Summary of Exploratory Review of the Literature

Intermediaries for Scale (IFS) Barriers to Data Cultures and Literacy at Institutions of Higher Education

MAY 2022

NCHEMS

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Introduction

In December 2020, the 13 organizations that constitute the Bill & Melinda Gates Foundation Intermediaries for Scale (IFS) launched their Data Working Group (DWG). The objectives of the group are (a) to learn what each other is doing with critical data and how that data is being applied within the institutions and beyond the Intermediaries for Scale ecosystem and (b) to understand the data-oriented work of the Intermediaries for Scale initiative and share best practices and learning.

As part of its work, the DWG seeks to more deeply understand barriers related to a culture of data literacy within institutions of higher education (IHEs) and develop strategies to address these barriers. In late spring of 2021, the DWG members generated a list of barriers (see Appendix A) they observed in their work to support cultivating data cultures and data literacy at IHEs as a preliminary step to identifying promising practices for addressing data capacity needs. The DWG then prioritized two of the barriers for further study to understand more deeply how those barriers are at play in the institutions the IFS supports. The two prioritized barriers and their related sub-barriers are:

- **Lack of infrastructure and resources**
  - Lack of affordable tech tools that integrate data
  - Cost of data infrastructure
  - Lack of continuity in data collections
  - Low Wi-Fi (broadband) bandwidth
  - Lack of bandwidth to manage data
  - Limited staff to provide guidance on data use
  - Staff resources in data capacity innovation
  - Institutional research is not prioritized
  - Lack of a Chief Data Officer

- **Limited training on how to use data**
  - How data are collected, managed, and analyzed
  - How to use the tool(s)
  - How to take a data inquiry and find answers
  - How to unpack or disaggregate data
  - Institutional research is not prioritized

The following report summarizes the findings of an exploratory review of the literature to answer the question: What are the root causes of the two prioritized barriers?

Methodology

This review of the literature was conducted in four phases: a) online search for relevant documents, b) review of documents for relevance to the topic, c) coding of the documents connected to the identified barriers and sub-barriers, and d) summary of the coded information. The online search for relevant documents was conducted in three phases: a) search of websites of relevant higher education organizations for related documents, b) scan

of titles of articles in the past five years of issues of key higher education journals, and c) Google Scholar search of each sub-barrier term (along with the words "in higher education") including a scan of the first five pages of results for related documents. A total of 87 potential references were found during the search process (31 from higher education organizations, 42 from higher education journals, and 14 from the Google Scholar search). Of those 87 potential references, 37 contained information of use to this review (18 from higher education organizations, 14 from higher education journals, and 5 from the Google Scholar search). A list of the higher education organizations and journal titles is included as an appendix.

Overall Summary of Findings

While each sub-barrier of the two prioritized barriers under exploration was researched individually, the results of the exploratory review of the literature were grouped by related topics for ease of review. An overall list of findings was summarized first, followed by detailed findings including citations from the literature.

Overall, the literature included numerous citations confirming that the listed barriers and sub-barriers were indeed contributing factors to the inability of IHEs to expand their data and analytics efforts, though a few contradictions were found and were included in this summary of findings. Some resources broke findings down by size and type of institution, providing more detailed information about where the barriers were impactful, and those specific details were included when available. Some of the citations made generalized statements about IHEs without corresponding data to support the statements. Therefore, caution is warranted in generalizing findings to all IHEs.

Limited information describing why the barriers occur was found in the exploratory review of the literature. Several studies included summaries of findings from surveys of institutional professionals; these surveys utilized multiple-choice methods that provided detail about *whether* or not various factors were barriers to creating data cultures. However, few, if any, of these tools were designed to gather data that explained *why* these factors were barriers. Most studies in this review that were focused on "why" involved faculty rather than staff professionals in data-related positions in IHEs. This review of the literature uncovered a need for more studies designed to unpack the reasons why these barriers to enhanced data and analytics efforts exist in IHEs. In addition, most survey data included in this summary involved surveys administered to one individual at an institution, while results were reported at the institutional level. Caution should be used when generalizing the opinions of one employee to an entire institution.

One note related to term use in the summary that follows: when using the term "institutional research," lower case letters are used when the term refers to the function of using data to inform decisions at an IHE, no matter where within the IHE that work takes place. Capital letters or the abbreviation "IR" are used when the term specifically refers to the Institutional Research Office, or staff assigned to the office, at an IHE.

I. Lack of Infrastructure and Resources

Research indicates that, overall, a lack of infrastructure and resources seems to be holding back the maturity of institutional data and analytics efforts. Also, differences in institutional characteristics means differences in infrastructure and resources, and therefore solutions will be unique to each institution.

Data and Technology Resources

- Lack of affordable tech tools that integrate data
  - Some research indicates that technology for data and analytics are not integrated and are not working well for IHEs.
  - Some research indicates that the cost of technology is viewed as a barrier to analytics at IHEs, particularly for community colleges and for institutions with the lowest enrollment size, and current levels of investment in technology are viewed as low.
  - Some research indicates that lack of affordable technology is not an issue for IHEs, but that other issues have more impact on IHEs' ability to use technology successfully for data and analytics projects. These other issues include lack of efficient use of existing technologies, and lack of technical knowledge and skills of the faculty, staff, and administrators who produce and consume the data.
  - Whether the cost of technology is a barrier for some IHEs may not be easily discerned because costs are not accurately measured.
  - Despite the potentially high costs of analytics, most institutions are investing in some types of studies, particularly those institutions that enroll a larger number of students.

- Cost of data infrastructure
  - The data infrastructure required to reorganize and integrate data to improve reporting and analysis may be too costly for some institutions.
  - Current technology for managing data may not be able to handle new types of data at IHEs. With these changes, new data infrastructure may be needed.

- Lack of continuity in data collections
  - At many IHEs, data collection and management are not centralized in one system; it is challenging to connect data from multiple systems and levels of data storage sophistication vary across units within institutions.
  - Institutional data are rarely easily connected to the external data needed to conduct analyses.
  - Technology upgrades and new systems make it difficult to access longitudinal data in one place.
  - Lack of technology integration negatively impacts use when users are expected to login to multiple systems and/or data from multiple systems are not integrated.

- Low Wi-Fi (broadband) bandwidth

o People in rural areas, particularly indigenous reservation areas, have less access to, and more expensive, broadband than people in urban and suburban areas.
o IHEs in rural areas face challenges in obtaining broadband capacity due to high costs, lack of infrastructure, and lack of competitive providers.
o Federal funding to identify areas o with broadband access needs has dried up, making it more difficult to identify areas of need.

Staffing Resources

- Lack of bandwidth to manage data
  o Institutional research (IR) and information technology (IT) professionals spend time managing data, but struggle with multiple aspects of its management, including integration, sharing, and documentation. Differences by type of institution may also be present, with one survey finding that IR office leaders at private not-for-profit 4-year institutions spend more time in data collection and management than those at public 4-year institutions.
  o IR professionals struggle with their capacity to respond to data requests.
  o Institutions that are part of systems have some assistance from the system office in supporting Integrated Postsecondary Education Data System (IPEDS) reporting but lack support from the system office in other areas of data management.

- Limited staff to provide guidance on data use
  o Research shows that connection to colleagues with expertise in using education data helps faculty use data more effectively.
  o IR offices do not have many staff to dedicate to data use guidance, but demands for this service is rising.

- Staff resources in data capacity innovation
  o Data from job board postings signal a need for more data and analytics staff at IHEs and a possible lack of individuals to fill such positions.
  o In general, IT professionals, business officers (particularly at institutions with lower enrollments), IR/institutional effectiveness (IE) professionals, and student affairs professionals at IHEs view lack of staff resources as a barrier to analytics.
  o Numerous factors contribute to IHEs' inability to increase data and analytics staffing, including campus resource limitations, perceived low pay, and lack of pay that is competitive with jobs outside of academia.
  o Lack of staff resources has negative impacts at IHEs, including slowed progress on initiatives, lack of ability to expand analytics work, and forced use of third-party vendors when in-house staffing is not available.
  o Newly mandated data collections with fixed deadlines often means a lack of IR staff time spent on analytics projects.
  o In addition to mandatory data collection and reporting, IR/IE professionals have many work functions to accomplish, with only a small portion of their time dedicated to data capacity innovation.

- Some IHEs have found success in using technology and developing processes to overcome staffing shortages, though specific examples were not provided in the literature review.

Data and Analytics Leadership
- Institutional research is not prioritized
  - IHE leaders do not list IR as a top priority. IR often does not report directly to the head of the institution. Most report to the provost/Chief Academic Officer and only 19% report to the president/CEO, though IR at 2-year institutions are more likely to report directly to the president/CEO.
  - The processes associated with institutional research (e.g., data use, planning, technology, etc.) and the roles of the functions of IR and IT may not be completely understood or appreciated in IHEs.
  - However, some research indicates that IR involvement in data and analytics at IHEs is valued and rated highly, at least by IT professionals.

- Lack of a Chief Data Officer
  - It appears that designation of CDOs is increasing in IHEs, but a lack of consistency in defining the position (and whether the person must hold the title Chief Data Officer [CDO] to be counted) makes accurate data collection difficult. For example, surveys by the Association for Institutional Research (AIR) and EDUCAUSE treat the title completely differently, resulting in the AIR survey counting a much larger number of CDOs in IHEs than the EDUCAUSE survey.
  - The impetus for creating the role of CDO will vary across campuses; but, reasons include leadership frustrations with their inability to obtain timely data, and friction between leadership and IR.
  - Reporting lines of CDOs may vary across institutions, so generalizations about the role are challenging to make.
  - CDOs have many roles and expectations, including data management, making sense of data, providing access to data, breaking down institutional silos to ensure collaboration, and promoting the utility of data.
  - Existence at an IHE of a CDO appears to positively impact IR/IE leaders' views that the institution has the capacity to meet the needs for data and information for decision making.

