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This chapter addresses how IR/IE both responds to and leads in our institutions and across higher education in measuring and improving student success. We introduce a new student success measurement framework in the context of internal and external facing needs, we define the importance of actionable information to inform decision-making, and we highlight data sources including new data created by predictive analytics. Throughout, we include an attention to equity and ethics.

Measuring and Enhancing Student Success

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Introduction

The role of institutional research and institutional effectiveness (IR/IE) is evolving faster than ever, propelled by external and internal pressures on the university that have direct implications for both the quantity and the nature of the work of IR/IE offices and staff. Externally, there are more demands for our institutions to demonstrate accountability for student success and learning outcomes as costs and student debt increase, national rankings become ever more important, enrollment pressures mount, and federal and state expectations expand, including performance-based funding models. Institutions must explain and justify their student success and learning outcomes in various channels to a multitude of audiences—students and their families, graduates, donors, policymakers, and the general public. Internally, that pressure is trickling down as institutions hold departments more accountable for demonstrating continuous improvement efforts; introducing new technological tools; piloting new programs; in addition to delivering instruction, co-curriculars, and student services in ways that meet today's students' needs.

These external and internal forces at the university level impact the purpose, structure, and function of IR/IE offices and staff. We have traditionally been tasked with collecting data and reporting it out. However, even in small IR/IE shops, this model is no longer enough. AIR's Statement of Aspirational Practice for Institutional Research, released in 2016, directly addresses these external and internal changes and lays out a vision for our profession of IR/IE as uniquely qualified and necessary leaders in the

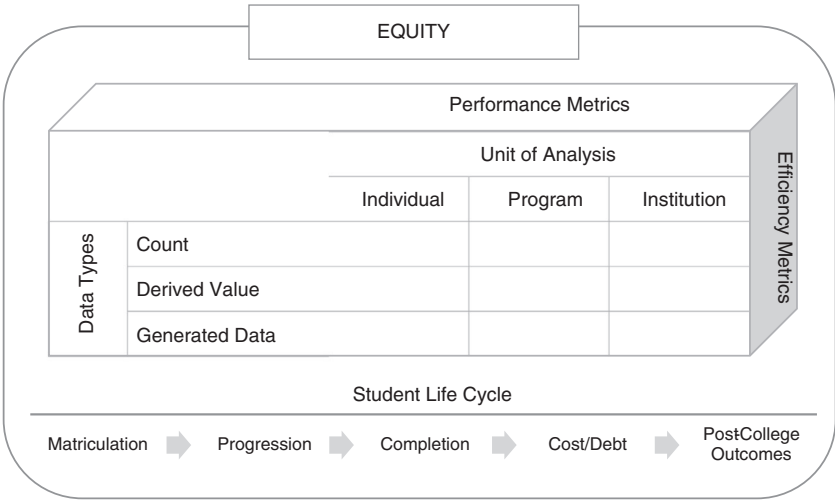
future of higher education. The mission of IR/IE offices must be to improve student success. We are now expected to engage externally and internally with efforts to tell the stories of our institutions, to take an active role in work to improve student outcomes, and to ensure continuing enrollments to sustain our institutions. Each of these requires working alongside other departments, such as enrollment management or public affairs, and managing stakeholder relationships. Each of these also require using the new tools we have increasing access to in the era of Big Data—an increased ability to track and measure student success and learning outcomes and powerful, low-cost analytic capabilities. IR/IE's expertise in the data from across the institution means that we have a unique role to play, and we can use that expertise to shape the conversation at the institutional level.

This paper will provide a description of a student success framework that can be used to examine student success metrics and how those metrics can and should be used for both external and internal purposes. We will discuss how IR can improve the measuring and reporting process to show actionable information to inform decision-making, which directly influences institutional work at the student, program, and college levels. Specific examples will highlight the changing nature of IR/IE and show how measuring additional elements with an equity lens will improve our valuable contribution to student success. We end with a call to action for all IR/IE professionals to be at the table internally when institutional decisions are made and externally as we work to improve our institutions and student success across higher education.

Student Success Measurement Framework. Each institution defines and measures student success outcomes slightly differently, depending on the institution's mission, student population, faculty, learning modality, and institutional structure. It is important to take a step back and discuss a student success measurement framework that can be used to guide our work before we discuss various student success metrics that can be used to benefit student success. The framework we introduce here is based on the work from Kinzie and Kuh (2016), Mullin (2012), and Janice and Voight (2016) (Figure 3.1).

