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1 **ABSTRACT**
2   Despite being frequently underrepresented in travel diary survey efforts, colleges and universities
3 – depending on their size, geographic location, and student body composition – can be major contributors
4 to travel demand in their respective regions; therefore, researchers ought to study travel patterns and
5 behavior at these educational institutions more often and in greater detail. This paper uses two case
6 studies to detail the approach, design, and methodology of conducting travel diary surveys at colleges and
7 universities. The first case study focuses on one stand-alone travel diary of students, faculty, and staff at
8 Arizona State University, one of the largest universities in North America. The data collected (14,464
9 valid responses) will help support the Maricopa Association of Governments' activity-based travel
10 demand model. The second case study examines the survey administered at eight colleges (7,923 valid
11 responses in total) across the state of Utah that was linked to the larger statewide household diary survey.
12 This paper highlights the similarities and differences between the two approaches, notes the relative cost-
13 effectiveness of both methodologies, and discusses the value of these datasets to regional travel demand
14 modelers and strategic planners at educational institutions.

1   **INTRODUCTION**
2   Metropolitan Planning Organizations (MPOs) and statewide Departments of Transportation
3   (DOTs) have long recognized the importance of conducting household travel diaries for the purpose of
4   generating and updating travel demand models. Depending on the survey methodology and the prevalence
5   of colleges and universities in the modeling area, household diary surveys have traditionally
6   underrepresented these communities and their population's travel patterns, especially those of the student
7   body. Large college and university campuses impact regional travel; therefore, they must be adequately
8   accounted for in diary surveys and travel demand models. Moreover, travel demand models typically use
9   trip rates stratified by demographic variables that may not accurately characterize university students,
10   such as household income, automobile ownership, and household size.
11   Conventional telephone interview surveys – an approach frequently used in household diary data
12   collection – have become increasingly susceptible to coverage bias and plummeting response rates as a
13   growing number of Americans abandon landline telephone service in exchange for cell-phone only
14   service (1). Increasing numbers of Americans, particularly young and mobile college students, live in
15   areas that do not correspond with their cell-phone area code, do not have a land-line telephone, and even
16   with a telephone match are a population constantly on the move and disinclined to participate in a survey
17   over the telephone. These biases are particularly prominent for students living in dormitories on
18   university campuses.
19   In addition, college students are a population that is extremely reliant on computers, smart-
20   phones, and email. Recent studies show the rapid increase in smart-phone and cell-phone ownership (and
21   therefore reliance) among college students. As of July 2012, 52% of Americans aged 18-29 owned a
22   smartphone, and only 5% of college students did not own a cellphone at all (2).
23   With these challenges in mind, this paper aims to describe a cost-effective and administratively
24   efficient approach to collecting travel diary information from university populations. This will be done
25   using two recent case studies as examples. The first is a 2012 one-day travel diary of students, faculty,
26   and staff at Arizona State University (ASU), one of the largest universities in America. The second is also
27   a 2012 one-day travel diary administered to students at eight colleges and universities, of various sizes,
28   around the state of Utah. The paper will highlight the similarities and differences between the two
29   approaches, their relative effectiveness at collecting robust travel data for an often underrepresented
30   portion of the population, and their potential applications.
31
32   **RELEVANT LITERATURE**
33   There is not immediately known to be a great deal of existing case studies regarding efforts to conduct
34   targeted travel diary surveys to college student populations. Two recent examples are a web-survey to
35   understand travel patterns at OSU (3). However while the OSU survey had a goal of obtaining
36   preliminary data for the future use of developing a mode choice model, the OSU study did not conduct a
37   travel diary, and rather focused on attitudinal and demographic questions, as well as questions regarding
38   non-SOV options. A second example is in 2009-2010 where Virginia DOT purchased a large add-on to
39   the National Household Travel Survey and in conjunction with that effort, Virginia DOT also decided to
40   conduct a supplemental one day travel diary survey of university students at four universities (Virginia
41   Tech, Old Dominion University, University of Virginia, and Virginia Commonwealth University) (4).
42   Students were randomly sampled from enrollment lists and sent email invitations. Some students also
43   received follow-up phone calls. In the study a travel date was initially assigned. Low response rates at all
44   four colleges resulted in the decision to change the approach such that if the student didn't respond
45   prompt manner, the travel date instead became "yesterday." The survey design was such that trips to
46   various campus buildings were defined as separate trips, which is similar to the approach taken in our
47   ASU case study. In Virginia, a further criterion used in defining trips was that these were movements of
48   more than 300 feet.
49
50   **CASE STUDY: ARIZONA STATE UNIVERSITY**

