of data science was implementing computer science to graph and visualize data to draw scientific conclusions.

- I define data science as the collection and analysis of data suited to explore a certain hypothesis. This definition has been refined a bit, but has not really changed because of the workshop.

- My [definition] hasn't changed that much.

- Data Science is the use of data through [statistics], mathematical, and programming methods to solve a problem. My definition is the same.

- Data science is mainly about cleaning data and preparing it for analysis. After the workshop, I would say it may be changed my opinion of its definition. However there are many concentrations within data science. In this workshop, the presenters mainly focused on machine learning and math modelling.

- Data science is essentially the process of examining large sets of data using computers and statistical methods to extract insights and knowledge. It involves using math and other

specialized skills to analyze complex data sets, and it helps organizations make better decisions by providing them with a deeper understanding of the data they have. However, the workshop has taught me how it help scientists to create models that can predict the future impact of climate change on coastal regions, allowing policy makers to plan and prepare for the effects of rising sea levels, and other environmental changes. It's a powerful tool for understanding the impacts of global warming on coastal regions, and for developing strategies to mitigate those impacts.

- You project the future outcome of a certain area with past data and current data we already have.

- I think my definition of data science has not changed. The workshop taught me how to connect data science to geology, ie how I would model concepts in geology.

- I think that my definition is still the same, where data science is just predictive analysis using existing data. Data science is an interdisciplinary field that involves the use of statistical and computational methods, not only do you need to have coding skills, but you also need to have some insights about Earth Science as well.

- Data Science is the ability to implement many multiple variables within a program that helps people analyze complex problems. My definition of Data Science has changed after experiencing this workshop because I learned first-hand how industry professionals use data to help maximize efficiency within their work.

- I would say that the definition is mostly the same, but I have a better idea of the meaning and the [methodology].

- I would say my definition has remained the same but now I have a deeper context on what that specifically means in a research capacity rather than an industry one.

- I think the workshop really defined what I already knew about data science while filling any holes that I wasnt certain about.

- I would still define it the same as I did before.

- Data Science is using scientific tool to extract information from raw data. My definition is confirmed.

- I would define data science as using models to help us make predictions or projections.

- Not much change.

- My definition didn't change much; my understanding of how it works has definitely expanding.

- My definition has not changed, but I was able to see it applied to something I was new to.

- Data science is a set of techniques beyond traditional statistical methods, including optimization processes. Yes my definition has changed, I did not realize that there was so much optimization algorithms.

- I still stand by my previous definition of what is data science but this workshop has further defined how theoretical aspects from mathematics can be applied in a real world setting.

- I think Data Science combines mathematics and computer science to solve real-world problems.

- Data science is beyond coding.

- I think my definition is the same for data science.

- I think my definition is same as previous one.

Question 3 - What do you think are common uses for the satellite data collected by research organizations like JPL? In other words, what is the value or purpose of the data collected by satellites orbiting the Earth?

- The data can be used to conduct data science and model the real world. It also serves as a crucial part to Earth's overall well being. Satellites can see first hand if the Earth is being harmed or actually getting better over time.

- Common uses include monitoring the affects of climate change and global warming, weather and national security.

- the satellites collect images and help quantify the physical characteristics of the geography of our earth.

- The purpose and value to collecting data from satellites in this workshop is to predict sea level rises and study ice sheets. This can help businesses and the government make better construction and budgeting decisions when it comes to constructing buildings.

- The purpose is to be able to analyze changes happening around the world and see how they could possibly [affect] us.

- To [collect] important data that can help us understand thing with greater detail such as the effects of climate change through the next 100 years.

- Can be used to tack weather and location, as well as the weight of ice sheets as we have learned.

- We can use satellite data to study various topics. Such as: distances to planets, how long it might take a rocket to reach the planet, space-planet interactions, and so much more. Satellite data is very useful as it helps researchers study earth, space, solar system, and etc.