The first element of any framework, particularly a student success framework, is attention to the audience (Kinzie & Kuh, 2016). In its simplest form, we have both external and internal audiences. External audiences are generally focused on accountability measures to highlight student success. For example, the Department of Education and state legislatures request aggregate data on student success measures to ensure institutions are staying within the parameters of success set by either the federal government or the state (such as in performance-based funding models). Additional external audiences are prospective students and parents, media, donors, higher education think tanks, and policymakers and their staff at the federal and state levels. Prospective students may gravitate toward national rankings (*U.S. News & World Report* and *Washington Monthly*),

Figure 3.1. Visualizing a new student success framework.



the College Scorecard, or Google search returns to get a sense of the type of institution they would like to attend. Internal audiences are typically individuals in the institutions who are accountable for enhancing student success (e.g., improving retention and graduation rates). This is a wide-ranging group, including faculty, advisors, department heads, deans, the president and chancellor, boards, and more. We in IR/IE support and influence both audiences, but the biggest impact we can make with our data is internally.

The second element of our student success measurement framework is the level of analysis and the type of data used. In his conceptual framework for student success, Mullin (2012) uses both the institution and the individual as the level of analysis. We recommend including an additional level—the program/college level—because student success and learning outcomes can vary by program and college. Mullin recommends using two types of data—counts and derived values. Derived values “represent counts placed within some context” (p. 128). A count would include the number of degrees awarded. A derived value would include the graduation rate. We add a third data type—generated data—that is produced when conducting predictive analytics, such as using an individual student’s score to show the likelihood of successfully completing a course (discussed in more detail, below).

It is critical for IR to examine all aspects of student success. The third element of our student success measurement framework is based on the Postsecondary Metrics Framework created by Janice and Voight (2016). Their framework was originally developed to recommend educational metrics and definitions using the Integrated Postsecondary Education Data

System (IPEDS) and the National Student Loan Data System. However, the framework is useful for examining internal student success metrics as well. The framework categorizes metrics into three broad categories: performance, efficiency, and equity. Both the performance and efficiency categorizations have a temporal aspect based on the student success lifecycle: matriculation, progression, completion, cost, and post-college outcomes.

- Performance metrics account for students at different phases during the student lifecycle. Performance metrics include many of the “typical” measures of student success, but they do not account for the full picture at our institutions.
- Efficiency metrics focus on access, progression, completion, and cost. Efficiencies are measured both for the institution (e.g., expenditures per student) and for the student (e.g., time to complete, student share of cost).
- Equity metrics highlight differences in academic preparation, economic status, first-generation status, program of study, race/ethnicity, gender, and age. Many of the equity metrics are tracked currently by institutions, but the lens of using equity to understand success across institutions is something we must push for.

However, we feel that equity deserves more emphasis. Rather than a limited and defined set of metrics, it is instead a lens through which we must view ALL metrics. Harris and Bensimon (2007) said it is critical for institutions to obtain the “awareness of outcomes inequities and accountability for eradicating inequitable outcomes” (p. 79). For this reason, our success framework places equity as an overarching lens where equity should be assessed for all metrics.

Visualizing a New Student Success Framework (Figure 3.1) contains a visual depiction of the student success framework. First, IR/IE should define the audience receiving the information. Second, determine the unit of analysis (individual, program of study, and institution) and data type (count, derived value, and generated data). Third, using an equity lens, capture efficiency and performance metrics that describe student success within a given timeframe during the student lifecycle.

The sections to follow will use the concepts from the student success framework to provide specific examples on how to (1) examine external- and internal-facing student success metrics, (2) identify equity gaps, (3) utilize generated data to improve student success, and (4) create actionable information.

External-facing Student Success Metrics. As part of the functions of our IR/IE offices, we are required to report student success based on requirements from the federal, state, and public/private organizations. External student success metrics are typically reported out at the institutional level. Institution-level metrics can be useful to determine whether

institutions' success rates are improving, to benchmark against peers, and to create an aspirational peer set to strive toward. However, gaps in these metrics include student learning outcomes, demonstration of student learning, and many of the efficiency and equity metrics listed in the Metrics Framework, above.