1   Arizona State University, with a 2010 total enrollment of 70,440 (56,562 undergraduate students
2   and 13,878 graduate students), is one of the largest universities in North America. It is located in the
3   Phoenix Metropolitan Area and spread across four campuses: Tempe, West, Polytechnic, and Downtown.
4   The university also employs over 12,000 individuals. Although the university is expected to grow in the
5   coming decades, the current size is enough to generate a large amount of travel demand both on and off
6   campus. Given that all four campuses are located within the boundaries of the Maricopa Association of
7   Governments (MAG), it is crucial for MAG's activity-based travel demand model to incorporate ASU-
8   generated travel demand and mode usage patterns. Ultimately, accurate and robust ASU data will help
9   MAG strengthen its ability to predict the impacts of ASU activities on modal usage and performance in
10   the region (5).
11   ASU last conducted a travel diary survey in 2007. The updated 2012 version was conducted with
12   the goal of improving data collection efficiency by leveraging technological improvements in web-
13   retrieval surveys as well as more accurately reflecting the 2012 ASU community and travel patterns of its
14   population.
15   Given the extent of research interests and the complexities involved with collecting trip-level
16   information of students (both ones that live on campus and ones that live off campus), faculty, and staff,
17   the questionnaire design process focused on minimizing survey length and reducing respondent burden as
18   much as possible. This was accomplished in five ways. First, the survey length was reduced by removing
19   selected questions and instead filling that void with other data sources. For example, rather than ask each
20   individual student about his or her daily class schedule, the project team procured class schedule and
21   enrollment data from the university. Again, given the population, the project team felt that the number
22   one thing to encourage complete surveys and higher response rates was a short survey (6). In addition, the
23   survey instructed students to report all movements on campus, which included a class schedule for one
24   typical weekday. Second, by simplifying question wording and strategically ordering the questionnaire to
25   create a better flow within the survey, respondents are less likely to perceive a high burden. Third,
26   improving the on-screen layout of individual pages and particularly challenging questions helps to reduce
27   confusion and, therefore, survey length. Fourth, by introducing logic-checking and on-screen validation,
28   respondents were not asked unnecessary questions based on previous answers already provided. This
29   improves the user experience not only by reducing the total number of questions asked, but also by
30   minimizing the frustration associated with seeing questions that are irrelevant or otherwise redundant.
31   What is more, these logic checks and data validation help improve data quality overall. Finally, all
32   respondents could use the interactive, real-time Google mapping technology by searching for an address,
33   a business name, or placing the market on the map to find each trip end (Figure 1). Once the location was
34   selected, its latitude and longitude coordinates were automatically geocoded by the survey software. The
35   primary benefit for respondents was that if a location was visited more than once – for example, a student
36   returned to his or her dorm three times on one weekday – that location only needed to be geocoded once.
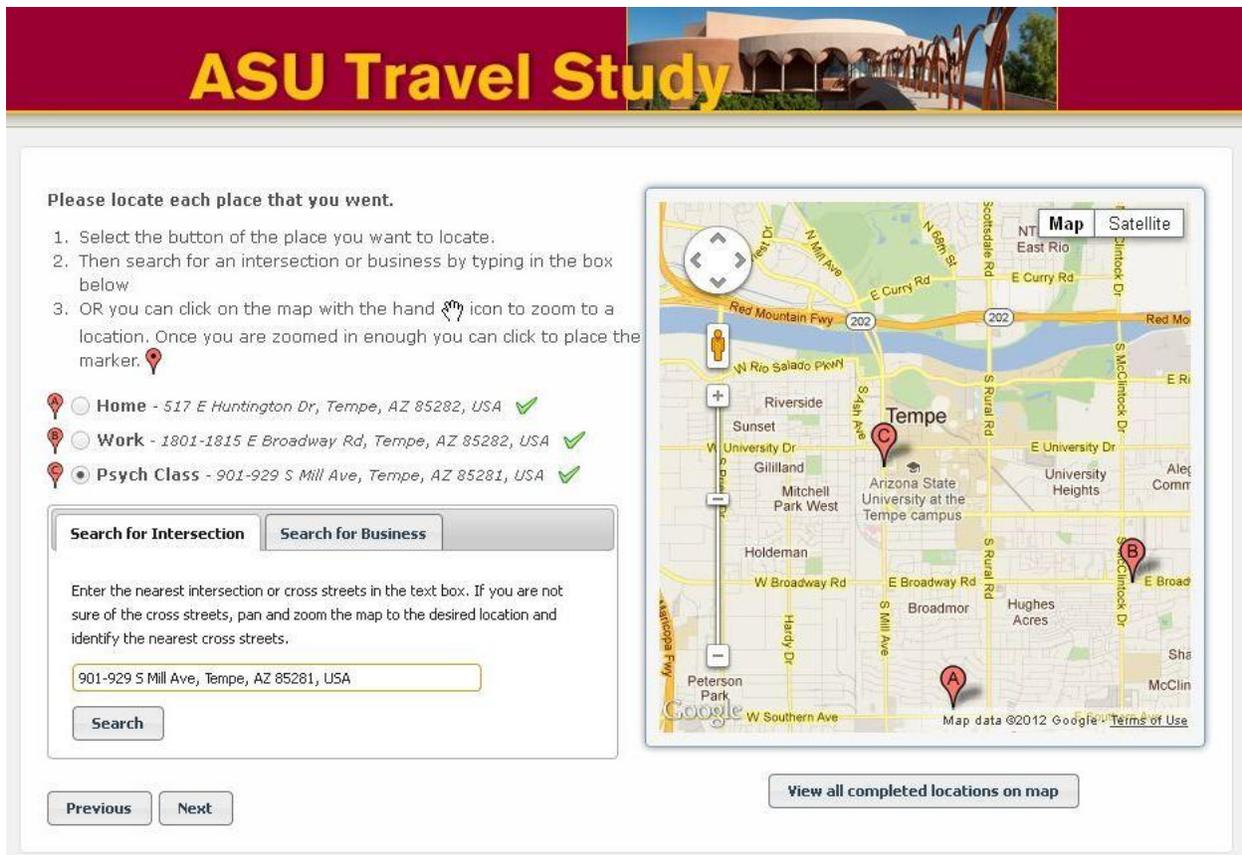
Figure 1: Interactive location mapping