- Satellite data collected by research organizations like JPL is an essential tool for monitoring the effects of global warming on coastlines around the world. These satellites allow researchers to observe changes in sea levels, ocean temperatures, and weather patterns over time, providing critical insights on climate change and its impact on coastal ecosystems. By analyzing large datasets, researchers can identify patterns and trends in environmental data, helping to develop models that can predict the future impact of climate change on coastal regions.

- To [observe] the physical change of the earth base on human factor.

- Aside from being useful for gps systems on my phone, they can provide valuable information about earth systems. In the workshop we learned how modeling the cryosphere and hydrosphere is important for the safety of coastal infrastructure.

- Satellites have many different purposes such as imaging of the Earth's surface and the height at each point of the earth. I learned that there are 2 satellites that use gravitational pull to map the height of the surface.

- The value and purpose of satellite data collected by research organizations like JPL lies in its ability to provide critical information to help address global challenges such as climate change and environmental degradation.

- Common uses for the satellite data collected by research organizations like JPL are tracking the Surface Mass Balance for ice sheets and checking the water levels around the world.

- A big use of the satellite data is to study the impact of certain phenomena on Earth, as well as our own impact on the environment. Other uses relate to finding ways to mitigate those impacts. For instance, by investigating what may have happened in the past that could be similar to the present and understand how we may prevent unfavorable outcomes.

- Modeling and quantifying natural systems and parameterizing their characteristics so that projections can be made and the systems themselves can be better understood.

- Satellite data allows us to collect data in places we could never visit or deep underground that would be nearly impossible to collect. It allows us to see what happened in the past and make projections about what could happen. for seeing the change in our environment and ecosystem.

- To help research about the environment and climate change.

- Monitoring ice sheets and sea level.

- Ice, ground water, heat, elevation change.

- Very high value and purpose data is being collected from satellites regarding sea level, altimetry, etc.

- Some common uses for the satellite data include environmental changes such as ice sheet melting, rising sea levels, and much more. The value of this data will help project changes to the earth in the future and help sustain human habitation.

- To monitor the polar ice sheets' melt and use that information to forecast sea level rises in certain geographical regions.

- There are many uses for the data collected from satellites by JPL, one use is the monitoring of glaciers and the effect it has on water rising along our coastlines.

- Common uses for the satellite data collected by research organizations are for finding the surface mass balance, mass balance, and discharge.

- Climate change, adaptation, and resilience. Mitigation. Technology advances.

- To retrieve data, such as using the instruments to measure how much of the ice sheets will melt through 100 years.

- For predictions in sea level rise

Question 4 - Can you tell us some ways (if any) that you might interact with satellite data on a daily basis?

- Your phone is constantly getting information from satellites.

- By using my weather app daily, I interact with satellite data.

- cell phone usage, television, gps, etc.

- GPS and weather app.

- using the weather app, using google earth or similar programs.

- GPS and weather app.

- Weather app and google maps.

- Cell phones, internet, computers, etc.

- There are several ways that I interact with satellite data on a daily basis. One common way is by checking the weather app, which use satellite data to provide information on current weather conditions and forecasts. I also use GPS or navigation apps, such as Google Maps and Waze. Which use satellite data to provide real-time traffic updates and directions.

- Maps, the weather apps.

- I interact with satellite data every time I use Google maps for directions. Some geologists also use satellite data, perhaps I'll be one of those geologists in the future.

- I would interact with satellite data anytime I wanted to view imaging of the Earth's surface, the height of areas above and below sea level, and the weather.

- GPS apps and weather apps on our mobile phone.

- Some ways I might interact with satellite data on a daily basis are by using wifi, GPS, and checking the weather.

- I believe I mostly interact with satellite data through GPS.

- Beyond what I stated before, I will likely interact, in some form, with the data available to us through NASA.

- The only interaction I may have with satellite data is using my phone.

- Checking the temperature.

- GPS.