Due to the ongoing pressures from multiple stakeholders, more institutions, particularly public institutions, are moving toward creating more transparent data environments. External-facing metrics have become more informative, and as a result, higher education is moving the needle on student success. For example, the Association of Public and Land-grant Universities' (APLU) Student Achievement Measure captures the progression and completion of both first-time, full-time students seeking bachelor's degrees as well as a separate metric for students striving toward associate degrees or certificates (<https://www.studentachievementmeasure.org/>). The measure draws on information from the National Student Clearinghouse to account for all students, including both full-time and part-time students, first-time-in-college and transfer students, and accounts for success at the same institution and those who transferred out of the reporting institution. Hundreds of public and private institutions and several national higher education associations endorse and use the metric.

There is an increased expectation that institutions should identify data to measure post-collegiate outcomes. The conversation in higher education metrics used to focus on how we can broaden access to more students. That is no longer enough. We must also demonstrate that students are seeing positive outcomes from their education resulting in a career with livable wages with the ability to pay back their loans. Currently, several states require a report on earnings as a part of their performance-based funding models. To be proactive based on this new expectation, the University of Texas (UT) System established collaborations with the Texas Workforce Commission and U.S. Census Bureau's Longitudinal employer-household Dynamics to capture unemployment insurance (UI) wage records (i.e., earnings outcomes) for graduates (Boyd Huie & Troutman, 2019; Troutman & Shedd, 2016). Unlike state-level efforts, this work captures graduates who stay in Texas and who migrate outside the state after graduation. Unlike federal and state reporting on earnings by institution, University of Texas System has created a tool (seekUT) to report 1st, 5th, and 10th year earnings by the 2-, 4-, and 6-level CIP codes (program of study). Earnings data are connected to student loan debt and National Student Clearinghouse data to provide students and parents insight into the overall debt taken out by program of study. Other public systems and individual states, such as Colorado, have joined in these efforts, with more to come. By connecting higher education data with UI wage records, UT System has also been able to explore the value of determining, when comparing students' earnings, who did and did not complete a degree, the impact majors have on earnings outcomes (Carnevale, Fasules, Bond Huie, & Troutman, 2017), and students'

intergenerational income mobility (Creusere, Zhao, Bond Huie, & Troutman, 2019).

Internal-facing Student Success Metrics. IR/IE offices are tasked with defining and measuring student success internally at our own institutions. This ranges from creating executive- and board-level Key Performance Indicators or Objectives and Key Results to measuring cohort success or the success of a small pilot. Examples include measures of course success, retention, persistence, pilot evaluations, end of course evaluations, graduation rates, and more. Because of improvements in data collection, data size, and analytic software, institutions can more quickly test pilots and innovations, and we can more quickly respond with data to evaluate the results. We have a lens across the institution to see what is working and not working on other teams. We understand the data, the context, and interpretations, and work to tell the data story in visuals and narratives. We are increasingly tasked with responsibility for driving institutional improvements and actively using our data for institutional decision-making, not simply reporting the data for others to use.

We in IR/IE help define the metrics, who is in the denominator and who is in the numerator, how we can set up pilot tests, and how we ensure valid and reliable research studies. We have a broad view across the institution and can often see how unintended consequences might affect the results of a study or pilot. We make sure the data are defensible and accurate, and that when it comes time to make the decision, the results are being used appropriately to inform that decision. When we report on a student success initiative, we present the data to show what exactly is working, for whom and why.

As we think about measuring student success internally, two changes have driven work for our offices and institutions. The first change is the exponential growth in the quantity of data we have on students and their behaviors, the speed at which we obtain these data, and their revolutionary impact on higher education (e.g., Clarke, 2017; DeMillo, 2017; Gardner, 2019; Miyares, 2017; Morse, 2013). Each click of a website or online resource can be stored and accessed as a data point. Each swipe of a student ID card can be stored and accessed as a data point. Each online chat with an advisor or financial aid representative can be stored as unstructured data. Metadata from website clicks can be collected and analyzed. Once we connect these data sources to student ID numbers, we can track students' behaviors across their campus experience, whether online or on ground. IR/IE teams must work with IT on data collection, storage, accessibility, and processing as data get bigger and bigger. We must advocate for the data to be accessed by analysts and decision-makers to improve our evaluations of programs and pilots. We must also be at the forefront of student privacy discussions and ensuring that data are protected and used appropriately in aggregate or disaggregated (see below) ways for internal improvements.