Other Factors Related to Lack of Infrastructure and Resources
- There are additional factors related to an IHE's technology infrastructure and resources that can impede the IHE's data and analytics capacity, including the following: a) decentralized technology decisions and infrastructure, b) an overwhelming number of technology vendors at an IHE, c) lack of inclusion in technology selection impeding adoption and use, and d) the perception that technology investment is more important than human resource investment, reducing likelihood of technology use.
- Even when the infrastructure and resources exist for data and analytics at an IHE, the lack of incentive to use data and tools, including lack of support for a culture of use, may be a barrier to their use by staff and faculty.

- Aspects of the IR unit can impact its effectiveness as a resource to the institution. The position of the IR unit within the institution and its evolution to new models beyond a simple reporting function can either expand or serve as a barrier to institutional data and analytics capabilities.
- Data users and consumers expect quick data access that does not involve working with intermediaries; rather, they expect the institution to provide the type of self-service data they are accustomed to in other aspects of their lives, such as banking and shopping.

II. Limited Training on How to Use Data

Data and Technology Training
- How data are collected, managed, and analyzed
  - Analytics are expanding as an expectation of IR. New skills may be needed by IR professionals to meet this demand.
  - Data management tools are evolving, and IR professionals need new skills to keep up with the technology.
  - Business officers at IHEs are concerned about the lack of resources to invest in analytics skills.

- How to use the tool(s)
  - Increased use of new technology for data and analytics means increased training needs for IR/IE and IT professionals to use these tools.
  - A focus on more accessible data (e.g., development of dashboards) has highlighted the need for training to increase and improve their use by IHE faculty, staff, and students.
  - Professionals in many positions across IHEs, including registrars and admissions office staff, advisors, and faculty, report the desire for increased training on data and analytics tools.

Data Analysis Training
- How to take a data inquiry and find answers
  - There is variation in expressed need for training on data inquiry across positions at IHEs. Research indicates that business officers at IHEs view lack of skills in data inquiry as the barrier of most concern for effective analytics, particularly those at research universities and those at institutions with lowest enrollments. While faculty are experienced at data inquiry related to their fields of expertise, they report a lack of expertise in data inquiry when it comes to educational research. However, registrars and admissions office staff list increased training in data inquiry low on their list of professional development needs.

- How to unpack or disaggregate data
  - The ability to access data only via dashboards can prevent IHE professionals from disaggregating data in ways necessary to meet their inquiry needs.

Overall Institutional Research Training

- Institutional research is not prioritized
  - Expanding use of data in IHEs requires new training and job descriptions for positions across the institutions and/or more involvement from IR when decision makers lack the institutional research skills themselves.
  - Specialized training is needed for IR staff members but finding time for that training given expanding work demands will be challenging.
  - There is variation in expressed need for training on the process of institutional research across positions at IHEs. Research indicates that student affairs professionals lack institutional research/assessment training. However, registrars and admissions office staff list increased training in institutional research low on their list of professional development needs.

Other Factors Related to Limited Training on How to Use Data

- Lack of data and analytics training capacity may be a more pressing barrier for smaller institutions.
- An additional barrier to training may be a lack of incentive to participate in it.
- Other skills are needed, particularly for IR professionals, beyond those previously listed as sub-barriers, including interpersonal, political, data translation, and leadership (specifically, articulation, communication, and collaboration) skills.
- Some research indicates that less data and analytics training are needed for institutional staff once self-service dashboards are developed and accessible.

Detailed Summary of Findings With Citations

1. Lack of Infrastructure and Resources

Overall, a lack of infrastructure and resources seems to be holding back the maturity of institutional data and analytics efforts.

The EDUCAUSE model looks at six dimensions of analytics maturity: data efficacy, decision-making culture, investment/resources, policies, technical infrastructure, and IR involvement. In the most recent results, five out of these six dimensions were reported at the 'developing' stage, which sits at level three on a five-point maturity scale from 'absent' (1) to 'optimized' (5). The lowest area reported was investment/resources at an overall average of 2.8, while the highest was IR involvement at an overall average of 3.7. (Drake & Walz, 2018, p. 44)

A common theme throughout all the interviews is the lack of resources. Resources - which can be finances and human capital to support a robust data infrastructure, technology to support data management and reporting, or expertise to provide training and support - may vary from institution to institution and are necessary to build a data culture and use data more broadly in decision-making. Many types of resources were mentioned. Institutions do not have enough individuals with the requisite analytical skills to answer the questions, and resources are in short supply to offer continuous, comprehensive training to staff. (Nadasen & Alig, 2021, p. 7)

Also, differences in institutional characteristics means differences in infrastructure and resources, and solutions will be unique to each institution.

Don't look for a one-size-fits all approach - each institution's mission, culture, organizational structure, and analytics maturity will dictate the specific next steps. However, the incremental approach used so often in higher education won't be enough. Tweaks won't deliver the change we need in time to make a difference in the lives of students enrolled in our institutions today. (Association for Institutional Research et al., 2021, p. 2)

a. **Lack of Affordable Tech Tools That Integrate Data**
   - Some research indicates that technology for data and analytics are not integrated and are not working well for IHEs.
     - According to the 2019 Campus Computing Survey, only 22% of respondents rated investment in analytics as very effective. "Current analytic tools, resources, and efforts currently fall far short of provider promises and of campus needs and expectations" (Green, 2019, p. 13).
     - Many IHEs have disparate technology tools that lack integration across the institution. In fact, "offices of IR and Information Technology (IT) may be completely unaware of the existence of these resources and assets, and even when they do, their relationship may be so frayed that it can prevent them from working together to develop, maintain, and enforce an organized policy around data governance and utility" (Gagliardi & Johnson, 2021, p. 110).
     - **Public 4-year:** "Respondents also identified data that are siloed because of technical infrastructure limitations that do not link disparate data sources together. In these cases, respondents noted that constructing the required infrastructure would require additional resources" (Nadasen & Alig, 2021, p. 6).
     - **Public 4-year:** "First and foremost, many of the various IT systems that are implemented across a campus are not easily compatible with one another . . . The solution to this problem requires an institution to expend resources to integrate disparate systems. The cost of this type of integrative project is another obstacle to the overall initiative" (Nadasen & Alig, 2021, p. 8).
     - **Systems:** IHEs that are part of systems have specific issues when campuses within the system do not utilize common data systems. "While some systems and campuses share data electronically and use common data systems and reporting formats, the opposite is true in the majority of systems and campuses" (Gagliardi & Wellman, 2015, p. 19).
   - Some research indicates that the cost of technology is viewed as a barrier to analytics at IHEs, particularly for community colleges and for institutions

with the lowest enrollment size, and current levels of investment in technology are viewed as low.

- o According to the 2019 National Association of College and University Business Officers (NACUBO) Study of Analytics, almost 70% of respondents indicated that "technology needed to support analytics is too expensive" (49.1% identified it as a contributing barrier and 18.7% as a pressing barrier) (Wayt, 2019)[1].
    - **Institution type:** The results differed slightly by type of institution, with 58.8% of community colleges, 66.6% of comprehensive/doctoral institutions, and 65.7% of research universities indicating cost of technology was a barrier (L. Wayt, personal communication, December 10, 2021).
    - **Institution size:** The results also differed by size of institution. 81.7% of institutions with enrollments of fewer than 4,000 indicated cost of technology was a barrier, 72.5% of institutions with enrollments of 4,000-7,999, 75.0% of institutions with enrollments of 8,000-14,999, and 57.2% of institutions with enrollments of 15,000 or more (L. Wayt, personal communication, December 10, 2021).
- o "A lack of investment in and funding for analytics resources was cited as a key challenge holding back analytics initiatives and maturity" (Brooks & Thayer, 2016, p. 5).
- o "In terms of investment, institutions are relatively immature with regard to funding analytics as an investment, investing in analytics training, and funding at levels sufficient to meet institutional needs" (Brooks & Thayer, 2016, p. 15).
- o According to the EDUCAUSE Analytics Maturity Index, Investment/resources has the lowest average maturity [of the 6 dimensions measured]. Fewer than one in four institutions have invested sufficient funding to meet current analytics needs, have a sufficient number of professionals who know how to support analytics, and have an appropriate number of data analysts to do analytics work. (Reeves & Pearlman, 2017, p. 5)
    - **Institution size:** Like the NACUBO study, "the dimensions of policies and technical infrastructure are statistically significantly different for institutions of varying size rather than type" (Reeves & Pearlman, 2017, p. 5).
    - **Community colleges:** While the finding is not statistically significantly different, the study notes that associate's institutions have the highest maturity in every dimension except policies. With the inception of the new scale this year, Associate of Arts degree (AA) institutions have pulled ahead of all other institution types. Many of the AA

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[1] *If the page number is not included, the content was summarized instead of directly quoted, or the content comes from an online-only resource that is not paginated.*

institutions are currently or previously have participated in the national Achieving the Dream initiative that focuses on evidence-based institutional improvement. This partnership could have a significant impact on the importance leadership places on analytics at these institutions. (Reeves & Pearlman, 2017, p. 5)