The questionnaire itself consisted of three major sections. After being introduced to the survey and its purpose, respondents filled out basic demographic information on which they were segmented (affiliation, campus, and whether they live on or off campus). Section two was the most substantial because it included a comprehensive one-day travel diary. In this section, respondents were first asked whether or not they made any trips yesterday (or the most recent weekday). The survey software used dynamic language based on the date and time that the respondent was completing the survey: if the respondent was completing the survey on a Sunday or Monday, respondents were asked to report trips from "Friday (the most recent weekday)" whereas all other respondents were asked to report trips from "yesterday". This allowed students to participate on any day of the week and still report weekday travel. It is also a departure from the traditional household diary approach of pre-assigning each household with a specific travel date. This method simplifies administration considerably and by staggering the survey invitations, the distribution of trips across the five weekdays was reasonably spread out (Table 1).

Table 1: Travel day of week

Travel Day	Percent
Monday	10%
Tuesday	39%
Wednesday	11%
Thursday	14%
Friday	27%
Total	100%

1   Defining the trip remains the most important and challenging exercise of designing a travel diary
2 questionnaire, especially at a university like ASU, with multiple campuses and a mix of students living on
3 and off campus. In this study – with an emphasis on capturing all trip types, including intra-campus – a
4 trip was defined as any change in physical address; that is, a movement from one place to another,
5 regardless of mode or duration. On screen, the trip was presented as follows: "A trip consists of any
6 movement by car, bus, bike, walking, or other means AND any change of address or location. Some
7 example trips include: walking from the library to class, biking to an off-campus coffee shop, going for a
8 run in South Mountain Park, taking the bus to a volunteer job, riding the intercampus shuttle to another
9 ASU campus, etc." If respondents indicate that they made a trip yesterday (or the most recent weekday),
10 they were asked to list all the places they went (Figure 2) before geocoding each of those locations.
11 Spatial analysis, using the trip end coordinates and the boundaries of each campus, allowed for trips to be
12 categorized into four segments: intra-campus, inter-campus, to/from campus (one trip end on-campus, the
13 other off-campus), and exclusively off-campus These trip segments, combined with respondent segments
14 (student who lives on campus, student who lives off campus, staff, or faculty) and trip mode information
15 provide the analyst with ample opportunity to dissect travel behaviors, for example: differences between
16 trip rates, trip types, and mode usage of undergraduate students residing on the Tempe Campus and a
17 graduate student who lives off campus.