A second change is the expectation that we in IR/IE are increasingly responsible for internal institutional improvements, not just measuring and reporting the data. Because we have a unique lens across the institution and we are the source of the data and reporting, we are expected to know what works, what doesn't work, and what the institution could do to improve. AIR's Statement for Aspirational Practice includes a recommendation for institutions to have a cabinet-level Chief Institutional Research Officer. This person would not only be responsible for the institution's data governance and analytic and data capacities, but also would be at the table for executive-level, data-informed decision-making. When student success metrics decrease, leaders should be asking IR/IE how we might improve, where we have seen improvements in other areas, and what initiatives or pilots may or may not work. We are increasingly hearing, "Don't just show me the data; tell me where to focus and what to do!"

With great data power, comes great responsibility. Each data point is an actual student with unique contexts and experiences. Cathy O'Neil, keynote speaker at the 2018 Association of Institutional Research FORUM and author of "Weapons of Math Destruction" (2017), points to the extra care that we must take when developing algorithms and predictive models, as they are often based on those with past success. For higher education, these successes have been among those aged 18–24, White, and middle- or upper-class students from educationally privileged backgrounds. We must work to ensure that our measurements of student success, our predictive models and algorithms, and our analyses are always attuned to equity. Tricia Wang, the keynote speaker at the 2019 AIR FORUM and prolific author and speaker, calls out the importance of thick data in addition to Big Data (Wang, 2019). "Thick data," a reference to Clifford Geertz's (1973) well-known concept of "thick description," is how Wang describes qualitative data including small sample ethnographic, interview, and text. It is not enough to have quantitative data points, but we also need a deeper qualitative understanding of our students and their experiences learning on our campuses.

One way that we in IR/IE can help solve for both O'Neil's and Wang's cautions are by disaggregating our data, where appropriate and maintaining confidentiality, to ensure that we are hearing each student's voice. By lumping everyone together, we might miss that a particular student success initiative shows great outcomes for one group, but leaves another group behind. A first step is slicing the data, even to small groups, by race, ethnicity, gender, amount of student debt, first generation, and other equity indicators. Care must be taken to account for intersectionality, to include in our slices not just African-Americans, for example, but also African-American women. A second step is including equity indicators in our analyses and our advocacy when evaluating student success initiatives. This does not mean reporting data widely where there are risks of misinterpretation with small sample or population sizes, but disaggregating in an informed, contextual manner. This also means that we must be cautious in our predictive

analytics and data creation to ensure that we are building models for all students, not just based on those with historical success. We in IR/IE have a lot of credibility and influence when we present data and results to stakeholders, and we have a responsibility to advocate for all our students.

Identify Equity Gaps Using the Student Success Framework.

Equity gaps exist (race/ethnicity, economic, and gender) for all outcomes across the student lifecycle (from matriculation to post collegiate outcomes) (Blom, Rainer, & Chingos, 2020; Haveman & Wilson, 2007; Zhang, 2008). Malcom-Piqueux and Bensimon (2017) encourage all higher education staff to be equity-minded when trying to close equity gaps that exist within higher education policy, programs, and outcomes. The student success framework can be used to assist in identifying equity gaps for performance measures and efficiency measures at the individual-, program-, institutional-level by type of data (e.g., counts, derived numbers, and generated numbers).

The student success framework can be used by IR/IE professionals to examine equity gaps that exist for student progression (e.g., retention). For example, UT System uses the framework as a playbook to highlight retention differences that exist by gender at the individual-, program-, and institutional-levels. Not only are total counts (numbers of students who retained by year) and derived numbers (percent retained) created to examine equity, but generated data based on historical data are used to establish probabilities of retention at the individual-level that can be aggregated at the program-level and the institutional-level. These generated data can help anticipate potential equity gaps in retention for specific majors and colleges. In doing so, programs and policies can be adjusted to ensure student success for all students.

Use of Generated Data to Improve Student Success. As discussed earlier in our student success measurement framework, we include a new type of data—generated data—created by predictive modeling and machine learning algorithms that can be used to improve student success. It is becoming increasingly common for IR/IE offices to perform more advanced analytics to identify patterns in student data and create predictive models for a variety of student success outcomes (e.g., first-year GPA, fall-to-fall retention, 4-year graduation). The ability to take a deep dive into advanced analytics will vary based on the IR/IE office's analytics maturity. The analytics maturity can range from an office that produces aggregated tables for their stakeholders to very mature offices who conduct predictive and prescriptive analytics (e.g., Gartner's well-known Analytics Maturity Model, see [gartner.com](https://www.gartner.com)). Predictive analytics can be used during all phases of the student experience (e.g., prematriculation, progression, and post-collegiate outcomes).