- Some research indicates that lack of affordable technology is not an issue for IHEs, but rather that other issues have more impact on IHEs' ability to use technology successfully for data and analytics projects. These other issues include lack of efficient use of existing technologies, and lack of technical knowledge and skills of the faculty, staff, and administrators who produce and consume the data.
  - o "Simply stated, most institutions have units that already have systems and technologies in place that can support institutional analytics initiatives" (Brooks & Thayer, 2016, p. 25).
  - o "Many of the enhancements to IR capacity are not highly dependent on new or expanded technologies. Still, technology can provide opportunities to increase efficiencies and allow maximum use of the existing investment in postsecondary education. More efficient use of existing technologies depends on advancing the technical knowledge and skills of the faculty, staff, and administrators who work at institutions as producers or consumers of postsecondary data" (Swing, 2016, p. 2).
- Whether the cost of technology is a barrier for some IHEs may not be easily discerned because costs are not accurately measured.
  - o "Several respondents reported that their institution never or rarely measures the cost of analytics work. Over half of respondents said that within the past two years, their institution did not regularly measure the cost for descriptive and predictive analyses; 49% said cost was never or rarely measured for early-alert projects. Leading reasons for not monitoring costs were that the institution did not have adequate staff capacity to conduct such analyses (over 50%), the data infrastructure is not fully developed (nearly 30%), and that it is unclear which data are necessary to conduct the analysis (over 20%)" (Parnell et al., 2018, p. 5).
- Despite the potentially high costs of analytics, most institutions are investing in some types of studies, particularly those that enroll a larger number of students.
  - o "At least 80% of both public and private institutions, as well as two- and four-year institutions, are investing in student success studies. A noticeably higher percentage of institutions that serve 20,000 or more students are making major investments in both descriptive and predictive studies as compared with institutions that serve fewer students" (Parnell et al., 2018, p. 4).

b. Cost of Data Infrastructure
- The data infrastructure required to reorganize and integrate data to improve reporting and analysis may be too costly for some institutions.
    - o "The addition of data warehouses to colleges and universities has made the data easier to use by reorganizing and integrating it across different functional subject areas to make it better suited to reporting and analysis. As better, more user-friendly BI tools have become available; a wider set of staff from across the campus can participate in producing information. In many schools, this has resulted in putting better information more directly in the hands of consumers, both staff (in the form of reports) and decision makers (in the form of dashboards). However, providing enterprise-class BI still requires extensive investments in technology and staff expertise, putting it out of the reach of many smaller schools (Childers & Walz, 2017)" (Drake & Walz, 2018, p. 41).
    - o "Smaller institutions are challenged to find affordable software solutions. This does not account for the cost of implementing the software solution or training users on how to use the tools" (Nadasen & Alig, 2021, p. 6).
- Current technology for managing data may not be able to handle new types of data at IHEs. With these changes, new data infrastructure may be needed.
    - o "However, the largest bulk of new generated data at universities is in unstructured textual data from sources such as email systems, social media, network logs, learning management clickstreams, help logs, discussion boards, machine/device output, and sensor array data (Wishon & Rome, 2016). These unstructured data sources often are delivered in different formats from the traditional structured data view, and often require new techniques and methods for the transformation, utilization, and analysis of the data (Wishon & Rome, 2016). Those sources have great value to the institution (Inmon, 2014), are the data areas that are growing exponentially, and are increasingly in demand by our consumers" (Drake & Walz, 2018, p. 48).
    - o "The issue with these new unstructured and personalized data sets is the massive scope of their data, and also the necessary processing power demanded to incorporate their unstructured nature into a usable analytics and reporting environment" (Drake & Walz, 2018, p. 48).

c. Lack of Continuity in Data Collections
- At many IHEs, data collection and management are not centralized in one system; it is challenging to connect data from multiple systems, and levels of data storage sophistication vary across units within institutions.

- "There may simultaneously be a well-heeled school or department with a sophisticated data warehouse and dedicated analysts. At the same time, another may rely only on a handful of spreadsheets and data enthusiasts littered across different departments and cloud drives" (Gagliardi & Johnson, 2021, p. 110).
  - "One of the biggest technical challenges that institutions face is aggregating data from multiple systems. The data needed for sophisticated analytics are usually dispersed and differentially formatted in student information systems, registrar's data systems, LMS log-files, and other systems. Some institutions have the technical and human resource capacity to merge these data into a common database for mining and analysis, but smaller and less-resourced institutions often do not" (Alamuddin et al., 2016, p. 21).
- Institutional data are rarely easily connected to external data needed to conduct analyses.
  - "The majority of both systems and campuses do not have data connections to workforce, K-12, community colleges, or to other 'external' databases" (Gagliardi & Wellman, 2015, pp. 13--14). Approximately 20% of both system and campus offices report connections to K-12 data systems; Roughly 15% of both system and campus offices report connections to labor/employment information; 7% of systems and 12% of campus IR offices connect to career/technical education offices (Gagliardi & Wellman, 2015).
  - "Information about students after they drop out, stop out, transfer out, graduate, or enter the workforce frequently requires linkages to external data sources that often carry participation fees and additional staff time for matching multiple data sources. Even when linking between government data sources, there can be significant time investments in establishing interagency agreements for sharing data and programming to align data across different systems" (Swing, 2016, p. 5).
- Technology upgrades and new systems make it difficult to access longitudinal data in one place.
  - "Upgrades to computer systems and changes in system vendors are frequent occurrences as higher education abandons homegrown systems in favor of more robust commercial software. These changes have expanded data capacities at the institutional level and opened up new opportunities to use data to inform decisions. The increased opportunities come at a cost, however. It is not uncommon for student records to cover 10 or more years, and to require querying of multiple record systems with different variable names, which requires significant staff time" (Swing, 2016, p. 5).

- Lack of technology integration negatively impacts use when users are expected to login to multiple systems and/or data from multiple systems are not integrated.
    - "Participants repeatedly noted the need to use multiple systems, due to a lack of integration between technologies on campus. The lack of integration of technologies within the organization's technological infrastructure was by far the most common barrier reported by participants" [in using learning analytics tools] (Klein et al.,i, 2019b, p. 614).
    - "All participants, but especially academic advisors, who reported having to have multiple monitors and online screens open in each advising system, acknowledged that lack of integration makes use of these systems cumbersome, time consuming, and even unreliable. The log-on requirements for the various tools often differed. One system would require part of the student ID, another used only names, and another needed a combination of identifiers. The necessity for participants to have multiple logons to access each system differently, reduced their ability to efficiently assist students or approach their workload. For academic advisors in particular, the need to use and log-on to so many systems to advise one student, made it difficult to have the time to use each tool to its full potential" (Klein et al., 2019b, p. 614).

d. **Lack of Wi-Fi (Broadband) Bandwidth**
   - People in rural areas, particularly indigenous reservation areas, have less access to, and more expensive, broadband than people in urban and suburban areas.
      - "Only 63.6% of Montana citizens have broadband access, and the average cost of the Internet is $91.54 per month—the third highest in the nation. The seven American Indian reservations in the state face even more barriers to access, with some having as low as 23 percent of the population with access to broadband . . . When colleges and universities across the country moved to emergency remote learning for the spring 2020 semester, it became clear that a digital divide existed between students (and families) who have access to a home computer with reliable, high-speed Internet and those who do not. Multiple news agencies reported that students and workers used parking lots as workplaces to capitalize on free Wi-Fi signals from the businesses nearby" (Salsbury & Hansen, 2022, p. 199).
      - "According to the Federal Communications Commission (FCC), Americans who live in rural areas are ten times more likely to be unserved than their urban counterparts. Thirty-nine percent of rural Americans (23 million people) lack access to 25 Mbps broadband services (41 percent on Tribal lands) compared to only 4 percent of

urban residents" (Schools, Health & Libraries Broadband Coalition, 2016, p. 89).

- IHEs in rural areas face challenges in obtaining broadband capacity due to high costs, lack of infrastructure, and lack of competition of providers.
    - "Anchor institutions in rural and high-cost areas face extraordinary challenges in obtaining adequate broadband capacity. The costs of deploying fiber to schools in more rural regions of the US can be two to three times higher than the average cost of deploying fiber to schools in metro or suburban areas" (Schools, Health & Libraries Broadband Coalition, 2016, p.1).
    - "Broadband prices are often much higher than anchor institutions can afford to pay. The Consortium for School Networking's Third Annual E-rate and Infrastructure Survey finds, 'affordability continues to be the primary impediment for securing robust connectivity; this is particularly true for monthly service fees but also for initial capital costs'" (Schools, Health & Libraries Broadband Coalition, 2016, p. 71).
    - "While the market sometimes provides sufficient financial incentives for broadband companies to deploy high-capacity broadband, the market does not always work. There are several factors that contribute to this market failure, including: The expense and complexity of building out and maintaining high-capacity broadband infrastructure; The limitations of legacy infrastructure, such as aging DSL lines; The absence of competition and open access policies that could allow multiple ISPs to operate using the same infrastructure; and Little return on investment when it comes to serving certain communities and regions" (Schools, Health & Libraries Broadband Coalition, 2016, p. 81).
    - "There are two reasons for this disparity between rural and urban areas. First, the cost of deploying broadband networks in rural areas is higher than in urban areas" (Schools, Health & Libraries Broadband Coalition, 2016, p. 89). "Second, because of low population density in rural areas, the costs of deploying broadband in rural areas must be recovered from a smaller user base" (Schools, Health & Libraries Broadband Coalition, 2016, p. 90).
- Federal funding to identify areas of broadband access needs has dried up, making it more difficult to identify areas of need.
    - "In 2010, the Federal Government created the State Broadband Initiative (SBI), which provided funding to each state and territory of the U.S. to map the availability of broadband networks and broadband subscribership across the U.S. That effort, administered by the National Telecommunications and and Information Administration (NTIA), culminated in the creation of the National Broadband Map." "NTIA's mapping effort came to an end in 2015 and responsibility for updating the map has been transferred to the