18

19 **Figure 2: Trip locations**

20   Finally, the survey concluded with a debrief section, which included questions about general auto
21 and transit use as well as attitudes about transportation-related statements.
22   A sampling plan was developed concurrently with the questionnaire. The purpose of this was to
23 determine the sample size and the margin of error in travel characteristics for the ASU Travel Study.
24 Target sample sizes were determined by considering two basic travel characteristics for which analysts
25 would like to achieve a high degree of precision. The first is the overall average trip rate per person,
26 which may be regarded as a measure of travel demand. The second is the percent of individuals driving
27 alone to campus, which may be regarded as a measure of modal split. Target sample sizes were computed
28 using standard sampling equations and assuming conservative values for confidence level, degree of
29 precision, and standard deviation of the travel characteristic of interest. In general, it was found that target
30 sample sizes were considerably smaller than expected number of respondents in the survey. As the ASU
31 community includes approximately 80,000 faculty, staff, and students, even a modest 10 percent response

1   rate would yield 8,000 responses. This sample size is larger than that of many general-purpose
2   metropolitan travel surveys and provides a high degree of precision for a wide range of travel
3   characteristics. The intent of the sampling plan was to therefore determine target sample sizes for specific
4   demographic segments including freshman, sophomores, juniors, seniors, graduate students, faculty, and
5   staff. During the survey administration process, if it was found that the sample size for a specific segment
6   was far below the desired target, then additional efforts could be directed towards enhancing response
7   rates for the specific segment.
8   Members of the ASU community were invited to participate in several, cost-effective ways.
9   Officials at the university first invited all members of the community to participate via an email
10   campaign. The email contained an introduction to the project, a description of its purpose, instructions for
11   how to participate, information about the incentive for participating (entry into a drawing for an Apple
12   iPad), and notes about the privacy policy. Given that the survey was administered entirely online,
13   students, staff, and faculty could click on the survey link and begin participating immediately. In
14   subsequent weeks, reminder emails were sent out on different days of the week at different times of the
15   day in order to notify those members of the university population that either missed the initial invitation
16   or needed a reminder to participate. In addition to the email campaigns, the survey was placed as a "To
17   Do" item in MyASU – a campus-wide portal where students, faculty, and staff manage their identities and
18   activities at the university. The ASU Travel Survey also appeared in a flashy banner advertisement as
19   well as in the "Announcements" section of the portal. Finally, paper flyers were distributed across
20   campuses, at transit stops, and aboard intercampus shuttles. With an extremely low marginal cost, these
21   combined methods yielded an overall response rate of approximately 18% across the entire community.
22   Table 2 shows the response rates by university segment.

23   **Table 2: Survey response rates**

Segment	Response rate
Undergraduate student	17%
Graduate student	13%
Faculty	20%
Staff	24%
Overall	18%

24   The data collected in the ASU travel survey are being used in a variety of ways to enhance
25   transportation modeling and forecasting efforts in the region. ASU is treated as a special generator in the
26   current travel demand model used by MAG for long range transportation planning purposes. The ASU
27   special generator model is being completely updated with new trip rates, trip length distributions, and
28   mode specific constants for the ASU community to better reflect the unique travel patterns of students,
29   faculty, and staff at the university. With very accurate information about the geographic locations of
30   respondents and their origins and destinations, it is possible to use the ASU travel survey data in an
31   activity-based travel microsimulation model development context. The MAG activity-based travel
32   demand model framework includes an ASU-specific model that requires the synthesis of the ASU student
33   population in the region with the simulation of the students' activity-travel patterns. The microsimulation
34   model that is specific to ASU is being estimated, calibrated, and validated using the data collected in the
35   web-based survey.
36   In addition, the survey collected year, make, and model data on each available vehicle, which
37   helps identify the types of vehicles that students own and use. As vehicle type choice is critical to energy
38   and emissions analysis, these data will be used in the activity-based model to simulate vehicle fleet
39   composition for the region's population and more accurately estimate vehicle emissions resulting from
40   personal travel demand.
41   The dataset also includes information on a number of variables that shed light on the attitudes and
42   preferences of college students that may be important from the standpoint of offering services that meet
43   their specific needs. These attitudinal variables also capture the perceptions of students with regard to

