Key Findings

Academic Analytics: The Uses of Management Information and Technology in Higher Education

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Producing meaningful, accessible, and timely management information has long been the holy grail of higher education administrative technology. The last decade has seen institutions make substantial investments in enterprise computing infrastructure to meet this goal. But have we met it? Our information systems produce many reports, but are we getting the information we need?

The pressure to provide management information is growing. Our institutions are resource-constrained and must often choose from among competing priorities. Most institutions are under intense pressure to maximize student retention and shorten time to graduation. Institutions are increasingly using the information they accumulate about their students to gain insights into big issues, such as academic performance, student success, persistence, and retention. Regulatory bodies, accreditation bodies, state agencies, and boards all are asking for more information to measure and evaluate the effectiveness of our institutions. Decreases in state aid to higher education are causing many public institutions to pursue alternative revenue streams. Each of these issues is increasing the demand for information. How successful are we at providing the information? If we provide it, is it usable? In short, are the investments we have made to improve our information infrastructure making a difference to our institutions?

These are the questions that drove ECAR to study the topic of academic analytics. We wanted to understand several issues:

- How well are institutional information needs being met?
- What are the primary technologies institutions employ?
- How prevalent are advanced applications such as what-if analysis, predictive modeling, and automated alerts?
- How do institutional factors such as management climate, leadership, and culture contribute to the use of management information?

The study *Academic Analytics: The Uses of Management Information and Technology in Higher Education* also looks at how institutions have chosen to deploy their analytical tools. For example, why do some institutions focus on the deep use of academic analytics within narrow functions, while others strive for broad adoption? Finally, the study looks at the characteristics of institutions that reported the most successful outcomes from the use of their analytical systems.

Academic Analytics

We arrived at the term *academic analytics* to describe the scope of what we studied through an iterative process. We wanted to conduct an investigation that was broader in scope than a study of any individual tool, such as data warehousing, or any information process, such as management reporting. A broader set of applications of information and activities interested us. The corporate sector calls our topic *business intelligence*, but we did not feel this would be an appropriate label for higher education. In our survey, we described the scope of our interest to include reporting, modeling, analysis, and decision support. While accurate, business intelligence is too cumbersome for easy use in the resulting report.

The term academic analytics is our imperfect equivalent term for business intelligence. We use it to describe the intersection of technology, information, management culture, and the application of information to manage the academic enterprise. Our use of the term *academic* is in no means intended to exclude the application of information to support decision making in the financial and business functions of the academy. We were very much interested in these areas as well.

Study Methodology

The research methodology for this study had four main components. We began with a review of the relevant literature on business intelligence, competitive intelligence, data warehousing, and information-based decision making. The major component of the methodology was an analysis of survey data from nearly 380 institutions. The survey was completed primarily by the chief information officers at responding institutions. Respondents represented a diverse set of institutions in the United States and Canada, including both public and private institutions and the full range of Carnegie classes, enrollment sizes, and budgets.

This quantitative analysis was augmented by qualitative interviews conducted with 27 individuals from 21 institutions and 2 corporations. We selected interviewees from institutions who indicated that they were enjoying exemplary success using academic analytics in one or more areas.

Finally, we developed two case studies: *University of California San Diego: Increasing Operational Efficiencies Through Business Process Redesign and Analytics*, and *University of Phoenix: Driving Decisions Through Academic Analytics*. The UCSD case study looked at that institution's experience implementing dashboards. The University of Phoenix case study examined how the institution has created a culture of analytical decision making.

Analytical Framework

In constructing our analysis, we used two frameworks. The first identified the range of technology platforms an institution could use as its primary infrastructure to support academic analytics. The second identified the range of applications of academic analytics that an institution could adopt. The technical platforms ranged from reliance on an institution's transaction system to the deployment of enterprise-wide data warehouses. In between were operational data stores as well as one or more data marts.

In terms of applications, we observed five levels of sophistication of use, starting with transaction-level reporting and extending to sophisticated uses of information to automatically trigger a business process. Intermediate levels of application included monitoring operational performance (for example, budget-to-actual performance), what-if analysis to support decision making, scenario planning, and predictive modeling. We used these frameworks to assess the difference in how academic analytic is deployed and used at responding institutions and to look for relationships among technology, its application, and successful outcomes.

Technology Landscape

The majority of respondents rely primarily on transaction systems to support academic analytics. In fact, 47 percent of respondents indicated that their primary technology platform was their transaction systems (for example, ERP). Significantly fewer respondents relied on one or more data marts or on an enterprise-wide data warehouse.