Federal Communications Commission (FCC). Unfortunately, the FCC has not received additional funding to maintain the map. The FCC continues to gather data through its annual reporting obligations on telecommunications carriers (Form 477), but these reports do not specifically ask for information about broadband connectivity for CAIs [community anchor institutions] and instead primarily focused on residential and business services" (Schools, Health & Libraries Broadband Coalition, 2016, p. 19).

e. **Lack of Bandwidth to Manage Data**
- Institutional research (IR) and information technology (IT) professionals spend time managing data, but struggle with multiple aspects of its management, including integration, sharing, and documentation. Differences by type of institution may also be present, with one survey finding that IR office leaders at private not-for-profit 4-year institutions spent more time in data collection and management than those at public 4-year institutions.
  - IT professionals at higher education institutions (IHEs) rated their institution's data management lowest of the nine factors measuring analytics maturity by the Higher Education Data Warehousing Forum (HEDW) (Drake & Walz, 2018).
  - "IT is also facing massive challenges in terms of data integration, data sharing, and data documentation in the age of expanded data governance efforts . . . IT may lack knowledge of complex business logic that the individual units across their institution leverage to get business done. This lack of business logic knowledge may create gaps between technical and functional subject matter experts, which may impede progress on shared goals" (Simon, 2021, p. 30).
  - IR leaders estimated that they spent 19% of their time on data collection and management, the largest percentage of the 12 items on the survey. Items, in order of percentage of time spent, included data collection and management, basic analytics, communication of information, attending meetings, educating data users, policy/governance/planning, advanced analytics, office management, administrative activities, professional development, technology management, and other. "IR office leaders at private not-for-profit 4-year institutions spend more time in data collection and management compared to their public sector colleagues." Analytical staff in the IR office spend 30% of their time on data collection and management, compared to 24% on basic analytics and 8% on advanced analytics (Association for Institutional Research, 2021c).
- IR professionals struggle with their capacity to respond to data requests.
  - An interviewee in a community college-focused study "shared that due to the workload of her team, and limited time and resources,

only requests that had a direct connection to student success or organizational effectiveness could be addressed" (Fay, 2020, p. 124).

- Institutions that are part of systems have some assistance from the system office in supporting IPEDS reporting but lack support from the system office in other areas of data management.
    - Institutions that are part of systems report having some assistance from the system office in supporting IPEDS, but "that the degree of support is relatively low in most other areas" (Gagliardi & Wellman, 2015, p. 18).

f. Limited Staff to Provide Guidance on Data Use

- Research showed that connection to colleagues with expertise in using education data helped faculty use data more effectively.
    - "This program provided the human capital required to help translate raw data into actionable knowledge for teachers" (Hora et al., 2017, p. 412).
- IR offices do not have many staff to dedicate to data use guidance but demands for this service is rising.
    - "The average IR office has a staff FTE of 3.9, ranging from a high of 6.3 FTE at the average public 4-year institution to a low of 2.8 FTE at the average private not-for-profit 4-year institution." IR office staff size correlates with institutional enrollment, so smaller institutions have fewer staff (Association for Institutional Research, 2021d).
    - IR staff do not spend as much time on educating data users as they do on other tasks (6% of their time, which was 7th of 12 options on a survey) (Association for Institutional Research, 2021c).
    - A study of community colleges showed that "[interviewee] perceived sense-making data analysis with professionals was one of the most time-consuming IR activities . . . [he] expressed there was a data literacy spectrum across users: 'The level of data literacy is from next to nothing to Ph.D. statisticians who just want a raw data set and to run their own numbers and draw their own conclusions.' [He] expressed the amount of time spent with their customers helping them make sense of the data had increased significantly over the past few years" (Fay, 2020, p. 142).

g. Staff Resources in Data Capacity Innovation

- Job board posting data signal a need for more data and analytics staff at IHEs and a possible lack of individuals to fill such positions.
    - "The AIR jobs board, on average, lists at least 75 open positions for data-related roles at institutions and organizations across the United States. The vacant positions range in level of experience required and department, as several jobs are located in areas outside of the IR office such as the business office, provost, and information technology (AIR, 2019). This signals both a high need for more data capacity on college

campuses and a shortage of professionals who are available to fill the demand for analytics help" (Parnell, 2020, p. 11).

- In general, IT professionals, business officers (particularly at institutions with lower enrollments), IR/IE professionals, and student affairs professionals at IHEs view lack of staff resources as a barrier to analytics.
  - o **IT professionals:** "In a 2015 survey conducted by EDUCAUSE, institutions noted they needed additional personnel to provide analytics services; this need ranged in size from a 59% increase from schools with more than 15,000 students to a 100% increase from schools with less than 2,000 students (Yanosky & Arroway, 2015)." (Perkins & Ariyachandra, 2021, p. 17).
  - o **IT professionals:** "For resources, institutions are underdeveloped in terms of having sufficient professionals who have specialized analytics training, know how to apply analytics, and know how to support analytics, as well as having an appropriate number of data analysts" (Brooks & Thayer, 2016, p. 15).
  - o **Business officers:** "The analytical and technical skills necessary to facilitate analytics capacity, whether it be the skills to manage data, to build a warehouse, to create dashboards, or others are in high demand in other industries. Because colleges and universities have limited resources, it is a challenge to find and retain a skilled workforce to support analytics capacities" (Wayt, 2019, pp. 6–7).
  - o **Business officers:** The 2019 NACUBO Study of Analytics survey found that 77.4% of respondents felt that "people are 'too busy' and using analytics is seen as adding more to their role." That was a contributing or pressing barrier to IHE analytics efforts (Wayt, 2019). Results did not differ much by institution type, but did differ by institution size, with only 68.3% of institutions with enrollments of 15,000 or more indicating that it was a barrier compared to 78-80% of institutions in categories of smaller enrollment (L. Wayt, personal communication, December 10, 2021).
  - o **Business officers:** The 2019 NACUBO Study of Analytics also found that 78.9% of respondents felt that the fact that"there are not enough staff members/workforce capacity" was a contributing or pressing barrier to IHE analytics efforts, making this barrier the second highest of the six options on the survey (Wayt, 2019). Results differed by type of institution, with only 68.6% of community colleges indicating that it was a barrier as compared to 79.2% of comprehensive/doctoral institutions and 80.0% of research universities (L. Wayt, personal communication, December 10, 2021). Differences were also noted by institution size, though not in a pattern, with the following percent of respondents indicating that it was a barrier: Fewer than 4,000 (84%); 4,000-7,999 (72%); 8,000-14,999 (82.7%); 15,000 or more (73%) (L. Wayt, personal communication, December 10, 2021).

- **IT, IR/IE, and student affairs professionals:** "many respondents said more staffing is needed. For example, only a third (32%) of institutions reported that they have sufficient staffing to carry out their student success studies. Three in 10 institutions report sufficient staffing for the management of analytics, and 2 in 10 have enough staff for analytics and reporting. The largest segment of respondents reported that while their institution has staff in place for these areas, more staff were needed to be optimal (48% for data functions, 42% for management of analytics, and 39% for analytics and reporting functions)" (Parnell, Jones, Wesaw, & Brooks, 2018, p. 14).
        - **IT, IR/IE, and student affairs professionals:** "Unfortunately, a sizable portion of institutions (35% for analytics reporting, 29% for management analytics, and 20% for data functions) reported that there were no staff functions in place for this work but that those functions were needed" (Parnell et al.,, 2018, p. 16).
        - **IR/IE professionals:** "Only 34% of leaders of IR offices that are primarily reporting units (i.e., more than 50% of their work is spent producing compliance and institutional reports) are satisfied with staff size with an average staff FTE of 2.9. By contrast, 48% of leaders of IR offices with broader portfolios of work are satisfied with staff size with an average staff FTE of 4.2" (Association for Institutional Research, 2021d).
- Numerous factors contribute to IHEs' inability to increase data and analytics staffing, including campus resource limitations, perceived low pay, and lack of pay competitive with jobs outside of academia.
        - "Several factors appear to contribute to shortages in personnel with extensive data-related experience. One leading factor is campus resource limitations, which impacts both the extent to which campuses can expand their data functions and retain seasoned professionals. For example, experienced campus data professionals may choose to pursue a position with a different institution, especially if the opportunity offers more attractive compensation and benefits. As a result, personnel shortages are especially relevant to under-resourced institutions, as such colleges may have the most difficulty retaining experienced staff" (Parnell, 2020, p. 12).
        - "In addition to seeking a position with a different institution, those who are skilled with data analyses and interpretation may find more appealing job opportunities in industries outside of higher education, such as healthcare and manufacturing" (Parnell, 2020, p. 12).
        - "We asked office leaders to indicate their agreement with the statement, "office staff are paid competitive salaries." Across all institutions, just under half of IR office leaders feel that salaries are competitive. Although the pattern of responses is similar for IR office leaders at public 2-year and private not-for-profit 4-year institutions, a majority of those at public 4-year institutions feel that staff salaries are competitive" (Association for Institutional Research, 2021e).