1   modal choices and preferences. This information will be used to group students according to their modal
2   preferences and attitudes; by analyzing the travel characteristics of the different groups, it will be possible
3   to identify the types of services and information campaigns that may enhance the use of alternative modes
4   of travel such as walking, bicycling, and riding transit.
5
6   **CASE STUDY: UTAH COLLEGES AND UNIVERSITIES**
7   Utah last conducted a statewide household travel diary survey in 1993. In an effort to update this
8   survey data and inform the Wasatch Choice 2040 long range development and transportation plan, a
9   statewide effort was conducted in 2012 for the Wasatch Front Regional Council, in conjunction with the
10 Mountainland Association of Governments, the Dixie Metropolitan Planning Organization, the Cache
11 Metropolitan Planning Organization, the Utah Department of Transportation, and the Utah Transit
12 Authority. With over 9,000 participating households, the 2012 household travel diary survey data
13 collection was the basis for understanding current travel and future year scenarios across Utah.
14   In addition to the main household travel diary survey, the project team also conducted six
15 supplemental and complementary surveys on a variety of topics such as a residential choice stated
16 preference survey and a long-distance travel survey panel over several seasons. One of these
17 supplemental surveys was a one-day travel diary for students at colleges and universities located within
18 the MPO boundaries across the state. The eight participating colleges included: Dixie State College, LDS
19 Business College, Salt Lake Community College, Utah State University, Utah Valley University,
20 University of Utah, Weber State University, and Westminster College. At this time there is also an effort
21 underway to conduct this identical survey at BYU (Brigham Young University) to obtain data for the
22 Mountainland Association of Governments. The development of this college survey pivoted off the
23 design of the household travel diary for the dual benefits of facilitating direct comparisons between the
24 responses in the college survey and the household travel diary survey, as well as the efficiencies gained
25 by already developing one survey. This coordination results in a cost-effective approach, which can yield
26 additional response from are colleges and universities with a relatively low level of effort.
27   In Utah whenever possible, the college questionnaire mirrored the household diary questionnaire,
28 with two main differences. The first is that college students as survey participants reported their own
29 travel only, not the travel of each household member. The second is that survey participants are asked to
30 describe off-campus trips only, which includes trips to or from campus as well as trips that occurred
31 entirely off campus. Whereas in the household diary survey walking seven minutes from home to the
32 corner store is considered a trip, in the college diary survey, if that same activity were to take place
33 entirely within the boundaries of campus (from the dorm to the college cafeteria), it was not considered a
34 trip such that the respondent was required to report it. The primary advantage of this approach is in
35 reducing respondent burden among a population with a lower tolerance for long surveys because most
36 participants would have fewer trips to report. Using this definition also focused on trips that occur on
37 publicly maintained roadways and transit systems, which is sufficient when the data are to be used in
38 supporting a four-step travel demand model.
39   The questionnaire itself consisted of four sections. Due to the fact that this survey was
40 administered at eight colleges and universities, the first section asked students to choose their
41 college/university from a list of participating colleges and then identify their college/school affiliation and
42 primary campus. The survey software incorporated branching logic, custom questions, and dynamic
43 language based on a student's answers to these background questions, all of which simplified the survey
44 administration process. Next, students provided demographic information, including their employment
45 status, residential location, and year in school. Third, students were asked about the trips they made
46 yesterday (or "Friday (the most recent weekday)" in the event that they were completing the survey on a
47 Sunday or Monday). Unlike the household diary survey where households were pre-assigned a particular
48 travel day and asked to report trips made on that day, students in the Utah college survey were instructed
49 to report trips from yesterday (or the most recent weekday), just as they were in the ASU Travel Study.
50 Again, this focuses on weekday trips but also on a recent day thus respondents are more likely to
51 remember the details of those trips. This has a positive impact the overall accuracy and quality of the