- Any activity that involves being outdoors.

- Gps, Phone, Weather and maps.

- I use google maps when I drive to a new area, and I use a wind finder app that uses satellite data to determine if there will be good breeze for sailing.

- Some ways we interact with with satellite daily are navigation and weather forecasts.

- I frequently check the weather, which uses satellite data.

- Yes, gps, GIS and environmental sciences classes.

- GPS,

- For GPS, and Natural disasters prediction.

Question 5 - Some of the projects and exploratory research carried out by JPL will eventually have applications for commercial, government and military systems. Are there any important benefits that derive from the research conducted by JPL? Are there any moral or ethical concerns that may be raised by the transformational technologies that this research develops?

- Overall, I believe research conducted at JPL is morally correct since it benefits the entire planet. I can see the issues involved with implementing change on communities that might not enjoy it though.

- Important benefits include having a forecasted analysis of what the future holds for humanity due to the current weather conditions. Because most of JPL research is for the benefit of life on Earth for centuries to come, I do not think there are ethical or moral concerns.

- lots of the data collected can be used to model things like climate and weather patterns. No moral or ethical concerns by me.

- Important benefits would include the ability to predict sea level rises to make better decisions. Some concerns would be how many sites would be flooded due to sea level rises and how can we prevent them [from] happening.

- Important benefits include discovering ways to help preserve the Earth, as well as being informed about the situations going on around the world. I don't think there are really any moral concerns with the workshop i [attended].

- The research conducted by JPL let's us know that we have to start now in order to deter the effects of climate change in the future.

- JPL research can be used to track locations. Can bring the concern of privacy however.

- There are benefits of the research conducted by JPL. I think they might benefit the military or other government organizations in the development of aircrafts, space ex ploration, etc. I am not too sure about the moral and ethnical concerns of this research, since I have no experience in this industry.

- JPL's research has practical benefits as it leads to the development of technologies that can be used to improve our planet, as it pertains to the global warming crisis. However, the transformational technologies that this research develops can raise moral and ethical concerns, such as concerns about privacy and data collect from satellites.

- It is hard to explain.

- There are always moral and ethical concerns in weapon development. However, as we learned in the workshop, satellite data can provide valuable data about earth systems.

- I understand now that there are many important benefits. The research that I learned about for example, actually drives a lot of politics since climate change affects countries around the world.

- This research will show where it is beneficial to own homes, where the sea level will rise, and how fast this change will happen. I think the main moral concern is if the information is concealed but the specific research I learned about was open source.

- I think one of the obvious benefits is scientific discoveries, these discoveries have the potential to improve our understanding of the natural world and inform innovative decisions. The privacy concern is the moral and ethical concern that may be raised by the transformational technologies that this research develops.

- There are many important benefits that derive from research conducted by JPL such as collecting data to help track global warming, tracking weather patterns, and analyzing how the data collected can affect the world around us.

- One of the benefits I can see from research conducted by JPL is the initiative on staying informed with the way our Earth is evolving and the outcomes of that evolution. For instance, the rise of sea level and the impact on the shores, especially those that are far away from ice sheets. In this case, we may consider the ethical implication of contributing to global warming leading to the melting of ice sheets. Since we are well aware of the outcomes, is it wise to ignore the warning signs for the sake of politics?

- Beyond what I stated before, climate modeling in particular has the capacity to shape the world on every level, assuming those in charge are willing to enact policies to defer the projections made by the climate modeling.

- There are plenty of important benefits from the research conducted by JPL. For instance, any research or data that arrives from JPL can be used to direct the government to take the appropriate action to resolve this issue, it helps catch things and study things within our environment even when we're not physically close to it.

- No. I think their projects are done for a good cause.

- I still think the moral concerns are that it can affect people's privacy and their security.

- Better climate models. No.

- *Technological benefits *moral/ethical concerns with defense/ military.

- I believe much of our discoveries about earth and other scientific discoveries will derive from the research conducted by JPL.