- o "77 percent identify 'hiring/retaining qualified IT personnel as a top campus IT priority . . . 78 percent agree/strongly agree that 'we have a difficult time retaining IT talent because our salaries and benefits are not competitive with off-campus job opportunities'" (Green, 2019, p. 11).
- Lack of staff resources has negative impacts at IHEs, including slowed progress on initiatives, lack of ability to expand analytics work, and forced use of third-party vendors when in-house staffing is not available.
    - o **Slower progress on initiatives and under-informed strategies:** "current trends show that many colleges are in need of more institutional research professionals and others who have data-related experience. Institutions that are unable to address the need for adequate staffing could risk slower progress on campus initiatives, under-informed strategies, and a campus culture that is unprepared to embark on the impending analytics revolution" (Parnell, 2020, p. 11).
    - o **Lack of ability to expand analytics work:**
        - ▪ "Staff size has the biggest impact on the structure and function of an institutional research office, and as a result, small offices do not have the capacity to handle certain types of projects, burdened as they are with routine reporting and other tasks." "According to the National Survey of Institutional Research Offices, 59% of two year and 54% of four year institutions are staffed by less than three FTE (2016, p.5) " (Prewitt-Freilino & Rush, 2017, p. 15).
        - ▪ **Community college study:** "Faced with a high demand for turnaround and compounded by limited time and resources, [interviewees] reported that the level of data analysis in IR data products was diminished . . . For example, [interviewee] shared the following on the influence of limited IR bandwidth on data analysis: 'There are many times when we don't have the time or the bandwidth to do that extra level of analysis, so we're just shipping off tables, charts, and reports to people'" (Fay, 2020, pp. 125–126).
    - o **Forced use of third-party providers when in-house staffing is not available:** "A similar challenge relates to the tools that institutions use to analyze data and present them to stakeholders. In-house analytical capability is not a given, but it is perhaps even more rare to find staff who can visually represent data to stakeholders in meaningful and actionable ways. While some institutions, such as Purdue and Rio Salado, have the resources to build their own solutions, many more are turning to the growing market of third-party analytics providers . . . These third-party platforms offer customization options, but the core algorithms they use tend to be proprietary and are not shared with clients. This secrecy can make it hard for institutions to gauge the integrity and flexibility of the algorithms; it also raises questions about the ethics of making decisions about students' instructional pathways

based on a black box that administrators, instructors, and students do not understand" (Alamuddin et al., 2016, p. 22).

- Newly mandated data collections with fixed deadlines often means a lack of IR staff time spent on analytics projects.
  - o "In addition to general capacity shortfalls, numerous newly mandated data collections, such as campus crime data and gainful employment reporting have been added to the workload of IR offices. A common refrain is that after mandatory reporting is complete, there is little time and few resources for research on issues that are important to a specific campus" (Swing, 2016, p. 2). "The number of annual mandatory reports constitutes a significant portion of the workload of IR offices. Additionally, the fixed deadlines associated with mandatory reports limit flexibility for scheduling and prioritizing other important work" (Swing, 2016, p. 4).
- In addition to mandatory data collection and reporting, IR/IE professionals have many work functions to accomplish, with only a small portion of their time dedicated to data capacity innovation.
  - o Percentage of IR office work by category: Reporting (27%), Information for decision support (22%), institutional effectiveness (10%), accreditation (9%), assessment (9%), analytics/business intelligence (8%), strategic planning (8%), other (6%). "IR offices at public 2-year institutions spend less time on reporting and more time on IE compared to 4-year institutions. IR offices at public 4-year institutions spend more time in analytics/business intelligence (BI) than the other two sectors" (Association for Institutional Research, 2021f).
  - o "we classified work functions into two main categories: traditional IR (i.e., reporting, decision support, and analytics/BI) and traditional IE (i.e., IE, assessment, accreditation, and planning). Then, we classified each IR office as predominantly IR-focused, IE-focused, or an equal mix based on the percentage of effort spent on the various work functions. Survey data reveal that 70% of offices are primarily focused on traditional IR, 19% are primarily focused on traditional IE, and 11% spend equal amounts of time on both IR and IE… A higher percentage of IR offices at public 4-year institutions focus primarily on traditional IR compared to the other sectors (80% public 4, 62% public 2, 67% private NFP 4)" (Association for Institutional Research, 2021f).
- Some IHEs have found success in using technology and developing processes to overcome staffing shortages.
  - o "Less efficient offices primarily fulfill requests on an ad hoc basis, which can be unpredictable in scope, required resources, and benefit to the IR function and to the institution as a whole. More efficient offices complete tasks in a routine manner: reports and analyses are recurring and scheduled in advance, so that templates and other processes may

be built to facilitate their completion" (Prewitt-Freilino & Rush, 2017, p. 13).

h. Institutional Research is Not Prioritized

- IHE leaders do not list IR as a top priority. IR often does not report directly to the head of the institution. Most report to the provost/Chief Academic Officer and only 19% report to the president/CEO, though IR at 2-year institutions are more likely to report directly to the president/CEO.
  - According to the 2018 National Survey of IR Offices, "54% report to the provost/chief academic officer (CAO), 19% report to the president/chief executive officer (CEO), and 7% report to an independent IR/institutional effectiveness (IE)/planning unit" (Association for Institutional Research, 2021b).
    - There are differences in reporting by institution type. "More than one-third of IR offices at public 2-year institutions report to the president compared to 10% and 16% at public 4-year and private not-for-profit 4-year institutions, respectively" (Association for Institutional Research, 2021b).
    - "We found that 38% of IR office leaders do not report to positions or divisions they deem ideal" (Association for Institutional Research, 2021b).
    - "Overall, fewer IR offices report to the provost or an independent IR/IE/planning unit in 2018 compared to 2015, whereas more IR offices report to the president in 2018" (Association for Institutional Research, 2021b).
    - There were changes in reporting from the 2015 to 2018 National Survey of IR Offices.
      - "Public 4-year and private not-for-profit 4-year institutions had a 4% net decrease of IR offices reporting to one of the three most common reporting lines. Those IR offices are now reporting to units like finance/operations/business and enrollment management/admissions compared to 2015" (Association for Institutional Research, 2021b).
      - "Public 2-year institutions saw a 6% net increase in IR offices reporting to one of the top three" (Association for Institutional Research, 2021b).
      - "There was a 5% net increase in the percentage of IR offices that report to IT" (Association for Institutional Research, 2021b).
  - "Though senior administrators are recognizing the importance of data and using data to inform their decisions, they are not necessarily making the connection between that process and how IR can and should play a role" (Larkan-Skinner & Shedd, 2021, p. 12).

- o "College and university presidents believe themselves to be conversant in the use of data, even if they do not spend much time doing so. Very few (8%) of presidents indicated feeling unprepared to use IR (evidence) to inform decision-making before their first presidency, even though only 5% responded that doing so occupied most of their time. . . . Despite being featured as a key takeaway of the report, only 12% of presidents highlighted using IR (evidence) as an area of future importance for their colleagues. Despite being fundamental to the areas seen as most important to presidents, classical IR may be perceived as a function of secondary importance" (Gagliardi & Johnson, 2021, p. 113).
- The processes associated with institutional research (e.g., data use, planning, technology, etc.) and the roles of the functions of IR and IT may not be completely understood or appreciated in IHEs.
    - o "Many colleges and universities have not cultivated a respect for the role of planning . . . often there are good intentions for planning, but fatigue sets in and there is little consistency in maintaining a focus on planning throughout the year" (Society for College and University Planning & Baker Strategy Group, 2015, p. 11).
    - o "In their defense, both units [IR and IT] are often neglected. Many are not given the necessary resources to grow proportionately with the expectations around data use or the role they are expected to play in creating and feeding a culture of evidence. The lack of a complete picture, strong data policies generated through collaboration and ongoing discussion, and the technical means to connect it in ways that help ensure the timely, accurate, and relevant delivery of data to end-users are impediments commonly experienced across institutions regardless of type" (Gagliardi & Johnson, 2021, p.110).
- However, some research indicates that IR involvement in data and analytics at IHEs is valued and rated highly, at least by IT professionals.
    - o "IR involvement is the most advanced dimension [of 6 dimensions of the EDUCAUSE analytics maturity index]. Well over half of institutions have largely achieved or fully achieved maturity in effective communication between IR and IT, as well as having IR leadership involved in planning for high-level strategic initiatives or questions" (Reeves & Pearlman, 2017, p. 5). And "[l]ooking at past data shows that IR involvement has been rated the highest every year since data collection started back in 2014 . . . These ratings are based on the belief that institutions have effective communication between IT and IR departments, and also that senior-most institutional research leaders are involved in planning for addressing high-level strategic initiatives or questions. IR involvement differs by institution type, with associate's institutions rated about the mean and higher compared with other institution

types: Associate's institutions scored 4.0, while private master's institutions rated below the mean at 3.4" (Reeves & Pearlman, 2017, p. 11).

- o "Institutional research, finance, IT, and advancement were most frequently cited as the departments leveraging analytics today. Of these, institutional research is the most involved in analytics according to the [EDUCAUSE Analytics] maturity index. The IR director is second only to the CIO in assuming a leadership or sponsorship role for analytics" (Brooks & Thayer, 2016, p. 5).

i. Lack of a Chief Data Officer

- It appears that designation of CDOs is increasing in IHEs, but a lack of consistency in defining the position (and whether the person must hold the title Chief Data Officer to be counted) makes accurate data difficult. For example, surveys by AIR and EDUCAUSE treat the title completely differently, resulting in the AIR survey counting a much larger number of CDOs in IHEs than the EDUCAUSE survey.
    - o "our analysis confirms the relative newness of such positions, with more than three-quarters of respondents indicating that their institutions do not even have analytics officer positions" (Brooks & Thayer, 2016, p. 26). Note—the survey broke this question down into categories: a) Analytics Officers, including Chief analytics officer or equivalent, Chief data officer or equivalent, Chief learning officer or equivalent; b) Institutional Leadership, including CIO or equivalent, President/Chancellor, CAO or Provost, CFO or CBO; c) Functional Support, including Director of institutional research, student success leader.
    - o "In Yanosky and Arroway's research of the landscape of analytics in higher education (2015), most institutions did not have a chief data officer or executive leader who led the analytics work for the institution and only 9% had dedicated analytics centers" (Perkins & Ariyachandra, 2021, p. 15).
    - o "Overall, fewer than half of institutions currently have CDO positions. This varies across the major institutional sectors. More public 2-year institutions (53%) have this position than 4-year institutions (public (44%) or not-for-profit (40%)). Of the institutions that have CDO positions, regardless of sector, the majority are filled by IR office leaders (86% overall and for each sector)" (Association for Institutional Research, 2021a).
        - ▪ "We found that IR office leaders who also serve as their institutions' CDOs are more likely to be members of the cabinets of the president/chief executive officer (CEO) or provost/chief academic officer (CAO) than those who do not serve as CDOs" (Association for Institutional Research, 2021a).