1 collected survey data. Finally, a debrief section asked students about their general travel to and from
2 campus (and to an off-campus job if employed) and opinions on a variety of transportation-related issues
3 in the area. The debrief section also included a set of questions regarding bike and walking behavior (and
4 reasons for and against walking and biking) that can now be compared to the same set of questions in the
5 statewide household travel survey.
6   As with the ASU Travel Study, the Utah college diary survey was administered entirely online
7 using email invitations. In order to target students at colleges and universities in Utah, the project team
8 developed a list of institutions – both public and private – that represented numerous geographic regions
9 within the state. The project team then worked with the client agencies to reach out to and recruit from
10 among the list of identified institution, generally targeting high ranking officials. Most institutions agreed
11 to participate and preferred to send the email invitations to their student bodies themselves. Students were
12 incentivized to participate by the opportunity to enter into a drawing for the latest generation Apple iPad.
13 One winner was to be randomly selected at each participating institution. Overall, this methodology and
14 incentive combination yielded a response rate of approximately 5-12%. Response rate variability
15 generally depended on the type of school and student body composition (percent of full-time students), as
16 well as the number of email invitations and reminders distributed and the overall level of engagement
17 from the college.
18

20 **Figure 3: Vehicle details for Student Living Off-Campuse**

21   At this time the analysis work on the Utah college diary dataset is underway. Preliminarily it
22 appears that the important predictors of travel and the means for weighting will be on- and off-campus
23 status, whether a part-time or full-time student, and the campus where the student is primarily located.
24
25 **CONCLUSIONS**
26   This study attempts to advance the frequency of and methods for collecting travel diary
27 information from members of college and university communities (and potentially in the future applying
28 these methods to other similar populations such as military bases or very large employers). The
29 opportunities for robust data and meaningful analysis are many. Given the recent advances in web-
30 retrieval software and the large population of traveling – not to mention technologically savvy – students,
31 faculty, and staff, these data can be obtained in a relatively cost-effective manner by using an online
32 survey instrument and coordinating with university officials to invite participants via email.
33   Even still, there is room for improvement in designing surveys specifically for the university
34 communities. More specifically, trip definitions have continued to evolve over the years and it has been a
35 nontrivial challenge for transportation market researchers to get it right. This issue is confounded by the
36 nature of campus travel patterns and confusion about what exactly constitutes a trip. In other words, much
37 of the on-campus movements are hard to classify. With all of this in mind, properly and clearly conveying

1 the trip definition to the survey participant is a crucial exercise with major implications on trip rates and
2 data quality in general. While the type of application (four-step vs. activity-based travel demand model)
3 will largely dictate the approximate trip definition, communicating that on-screen to the respondent will
4 nonetheless be important.
5   Lastly, as we advance the technology and quality of data obtained as part of college and
6 university travel diaries, we also must continue to remain alert to how our methodologies impact data.
7 With a college population that often responds instantly to email invitations, in our case studies (both
8 Arizona State University and the colleges and universities around Utah), the project teams remained
9 extremely sensitive to the day of the week and hour of the day that email invitations were sent out and
10 tried to evenly stagger the days of the week and hour of the day so that the trips that were reported as
11 "yesterday" were well distributed and that students who checked email in the morning, afternoon,
12 evening, and late into the night were well represented in the dataset. An additional administration
13 consideration is the incentives offered – in both our case studies a raffle of the latest generation iPad was
14 an extremely cost-effective and enticing incentive to college students. And lastly, when designing an
15 online survey for college student populations – it is even more important to continue to advance the state
16 of the practice by designing surveys to be mobile or tablet optimized. This detail, although
17 straightforward for many questions, is a challenge for travel diaries and an opportunity for future
18 improvement beyond what was accomplished in these case studies.
19   In addition to applying these survey results in travel demand models, collected survey data can be
20 analyzed in other interesting ways. This is true because large university campuses, in general, are case
21 studies for densely populated areas with a diverse composition of trips. For example, campuses tend to
22 friendly to alternative modes (shuttles, biking, walking, etc.) and are host to a variety of trip types
23 (commute, recreational, exercise, etc.). As such, examining the decision making, mode choice, and
24 general trip patterns of campus communities may shed light not only on the effectiveness of strategic
25 plans, campuses designs, and campus infrastructure, but also on those same features and pursuits outside
26 the campus boundaries.
27

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