- The JPL does research on sea level forecasting, which has big implications for coastal communities. Such information is essential for city planners to identify areas at risk. One ethical issue from the research is that it has a global impact and if a site is identified as "at risk" but does not have the resources to combat the change; this presents an ethical dilemma.

- There are many benefits that derive from the research done by JPL that benefit society such as coastal planning and better insights into the natural process of the world. Some moral or ethical concerns could be privacy and electronic waste.

- There are many important benefits that derive from the research conducted by JPL such as coastline extraction, sea-level projection, and ice flow. There may be ethical concerns about polluting space with too many satellites, but they are important for the future.

- permafrost melting will impact commercial and housing development.

- I don't think there is any moral concern because the research being done is to help further help our planet.

- It can impact the humanity to a great extent.

Question 6 - Who do you think are key stakeholders in the development and deployment of advanced satellite technologies and the data collected by these technologies?

- Government, local governments, the users.

- The U.S. Government, the army and private corporations are key stakeholders.

- military, corporations, and scientists.

- NASA

- Companies who are inclined to care about the research going on. So NASA , some ocean conservation companies and people like that.

- The government and private corporations like SpaceX.

- Science Institutions and the government.

- Military and government organizations.

- The key stakeholders in the development and deployment of advanced satellite technologies and the data collected by these technologies include government agencies, research organizations, and private companies.

- Human factor .

- Satellite data can benefit the scientists who analyze it and make models to the people who use the models.

- Probably military companies, companies that need data on the weather, and geologists.

- Scientific and research communities, environmental organizations and government are key stakeholders in the development and deployment of advanced satellite technologies and the data collected by these technologies.

- I believe key stakeholders are government agencies and government officials.

- Researchers at NASA, and other national laboratories and agencies, may influence the development and deploy ment of satellite technologies by writing proposals in order to gather the data that they need.

- Key stakeholders are governments with space agencies who benefit from knowledge acquired by these technologies.

- Most likely national laboratories part of NASA such as JPL and Goddard.

- NASA and government.

- Government

- No idea.

- Average person, governments.

- Defense/government.

- The government, NASA and other space agencies, the public and private sectors.

- The key stakeholders for the data collected by satellites and research done by the JPL are people like city planners who will be most affected by the changes that can be forecasted.

- There are many key stakeholders such as the government private sector and general public.

- I think they are the leaders or politicians of government organizations.

- Government and private sector.

- The governments.

- Government Bodies.

- I believe I have a better insight on how a research position is handled.

Question 7 - Did you develop any new areas of knowledge, skills, or abilities by participating in this workshop? What value do you think it has offered your education and/or career development?

- I was not aware of what is happening with Greenland, so it was fascinating to learn about. I appreciated how many of my math/coding skills were put into use and applied in this real-world scenario. It reassures me that my knowledge can be applied in other areas aside from teaching.

- yeah it was my first time working with image classification. I plan to work more on images this summer and will probably incorporate some of the techniques used in this workshop— like the meshing concept.

- Yes. I was able to interact with others in a professional setting and network. I was able able to get ex posure to mat lab and how it is implemented in the data science field

- I learned a lot about the sty le of coding used in data science and how to interpret the outputs. I also learned a little about how to try and break into the field.

- I learned more about building mesh diagrams and being able to use MAT LA B to interpret data.

- I learned MAT LA B and a better understanding of the situation of the Earth. This workshop has widened my perspective on where data science and analysis is needed and what kinds of problems it is used to solve.

- From the workshop, I did learn about machine learning as well as some matlab. I was able to play around and run the code provided. It was interesting, but I didn't think it benefitted me as it is not related to my area of interest.