Predictive student success models can be developed using historical university data that can help student success leaders anticipate the likelihood of students not succeeding at an institution and crafting intervention

and support strategies to improve students' likelihood of success. Troutman and Creusere (2018) used historical pre-matriculated student data (academic and demographic indicators), financial aid information (first offer letter), and student performance data (first-year retention) to create two student success outcome variables. The first student success outcome is the probability that a student will matriculate to the institution based on their first offer letter (financial package of scholarships, grants, and loans). This commonly overlooked metric is a very important data point for two reasons. First, most universities' yield rates are around 50% and second, we can target student success efforts because models will anticipate who will matriculate six to eight months prior to the student's first semester. The second student success outcome (first-year retention) can be coupled with the students' matriculation probability to get a better sense on which students might need early contact by student success programs on campus. Theoretically, if we know that a student has a 90% likelihood of enrolling at the institution, but we also know that the student has a 40% likelihood of being retained, we can craft messaging to encourage the student to participate in student success efforts and send information about academic support programs. This outreach can create a safety net and instill confidence for students. The probabilities created from the predictive models can be examined at the institution-, college/program-, and student-levels and be used to answer a variety of analytic and research questions.

These model scores are newly generated data points that can be leveraged to help understand the success of pilots and to help drive interventions. For example, if we run a pilot in a set of courses, do the students in those courses beat their expectations for course success and retention? Perhaps our models showed that 80 of the 100 students were likely to be retained after one year. We can use this new data that our teams created to see if we beat expectations, and we found that 90 of the 100 students were actually retained.

The IR/IE profession is ever evolving, and offices are adapting to the needs of their institutions and stakeholders (Gagliardi & Wellman, 2015) by leading the way to transform data. Within this evolution, IR/IE professionals have transformed from reporting agents to advanced analytical, decision support individuals. However, one of the biggest challenges with generated data is to translate data insight into actionable information (changing institutions' practice and policies) (Ransbotham, Kiran, & Prentice, 2015). As higher education obtains more and more data on student success, it will become unmanageable to process data without using the most up-to-date data tools and machinery. It is a critical time in IR/IE to remain relevant in higher education because machines could easily within the next 10 years make our profession obsolete. There are more and more automated data applications, and machine learning and artificial intelligence are being introduced in higher education that create generated data. These data tools include business intelligence software (interactive dashboards) and

advanced analytics (machine learning and predictive modeling). The tools can enable IR/IE professionals to assess the impact initiatives, pilots, and innovations impacting student success. However, computers should not be the dominant factor for why decisions are made to modify student success initiatives, programs, and practices based on an algorithm. IR/IE professionals bring to the table the human aspect to data interpretation based on the technical/analytical and contextual (historical institutional changes in data and policy) intelligence (Terenzini, 2013) that they have gained while working in higher education. Both the machine and human components should work in tandem to positively impact student success outcomes in higher education.

From Student Success Metrics to Actionable Information. Key to moving away from narrow reporting functions to having a seat at the table for student success efforts is our ability to provide actionable information to inform decisions that lead to change. Actionable means that decision-makers, such as strategic enrollment managers, student success champions, and executive leadership, can do something with the data, such as making decisions or informing direction, beyond the nice-to-knows or required reporting. To turn data into actionable information, the right data need to be available at the right time in the right place to make the decision.

Dashboards, where users can pull data on-demand, can be effective tools to convert individual student success metrics into actionable information. For example, at Capella University, Power BI dashboards built by IR/IE based on IT-developed data tables are available to senior academic leaders via a mobile app. In meetings, whether the discussion topic is budget or strategy or deciding how to present materials for the board, leaders can bring up the app and make data-informed decisions in the moment. IR/IE leaders can also pull up the mobile dashboards in meetings to provide additional color or support for the discussion, or help the discussion stay on track. Additionally, the way the data are presented can help inform decisions. When deans are advocating for their programs, the provost or president can pull up the data and ask pointed questions based on the data such as how a program was selected for review or to receive additional resources. With everyone looking at the same data, there is increased accountability for decisions.

Among the biggest benefits of dashboards are showing several metrics on one page and getting the data into the hands of leaders when they need it to make decisions to drive a data-informed decision-making culture. This is where users can more easily find the story in the data, tracking across different metrics that might show different points of time or different inputs, outputs, and outcomes. For example, instead of one chart on course success metrics, perhaps add in a companion chart on student readiness, such as number of transfer credits or credits accumulated. Another benefit is the ability to build dashboards without IT assistance, given products such

as Tableau or Microsoft Power BI. Additionally, many of these dashboard software providers offer native analytic capabilities, such as Microsoft Power BI's new "Key Influencers" tool.