- o "As the chief data officer role is considered in the academy, it is accompanied by a plethora of inconsistent titles . . . In this study, the chief data officer is defined as the senior executive who holds organization-wide responsibility for data, information strategy, data governance, and usage. This individual may hold the chief data officer title or a closely related title (such as assistant vice president for data and analytics, chief of analytics and data transformation, vice provost for decision support), so long as their job makes specific reference to these organization-wide responsibilities" (Browning, 2021, p. 47).
  - o A qualitative study of six CDOs at research institutions found that there was a lack of role clarity (lack of understanding of the CDO role), lack of resources (high salary of such a position and staff turnover in data leadership positions), and a frustration with the slow change environment in higher education from CDOs who came from outside academia (Browning, 2021).
- The impetus for creating the role of CDO will vary across campuses, but reasons include leadership frustrations with their inability to obtain timely data, and friction between leadership and IR.
  - o Leadership, particularly the president, was the catalyst. Presidents were data-oriented but frustrated with their inability to obtain data in a timely manner. They had tried using a data committee but found that it did not work (Browning, 2021).
  - o There was friction between leadership and IR as institutional data needs became more sophisticated. IR failed to evolve beyond compliance-oriented reporting. IR was linked to IPEDS and the CDO was not. IR focused on what happened in the past and not on operational efficiencies of the future (Browning, 2021).
- Reporting lines of CDOs may vary across institutions, so generalizations about the role are challenging to make.
  - o In a qualitative study of only 6 interviewees (all CDOs from R1 or R2 institutions), two reported to the Chief Financial Officer, and each of the other four reported to the following: Associate Vice Chancellor for Administration and Finance (also dotted line to Provost, but they rarely engaged), Provost and Executive VP, VP for IT, and Vice Provost of Research (Browning, 2021).
  - o Four of the six CDOs in the study reported one level away from the CEO (reporting to an individual who reported directly to the CDO). Reporting level for the other two CDOs was not listed. All six reported having regular engagement with senior leaders on data and analytics. This was significant because some CDOs do not have direct access and hear of data needs secondhand. "The findings suggest that the chief data officer should ideally be organizationally positioned so that they have access to strategic conversations that occur at the executive level" (Browning, 2021, p. 126).

- CDOs have many roles and expectations, including data management, making sense of data, providing access to data, breaking down institutional silos to ensure collaboration, and promoting the utility of data. Responsibilities include the following:
  - Responding to data velocity through management of a proliferation of data (systems and vendors), making sense of the data, and providing access to that data (Browning, 2021).
  - Having a holistic campus view by breaking down silos, collaborating, and ensuring a relationship between the CDO and IT (Browning, 2021).
  - Promoting the utility of data through making relevant data accessible to campus and utilizing project management (Browning, 2021).
- Existence at an IHE of a CDO appears to positively impact IR/IE leaders' views that the institution had capacity to meet needs for data and information for decision making.
  - "We asked IR office leaders to evaluate institutional and IR office data capacity by indicating their levels of agreement with the following two statements: 1) There is sufficient capacity across the institution to meet stakeholders' needs for data and information for decision making. 2) There is sufficient capacity within the IR Office to meet stakeholders' needs for data and information for decision making. Disaggregating the data by role, we found that a higher percentage of IR office leaders who serve as CDOs agreed with these two statements than office leaders who are not in that role (Chart 2). Further, even when CDO roles exist, but IR office leaders do not fulfill those roles, IR office leaders agreed with these statements more than office leaders at institutions without CDOs" (Association for Institutional Research, 2021a).

j. **Other Factors Related to Lack of Infrastructure and Resources**
  - There are additional factors related to an IHE's technology infrastructure and resources that can impede the IHE's data and analytics capacity, including the following: a) decentralized technology decisions and infrastructure, b) an overwhelming number of technology vendors at an IHE, c) lack of inclusion in technology selection impeding adoption and use, and d) the perception that technology investment is more important than human resource investment, reducing likelihood of technology use.
    - Decentralized technology decisions may lead to decentralized technology infrastructure, which negatively impacts rollout and use. An overabundance of technology and vendors may overwhelm an institution and its IR and IT professionals.
      - "However, the highly decentralized organizational structure of the institution, in which budget and technology decisions are made at the department level, has created an

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environment in which multiple LA tools have been implemented simultaneously, with varying levels of access, functionality, and adoption . . . [Learning analytics] tool resources are often unevenly distributed, associated institutional policies are imprecise or contextualized to specific departments and their corresponding traditions and cultures act to limit the use of LA tools on campus . . . These barriers include decentralized decision making, unclear or lacking policies, trainings, and communications, and a lack of perceived commitment by and trust in leadership planning related to LA tools" (Klein et al., 2019a, p. 577).

- "Increasingly, IR practitioners are also confronting their roles in standing up new data warehouses, engaging an ever-increasing number of vendors hoping to enter the campus data space, and leveraging new data sources and tools that go beyond the traditional student and academic data domains" (Simon, 2021, p. 27).

o User involvement in technology selection, including an understanding of the meaning behind the tools, positively impacts use.

- "Trust in the decision making of leadership related to purchase and implementation of LA tools was regarded as an important factor as to whether or not advisors and faculty would adopt these tools. While both faculty and advisors deemed trust important, advisors were more likely to express concern about leadership's approaches to purchase and implementation of LA tools" (Klein et al., 2019a, p. 583). "Understanding the meaning behind the tools elevated a level of trust in the users and opened them up to adopting tools that they would not normally use. However, to make this meaning visible to users requires a strategically inclusive approach to leadership related to tool implementation on campus. Essentially, trust must encompass both the LA tool, itself, and the process and purpose behind the use of the tool" (Klein et al., 2019a, p. 587).

- "All advisors in the study believed that increased inclusion in the decision making related to use of these tools would increase potential adoption by users. They also believed that inclusion would create an environment in which appropriate and useful tools would be made available to them. Faculty members were also concerned with inclusion in tool creation, selection, and purchase" (Klein et al., 2019a, p. 584). "Participants, especially advising staff, noted that they often felt excluded by institutional leadership from

decision making related to purchase and implementation of LA tools. Yet they were expected to use these tools in their practice, even when the tools often did not align with their needs" (Klein et al., 2019a, p. 585). "Not including users' perspectives and voices at the institutional decision making level can hamper broad adoption and use within the institution. Participants noted that when leadership approached decision making from a collaborative perspective, they were more likely to get buy-in from those affected by the decisions" (Klein et al., 2019a, p. 585).

  - "Directly related to resource availability is also resource stratification. How are budgets aligned for data projects? How are resources spread across the broader organization? What is the perception of resource allocation amongst campus constituents? All of these questions impact a willingness to partner" (Simon, 2021, p. 29).

- The perception that investment in technology is more important than investment in human resources can negatively impact the use of analytics tools.

  - "Concerns around fiscal resources versus human resources and duplicative purchasing of tools that did not meet users' needs were reported as important factors for dissatisfaction, of both LA tools and of the institutional decision makers, and lack of adoption . . . The idea that investment in technology was more important than investment in individuals was a large concern, especially by advisors, who often value face-to-face, human interactions over technological ones and whose caseloads often exceed 200 students each semester. The costs related to the purchase of technologies, like LA tools, that often go unused, are not broadly used, or are not mandated because there seems to be no overarching plan related to purchase of these technologies, led to a lack of trust in institutional decision making by study participants" (Klein, Lester, Rangwala, & Johri, 2019a, p. 583).

  - "And both faculty and advisors reported being equally concerned that LA tools, whose predictive nature could have an increased impact on both their and their students' decision making, required a human touch, one that they, not a tool, could provide" (Klein, Lester, Rangwala, & Johri, 2019a, p. 584).

- Even when the infrastructure and resources exist for data and analytics at an IHE, the lack of incentive to use data and tools, including lack of support for a culture of use, may be a barrier to their use by staff and faculty.