- By attending this workshop, I was able to learn about the huge impact of carbon emissions on our planet, and the potential consequences of melting Arctic ice sheets on the beaches of Southern California. The warming of our planet caused by greenhouse gas emissions is causing rising sea levels, which can lead to devastating consequences for coastal regions around the world. I also gained insight on how JPL scientists use coding and data science techniques to build advanced models that predict the effects global warming has on our planet. In addition, the scientists from JPL also gave us tips on how to reach out to other JPL scientists for potential internship opportunities.

- Discipline and lots of logical and assumption would be the a head start before making any modeling in the work area.

- I learned about the quantitative side of earth science, how models are made and how they are useful.

- Yes, I think that I am a lot more familiar with the interface that is used as well as how it is used. Also, I learned a lot about climate change and how it's happening. Something I also learned was how these things are mapped. It was super insightful to see the mesh mapping. For me, I think that this was super insightful to see what kind of data they work with, what they do with the data, and the trends they see from their data. It has offered me insight on what topic I want to pursue in the data science world and different ways I could manipulate data sets.

- After this workshop, I know that knowing python/ mathlab/... plays an essential role in becoming a scientist. Moreover, you need to have some insights about the topics that you want to work on such as earth science or the planet. I understand more about the working environment of an scientist at JPL or NASA. You can be independent or a team player depending on the group that you are working in. Most importantly, you have to be creative and questionable, always eager and willing to find the answers.

- I learned how MATLAB is used in the professional setting and how long it takes for data to be collected. I think this workshop tremendously helped my educational and career development because it helped me understand which direction I want to go.

- I certainly developed skills in computer science and data science throughout this workshop. A lthough it was short, it was extremely valuable in becoming more informed of the role data science plays in research. I also became more familiar with the process of building a good coding model to study various processes, whether it would be for researching or other purposes. Along with all of these skills, I also learned what it takes to become part of a national laboratory, and particularly, NASA.

- Absolutely this was profoundly helpful. My career will likely move in a whole new substantive direction thanks to the knowledge provided by this workshop.

- This workshop really gave me an insight as to what happens after your undergrad. It has shown me how many areas of science there are and that there will always be a fit for you no matter what background you are in.

- i did a little bit in programming and learned a lot about ice sheets and sea levels

- Yes

- I know what I am interested and not interested in this workshop and help shaped my idea of what I want to do as a future career

- Learned more about coding. And learned more about a possible career path

- Machine Learning; knowledge of relaxation

- This workshop helped confirm working in a field that I am passionate about more than the amount of money I will be making. I learned about the different departments and projects available to me if I wanted to work in this field. I found it very interesting to ex pand my MAT LA B coding skills and get experience with a real-world model to answer a specific research question.

- Yes, I was able to practice my programming skills, learned some new things about climate science and I was able to network. Such experiences are very important to my career development.

- I developed new knowledge in how data from satellites is utilized and what projects are being done at jpl allowing me a focus on what to pursue for my education and career development

- Yes. I learned how to implement MAT-LA B while coding. Also, I learned how CADD improves the safety of our Earth.

- I want to do research although I feel [intimidated] and fear not knowing.

- It has helped me in analyzing data, as well as making connections with the people from JPL.

- Yes. I developed skills like MATLAB and Python in this workshop.

Question 8 - During your time as a college student, there are many different career and professional development opportunities offered by the college, such as internships, guest speakers, job fairs, and so on. How do you think this workshop compares to your experiences with other career and professional development opportunities offered by the college?

- This workshop is a bit more hands on and was a great way to better understand NASA JPL.

- I believe this workshop felt very personal and welcoming, as opposed to some booths at a job fair. The JPL reps seemed genuinely interested in all you had to say and wanted to make sure to provide the most help as possible.

- This was by far the best opportunity I have engaged in.

- The only other professional development opportunities I have attended is the job and internship fair. Compared to that, I would say the workshop allowed me to establish a better connection and really talk to the representatives from JPL. I also liked being in a smaller group since it allowed me to talk to the JPL representatives better.

- This is the first career oriented event I've been able to attend.