While dashboards have driven higher education decision-making forward, there are also some key challenges. First, just because we build a beautiful dashboard does not mean that individuals will use it to improve institutional effectiveness. One possible reason for lack of use is that we sometimes design student success dashboards in a silo, rather than working with others to provide the contextual data needed to make the dashboard meaningful for the end users. This type of collaboration is time-consuming and challenging, but we end up with a better, more usable product. Users not only need a sense of ownership; they also need the dashboard tuned to their own needs as they run their teams and work.

Another possible reason for why they might not use it is due to the complexity of the tool and understanding the context behind all the metrics. Dashboards should be designed from the user perspective, so that they can be easily used and understood. Dashboards should be intuitive to use, to click on, and should include tooltips to explain the metrics. They should also use easily understandable charts and visuals. Although box-and-whisker charts are amazing from an analytic perspective, they might not be easily understood by the lay dashboard user. Last, dashboards should answer most of the user's day-to-day questions that would benefit them during their workday, with different views and perspectives to account for different groups of users. Dashboards will not answer all the questions, but should cover most questions. We in IR/IE will still be asked to run ad-hoc numbers for our stakeholders, but with dashboards, our value to our stakeholders moves from reporting the data to doing research and analysis to dig deep and tell the story.

In our experience across our institutions, we have found that the most actionable data are delivered in dashboards tied to ad hoc analyses and story telling. Academic leaders want to know the state of their institutions, what is working, and what is not, and they want to be able to tell the story of the data.

Conclusion

Our profession of IR and IE is ever evolving and both adapt to the needs of their institutions and stakeholders (Gagliardi & Wellman, 2015) and lead the way in data-informed decision-making driving student success. IR/IE professionals have changed from reporting agents to advanced analytical and consulting partners who effectively communicate with a variety of stakeholders with needs both internal and external to the institution. We are accountable for measuring student success, outcomes, and learning effectively, for telling the stories of our institutions' effectiveness, and for driving change in our institutions based on our insights.

IR/IE have elevated roles in our institutions due to increases in accountability for student success and increases in data, analytic, and visualization tools. With so much data available and so many stakeholders both in and outside of our institutions, it is helpful to put a framework around measuring student success that can focus both the data and the conversations on the data.

The student success framework that we introduced in this chapter can help us contextualize our data and provide guidance for accounting for many types of data as we integrate data and data-informed decision-making into our institutional operating culture. The center of our Student Success Measurement Framework holds the data, with the outer framework including first, the audience receiving the information, second, the unit of analysis and type of data, and third, using an equity lens, the outcome metrics measured. Placing the data in this framework can help academic leaders contextualize the data and use it more powerfully for decisions.

Using this framework, we focused on three areas in measuring student success: external- and internal-facing metrics, focusing on delivering actionable information, and how generated data can be used to improve student success. Each of these examples shows the heightened role that the data, metrics, and IR/IE have in our institutions and across higher education. For example, the seekUT tool produced by the UT System's collaboration with the Texas Workforce Commission and the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) was led and directed by IR/IE and has generated new ways of measuring outcomes for institutions and states across the country.

Internal data on our students are both generated and leveraged by IR/IE and it is our responsibility to ensure that we are following ethical principles with attention to equity indicators as new data are generated, new algorithms are built, and long-time metrics are used. Increased capabilities in data collection, storage, statistical tools, and visualization software allow for more generated data, such as model scores and predicted probabilities, and automations of the data and results. However, we in IR/IE must continue to be heavily involved in the selection of variables for models and the interpretations of results. Automations mean that we should step up more, not less.

Finally, we focused in this chapter on actionable information, and how the data on student success are not helpful unless they are used, in the right place at the right time, to make decisions. Dashboards and visualizations are powerful tools assisting in freeing the data and leaders accessibility to results, but we need to continue to shape the story, consider the metrics, and design the dashboards within the Student Success Measurement Framework.

We in IR/IE have demonstrated and must continue to demonstrate that we are at the table in institutional decision-making. The future is guaranteed to include more data, more data sources, and more internal and external

pressures for accountability. We in IR/IE are ready for and will lead in this future.

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