- o "[Learning analytics] tool use is not incentivized extrinsically at the institution, because it is not incorporated at the institutional level into the assessment of individuals at the university . . . Advisor participants noted that if they are not expected to use, not rewarded for use of, or not assessed on use of LA tools in their practice, they are less likely to incorporate them. Use of incentives and rewards was an especially important lever for tenure-track faculty participants, whose evaluations are not focused on incorporation of technology into their teaching practice" (Klein et al., 2019a, p. 586).
  - o "Outside of team-taught courses or accreditation policies that mandated data collection and reporting, for many faculty the decision whether to collect, analyze, and utilize teaching-related data was left completely up to them. Given that the incentive structure within research universities prioritizes research accomplishments, for many respondents there simply was no compelling reason to commit scarce time to the design and implementation of a continuous improvement system" (Hora et al., 2017, p. 419).
  - o "Institutional barriers to assessment can also include a lack of infrastructure to support assessment activities. For example, if a senior student affairs officer (SSAO) outlines the need for assessment, but support systems, such as training, technology, and personnel are lacking, then it will be difficult to create and sustain a culture of assessment" (Balser & Kniess, 2018, p. 82).
- ● Aspects of the IR unit can impact its effectiveness as a resource to the institution. The position of the IR unit within the institution and its evolution to new models beyond a simple reporting function can serve as a barrier to, or expand, institutional data and analytics capabilities.
  - o "A primary institutional challenge is a recognition that higher education institutions (IHEs) operate in silos . . . These operational silos create barriers for collaboration, and it takes energy and effort to confront and overcome this challenge . . . The relative position of the IR function impacts strategic priorities, time on specific tasks, and in many cases, may either accelerate or hamper analytic implementations. From a practical perspective, these silos create data ownership issues, territorialism, and, depending on the maturity of the data landscape, organizational inefficiencies of varying degrees of adverse outcomes" (Simon, 2021, p. 29).
  - o "Although there is variation in how IR units are structured and how much resources are available to them, most continue to be oriented primarily toward compliance with federal, state, accreditation, and other external reporting requirements" (Cubarrubia & Le, 2020, p. 19).

- "IR has recently shifted from a mostly passive model of reporting toward a proactive model of engagement" (Berg & Hanson, 2017, p. 32).
- Data users and consumers expect quick data access that does not involve working with intermediaries; rather, they expect the institution to provide the type of self-service data they are accustomed to in other aspects of their lives, such as banking and shopping.
    - "Another significant challenge is that expectations of information consumers are evolving faster than our ability to shift to address them. A new breed of 'self-service' BI tools have been emerging and promising to put the power in the hand of information consumers by bypassing traditional data preparation work that has normally been the province of central experts. In addition, information consumers who are accustomed to having information at their fingertips in the consumer world from their banks and online retail giants balk at having to ask data intermediaries for information about their own units" (Drake & Walz, 2018, p. 45).

2. Limited Training on How to Use Data
a. How Data are Collected, Managed, and Analyzed
- Analytics are expanding as an expectation of IR. New skills may be needed by IR professionals to meet this demand.
    - "When asked for the type of skills needed, the top were predictive modeling (92%), analytics tool training (89%), data visualization (88%), user experience development (87%), and data analysis (87%) (Yanosky & Arroway, 2015)" (Perkins & Ariyachandra, 2021, p. 17).
    - "A keyword search was conducted for BI and analytics keywords in each year's AIR conference book (Association for Institutional Research, 2012/2018). The keywords searched for included: data science, business intelligence, analytics, dashboard, and visualization." "The results indicate the biggest increase in referencing visualization and analytics. In 2012, visualization was mentioned 14 times and jumped to 86 in 2016. Analytics jumped from being mentioned 42 times to 84 in 2018" (Perkins & Ariyachandra, 2021, p. 18).
- Data management tools are evolving, and IR professionals need new skills to keep up with the technology.
    - "When engaging colleagues in IT who are accustomed to working with data transactionally and 'live' data, IR professionals often face a steep learning curve to adapt to a new way of interacting with data" (Simon, 2021, p. 30).
- Business officers at IHEs are concerned about the lack of resources to invest in analytics skills.
    - According to the 2019 NACUBO Study of Analytics, 39.2% of respondents felt that not having "the resources to invest in needed

skills for our core analytics staff" (Wayt, 2019) was a contributing barrier and an additional 27.0% felt it was a pressing barrier to institutional analytics efforts. This was the highest pressing barrier of the 6 options in the survey (Wayt, 2019).

- o Results differed by institution type with 53.8% of community colleges, 58.4% of comprehensive/doctoral institutions, and 67.7% of research universities indicating that it was a contributing or pressing barrier (L. Wayt, personal communication, December 10, 2021).
- o Results also differed by institutional size, with the institutions with the lowest enrollments more likely to identify it as a barrier - Fewer than 4,000 (76.3%); 4,000-7,999 (70.6%); 8,000-14,999 (63.5%); 15,000 or more (46.8%) (L. Wayt, personal communication, December 10, 2021).

b. How to Use the Tool(s)

- Increased use of new technology for data and analytics means increased training needs for IR/IE and IT professionals to use these tools.
    - o "These tools require new skills, vocabularies, and resource streams to implement. Beyond the cost of the tools or technologies themselves, institutions are increasingly stretching thin human resources in both Institutional Research (IR) and Information Technology (IT) to keep up with all of the 'shiny' new capabilities . . . IR practitioners must balance maintaining their current work demands for official, ad hoc, rankings, and accreditation reporting while also adjusting to new demands on their time as technologies and tools advance" (Simon, 2021, pp. 26–27).
- A focus on more accessible data (e.g., development of dashboards) has highlighted the need for training to increase and improve their use by IHE faculty, staff, and students.
    - o In a study focused on community college IR/IE, an "[Interviewee] shared the focus of the past few years has been data access through dashboard development. Now that the data was accessible to more people, [he] shared his team began to see more gaps in their training and in the data literacy of faculty and staff . . . He said that training for faculty on how to use data for the assessment of student learning was well established and supported at his college. On the other hand, there was very little training on how to use data for staff as his college. [He] shared this was a current priority for his IR team . . . his team's initial focus was on increasing awareness and promoting basic training among the casual data users at the college to increase their skills" (Fay, 2020, p. 140).

- Professionals in many positions across IHEs, including registrars and admissions office staff, advisors, and faculty, report the desire for increased training on data and analytics tools.
  - **Registrars and admissions office staff:** AACRAO surveyed its membership on professional development and training. Of the 10 professional proficiencies of interest listed in the survey, four were related to data and technology. "Record keeping services and data stewardship" was second (82%), "Data system management" was third (77%), "Enrollment technology" was fifth (73%) and "Emerging technologies" was eighth (68%) (Kilgore & Ast, 2021).
  - **Advisors:** "Given the multiple, sometimes competing, and often duplicative systems present at the institution and the limits of accessibility to all systems, participants, especially advisors, were often unsure how, when, or whether to use these tools. Further, specific policies, like the Family Educational Rights and Privacy Act (FERPA), and concerns over potential privacy violations made users shy away from leveraging the full capacity of LA tools" (Klein et al., 2019a, p. 580).
  - **Faculty:** "Faculty deemed LA tools and related policies and training at the institution as minimal, not always tailored to their needs, and focused on the mechanics rather than the implications of these tools and their data . . . Faculty participants were more likely to use LA tools if a colleague could vouch for the tools usefulness and could show them how the tools could directly support their specific work" (Klein et al., 2019a, p. 582).

c. **How to Take the Data Inquiry and Find Answers**
- There is variation in expressed need for training on data inquiry across positions at IHEs. Research indicates that business officers at IHEs view lack of skills in data inquiry as the barrier of most concern for effective analytics. While faculty are experienced at data inquiry related to their fields of expertise, they report a lack of expertise in data inquiry when it comes to educational research. However, registrars and admissions office staff list increased training in data inquiry low on their list of professional development needs.
  - **Business officers:** According to the 2019 NACUBO Study of Analytics, lack of skills in data inquiry is the barrier of most concern out of the six options listed as potential barriers to effective analytics. 66.4% of respondents selected the item, "End users may have access to analytics but don't know how to translate for actionable information" as a contributing barrier and 14.5% selected it as a pressing barrier (Wayt, 2019).
  - **Faculty:** While faculty are experienced at data inquiry related to their fields of expertise, they report a lack of expertise in data inquiry when it comes to educational research. "One of the

constraints facing effective data use is the fact that most faculty lack expertise working with educational data. The skills that respondents reported lacking included the ability to conduct educational research, analyze assessment data to identify patterns and construct implications, manage extensive amounts of data, and to write effective assessments" (Hora et al., 2017, p. 411).

- o **Registrars and admissions office staff:** Compared to other professional development options, registrars and admissions office staff do not report the desire for increased training on data inquiry. AACRAO surveyed membership on professional development and training needs. Of 13 choices for top three core competencies by interest level, "Interpretation and application of institutional and external data" was selected by about 20% of respondents in managerial positions (highest), senior leadership positions (middle), and front-line staff (lowest). It was 12th for front-line staff, and 9th for managerial and senior leadership. Only 9% of senior leadership respondents selected it as a top-three most important core competencies for managerial staff (Kilgore & Ast, 2021).

d. How to Unpack or Disaggregate Data
- The ability to access data only via dashboards can prevent IHE professionals from disaggregating data in ways necessary to meet their inquiry needs.
    - o "Even when users can access data, the software and tools that are available to them often don't allow for deep inquiry. Dashboards might be delivered in such a way that users aren't able to collect, sort, and disaggregate the data in the way(s) needed, for example" (Nadasen & Alig, 2021, p. 6).

e. Institutional Research is Not Prioritized
- Expanding the use of data in IHEs requires new training and job descriptions for positions across the institutions and/or more involvement from IR when decision-makers lack the institutional research skills themselves.
    - o "Colleges often have employees in roles that require the use of data, whereas previously, they did not. As a result, they need to reskill people and reconfigure job descriptions to emphasize the use of data or create new lines that focus on the use of data. Efforts to realign talent to modern job needs can generate tension without patience and support. Moreover, employees are sometimes unwilling to adapt to new expectations, which can lead to the creation of a toxic environment" (Gagliardi & Johnson, 2021, p. 110).
    - o " Many decision-makers in higher education lack formal training and/or expertise with educational data (Horta, Bouwma-Gearhart, & Park, 2017) resulting in a growing data analytics gap within senior institutional managers in a situation of needing to become

comfortable employing analytical results that they do not fully understand nor have the ability to replicate results (Ransbotham et al, 2015) . . . Most senior institutional leaders rely on a small group of associates to provide context-based information to manage an institution; if IR professionals are not in that small group it only compounds the data analytics gap issue as data nuances, quirks, and policy implications might go unnoticed or unacted upon (Webber, 2018)" (Mathies, 2018, p. 87).