- This is probably the best thing that has helped me towards a path to an internship.

- This workshop was the most unique giving me the most hands-on experience.

- N/A

- This was the first career development workshop that I have attended at CSULB, and it proved to be extremely insightful. The workshop provided me with a wealth of knowledge on topics such as climate change, global warming, and other ST EM fields, and I am grateful for the opportunity. Based on my positive experience, I would definitely attend future workshops.

- It was unique for me since there was hand on experience during the workshop with actual people from the JBL company.

- This workshop was one of the better opportunities to network. I'm taking a careers class that offers similar opportunities to network, but it's shorter, less intense, and involves more geologist which is nice.

- I like this one a lot more since it's much more interpersonal. It felt more like a classroom so it was much easier to ask questions. Also, I really liked how this one actually had people working in the field. Even with guest speakers, job fairs, etc., they don't always choose people who are actively in the field doing what they do. I really like how well-rounded the choice of speakers were for this event. There was a Mech. E. background, CS background, and meteorology background who were able to answer all these questions we had as a team.

- This workshop is more informative and supportive of ST EM students comparing to other job fairs or guest speakers.

- I think this workshop compares differently to other programs because there is a direct hands-on approach to work with industry professionals.

- By far, the best workshop I have ever attended. I feel more confident about research opportunities, and I became more familiar with essential data science skills. This workshop is exactly what I needed to help steer me in the right direction for my career and help me feel less stranger to computer science.

- This was by far the best organized and informative sessions I have ever experience[d] and that is coming from someone who attends a ton of workshops.

- I think this workshop is much better than any career fair cause it gives a more in depth experience about one particular company which helps determine what I want to do with my career rather than seeing all my options which can be overwhelming.

- This was very helpful to narrow down my career path and was very open and interactive and welcoming.

- The panelists is so much nicer and more willing to help comparing to panelists at career fair. They are genuine and very passionate about what they do.

- This is my first one where it was interactive and I wish we had these ty pes of workshops targeting prospective data scientists.

- Provides a more focused [opportunity].

- This workshop has been extremely important towards my career trajectory, in addition to skills learned.

- I've been to many different career and professional development opportunities being a student of ten years and this was the best one I've attended. It was great getting the inside knowledge of applying to internship, the networking opportunity provided, and being provided with in depth exercises and examples of what work would actually be done working for JPL.

- I think that the workshop was better then most of the other experiences I have had. Because the group was smaller it provided a more intimate experience.

- This workshops is much better as it was more holistic and offered a more hands on approach using professional tools actually used in the industry.

- I think this workshop was an amazing experience due to the helpful people and excellent learning experience. I am very glad I joined this workshop.

- One of the best, most relevant, and most equitable (I got [paid] to learn & talk!).

- I feel that this workshop was very useful for me to because of the opportunity to make networks with the guest speakers.

- This opportunity was more of hands-on which is really cool and different than then other opportunities.

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Dr. Reeb oversees a multimillion-dollar portfolio of research and learning development programs. He is the principal author and editor of the book *Empowering the New Mobility Workforce* (Elsevier 2019), which was endorsed by the late Norman Mineta. He is a member of a National Academies of Sciences, Engineering, and Medicine Rural Transportation Issues Coordinating Council (A0040C) and two standing committees focused on Native American mobility issues (AME30) and workforce development and organizational excellence (AJE15). His research-driven reports, publications, and workforce development programs promote innovation and civic partnerships between leaders in business, government, and education. "Transportation in GIS," a pilot class Tyler developed in partnership with Los Angeles Trade Technical College, won the American Planning Association Award of Excellence for Opportunity and Empowerment. Tyler is currently teaching and developing new online curriculum for the University of La Verne's Masters of Health and Public Administration programs. He is also pilot testing Intelligent Transportation Systems (ITS) and data science talent pipeline programs at CSULB in partnership with Gannett Fleming and Jet Propulsion Laboratory.

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