- Specialized training is needed for IR staff members but finding time for that training given expanding work demands will be challenging.
    - **Training for planning:** IR professionals rate their training for planning effectiveness lower than other professionals involved in planning at IHEs. In a SCUP survey, responding to a question about receiving proper training for planning effectiveness, IR professionals rated their training as 4.8 out of 10, tied for 11th lowest out of 15 categories of professionals. The aggregate score was 5.2 (Society for College and University Planning & Baker Strategy Group, 2015).
    - **Training in technology and analysis techniques:** "Additionally, there will be an increasing demand to expand the skill-set of institutional research offices to operate in this new infrastructure. With the new environments, it becomes more essential for programming skills to be embedded directly in the traditional IR office. While SQL still dominates the market of BI and query capabilities, Python and R are becoming more common tools for managing, extracting, analyzing, and visualizing data. Additional new analysis techniques such as machine learning algorithms and sentiment analysis can provide great insight into higher education institutions, and it benefits an institutional research office to have these capabilities in-house (Wishon & Rome, 2016)" (Drake & Walz, 2018, p. 49).
    - **From a study of community college IR professionals:** "'I think I'm seeing systemically there's a big divide in the IR skill set because there are more tools out there for IR to use and we're moving so fast trying to meet the data needs. In some ways we've not had an opportunity to bring everybody up to speed. Like Tableau is a great example. You have people who are cutting edge, and then we have some institutions that still have not mastered just building a basic dashboard yet'" (Fay, 2020, p. 129).
    - In a study of community college IR professionals, "[Interviewees] reported that balancing the time for professional development while meeting the service needs of their college was challenging" (Fay, 2020, p. 127).
- There is variation in expressed need for training on the process of institutional research across positions at IHEs. Research indicates that

student affairs professionals lack institutional research/assessment training. However, registrars and admissions office staff list increased training in institutional research low on their list of professional development needs.

- o **Student affairs professionals lack institutional research/assessment training:** "While some student affairs and higher education master's degree programs include a course on assessment, many programs do not have it as a required course in their curriculum. As a result, student affairs practitioners may not feel comfortable with assessment language and may feel as if they lack the capacity to do effective assessment " (Balser & Kniess, 2018, p. 82).
- o **Registrars and admissions office staff:** Compared to other professional development options, registrars and admissions office staff do not report the desire for increased training on the process of institutional research. AACRAO surveyed membership on professional development and training needs. Respondents in 3 categories - senior leadership, managerial, and front-line were asked about the relative importance of core competencies for front-line staff. Of the 13 competencies listed, "interpretation and application of institutional and external data" was 13th of 13 for senior leadership and managerial staff and 12th of 13 for front-line staff when reflecting on their own needs for training (Kilgore & Ast, 2021).

f. **Other Factors Related to Limited Training on How to Use Data**
- Lack of data and analytics training capacity may be a more pressing barrier for smaller institutions.
  - o "Training appears to be an issue for smaller institutions: 38% of institutions that serve fewer than 1,000 students and 27% of institutions serving 1,000 to 4,999 students claimed that their institution wide data strategy never or rarely includes training, while only 18% of respondents from institutions serving 20,000 or more students said never or rarely" (Parnell, Jones, Wesaw, & Brooks, 2018, p. 12).
- An additional barrier to training maybe lack of incentive to participate in it.
  - o "Users not only need to be trained on the proper ways to use these tools and communicate with students, they also require meaningful incentives to take on the potentially steep learning curve" (Alamuddin, Brown, & Kurzweil, 2016, p. 23).
- Other skills are needed, particularly for IR professionals, beyond those previously listed as sub-barriers, including interpersonal, political, data translation, and leadership (specifically, articulation, communication, and collaboration) skills.

- Interpersonal skills: "As important as the technical and analytical skills are to successfully perform the D&F of IR as an IR unit, leaders in the field must also understand critical issues, possess the contextual knowledge, and be able to provide college presidents with the information that they need to make crucial decisions. These IR leaders must also have the interpersonal skills to work collaboratively with institutional leadership. Cantwell and Richter (2018) reimagined IR leadership skills as articulation, communication, and collaboration. They believe these to be foundational skills that complement the three tiers of intelligence. Knight (2014) challenges IR professionals to focus on emotional intelligence, making this topic the longest of his book, and stating, 'increasingly, expertise in a specific skill set gets people hired, but emotional intelligence determines performance' (p. 40)" (Gagliardi & Johnson, 2021, p. 117).
- Political skills: "We specifically call out political savvy and networking skills needed by IR leaders to meet the evolving expectations of college presidents. We second Knight's assertion that 'to appear apolitical, the institutional researcher may need to be the most politically astute person on campus' (2014, p. 108)" (Gagliardi & Johnson, 2021, p. 117).
- Data translation: "The need for data translators will be so high that by the year 2026, millions of professionals with the skill will be needed across industries . . . As more institutions use predictive modeling and artificial intelligence to make decisions, it will be especially important for professionals to accurately interpret results . . . Therefore, colleges need a new kind of communication, and the translator role can address that need" (Parnell, 2020, p. 12).
- Leadership skills: "We posit that the challenges posed by a diffuse user group within the digital institution should not be a disruptive force, but instead leveraged to increase the capacity and use of institutional research . . . we suggest that IR leaders should focus on the interaction of three non-technical related skills in the digital institution. The skills are articulation, communication, and collaboration" (Cantwell & Richter, 2018, p. 99).
- The need for these skills differs by institutional size. IR professionals at smaller institutions need analytical and technology skills. IR professionals at larger institutions need coordination, management, and communication skills. "Parmley's research suggests IR officers at smaller institutions may have to worry less about issues of coordination and communication - getting a seat at the table in order to advocate for institutional research - than their colleagues at larger institutions. Consequently, IR leaders at small colleges are challenged to boost their own analytical capacity through technology, as opposed to coordinating and managing the

priorities of number of IR staff, given that most small colleges typically only have one or two IR professionals" (Prewitt-Freilino & Rush, 2017, p. 12).

- Some research indicates that less data and analytics training are needed for institutional staff once self-service dashboards are developed and accessible.
    - "These universities, and other institutions like them, are providing tools that allow for easy navigable access to key pieces of information for broad segments of their user base. This allows end users to find information about standard questions on their own, as well as do further exploration in an environment that has the institution's data governance baked directly into it, and all this is accomplished without the requirement of any additional training for the end users" (Drake & Walz, 2018, p. 46)

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Appendix A: Complete List of DWG-Identified Barriers

- Limited training on how to use the data
  - How data are collected, managed, and analyzed
  - How to use the tool(s)
  - How to take a data inquiry and find answers
  - How to unpack or disaggregate data
  - Institutional research is not prioritized
- Lack of trust with the data
  - Inconsistent definitions
  - Lack of transparency around how data are collected and interpreted
  - Unclear data privacy policies
  - Lack of ethical principles and practices around data use
- Lack of accountability on data use
  - Decisions are made using hunches/guesses instead of data
  - Fear of gaining access to data
  - Leadership not prioritizing data use in offices
  - Folks not making time to use data
- Resistance to change/culture
  - How to make data actionable
  - Lack of clarity on how data informs work
  - How does data inform agenda and long-term goals?
  - How does data inform interventions?
  - How do we adjust for gaps in the data?
- Lack of infrastructure and resources
  - Lack of affordable tech tools that integrate data
  - Cost of data infrastructure
  - Lack of continuity in data collections
  - Low Wi-Fi (broadband) bandwidth
  - Lack of bandwidth to manage data
  - Limited staff to provide guidance on data use
  - Staff resources in data capacity innovation
  - Institutional research is not prioritized
  - Lack of a Chief Data Officer
- Lack of centralized data resources
  - Decentralized data
  - Lack of data democratization
  - Access to data
  - Communication
  - Bypassing data governance

Appendix B: List of Higher Education Organizations and Journals

Websites of the following higher education organizations and Intermediaries for Scale were searched for relevant documents as part of the review of the literature.

American Association of Community Colleges (AACC)
American Association of Collegiate Registrars and Admissions Officers (AACRAO)
American Association of State Colleges and Universities (AASCU)
American Council on Education (ACE)
American Indian Higher Education Consortium (AIHEC)
Association for Institutional Research (AIR)
Association of Public and Land-grant Universities (APLU)
Achieving the Dream (ATD)
Complete College America (CCA)
Council of Independent Colleges (CIC)
CUPA-HR
E3 Alliance
EDUCAUSE
Excelencia in Education
Gardner Institute
Growing Inland Achievement
Ithaka S+R
MDRC
National Association of Colleges and Employers (NACE)
National Association of College and University Business Officers (NACUBO)
National Association of Independent Colleges and Universities (NAICU)
National Association of Student Financial Aid Administrators (NASFAA)
National Association of System Heads (NASH)
NASPA
Northwest Commission on Colleges and Universities (NWCCU)
Society for College and University Planning (SCUP)
State Higher Education Executive Officers (SHEEO)
The Campus Computing Project
United Negro College Fund (UNCF)

The past five years of issues of the following higher education journals were scanned for article titles related to the research question as part of the review of the literature.

Community College Review
Higher Education
Higher Education for the Future
International Journal of Educational Technology in Higher Education
New Directions for Higher Education
New Directions for Institutional Research
Studies in Higher Education
The Journal of Higher Education
The Review of Higher Education