Not surprisingly, the most common technology platform for performing academic analytics actually comprises multiple technologies. To categorize respondents' technologies, we defined three primary levels of technology platforms:

- Level 1—Transaction system only
- Level 2—Operational data store or single data mart used in conjunction with extract, transform, and load tool (ETL) and reporting tools
- Level 3—An enterprise-wide data warehouse or multiple data marts used in conjunction with ETL tools, reporting tools, executive dashboards, or alerts

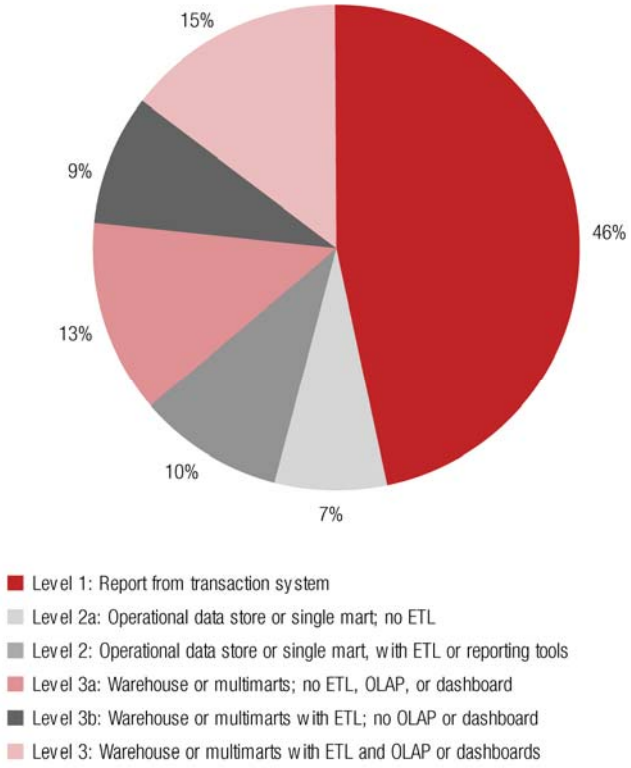
After analyzing survey responses, we discovered that many respondents are in a state of transition between the levels. For example, many institutions are in the process of implementing ETL tools and therefore are between levels 1 and 2. Likewise, some respondents appear to be moving from level 2 to 3. These respondents are in the process of implementing ETL tools or dashboards or online analytical processing tools (OLAP). Therefore, we expanded our definitions of the levels as follows:

- Level 1—Transaction system only
- Level 2a—Operational data store or single mart; no ETL
- Level 2—Operational data store or single data mart used in conjunction with ETL and reporting tools

- Level 3a—Warehouse or multiple data marts; no ETL, OLAP, or dashboards
- Level 3b—Warehouse or multiple data marts with ETL; no OLAP or dashboards
- Level 3—An enterprise-wide data warehouse or multiple data marts used in conjunction with ETL tools, reporting tools, executive dashboards, or alerts.

Figure 1 presents the distribution of respondent's technology platforms across the six levels.

Figure 1. Distribution of Respondents, by Technology Platform



Not surprisingly, more extensive platforms (level 2 and level 3) were more costly. While our cost data from this survey are inconclusive, it appears that the average cost of achieving a level 3 technology base is 50 percent greater than the average investment reported by those with a level 1 technology base.

There also appears to be a relationship between the technology level a respondent employs and his or her satisfaction with the performance of the technology. We asked respondents to evaluate their technology platform from three dimensions:

- The ability to provide decision makers with timely access to data
- The ability to make information widely accessible
- The ease of use of their technology tools

Respondents were asked to indicate their level of agreement with each of the above statements using a five-point scale ranging from 1 = strongly disagree to 5 = strongly agree. We found that satisfaction with the performance of academic analytics increases as the complexity of the technology platforms increases. Respondents with a level 1 technology infrastructure reported the lowest levels of satisfaction across all three performance dimensions. There was a significant increase in satisfaction between respondents with level 1 technology base and those with level 2 or above. Respondents with level 2a, level 2, level 3a, and level 3b technology platforms reported comparable levels of satisfaction with only small differences among the levels. Satisfaction increases significantly again for those respondents with level 3 technology. These respondents reported the highest level of average satisfaction with the timeliness of information, the breadth of access to information, and the ease of use of their tools.

Applications of Academic Analytics

We asked survey respondents to describe their use of academic analytics across their institutions. The key questions we assessed were:

- How have institutions deployed academic analytics?
- How is academic analytics used in different functional areas?
- What is the nature of institutional upgrade plans for academic analytics?

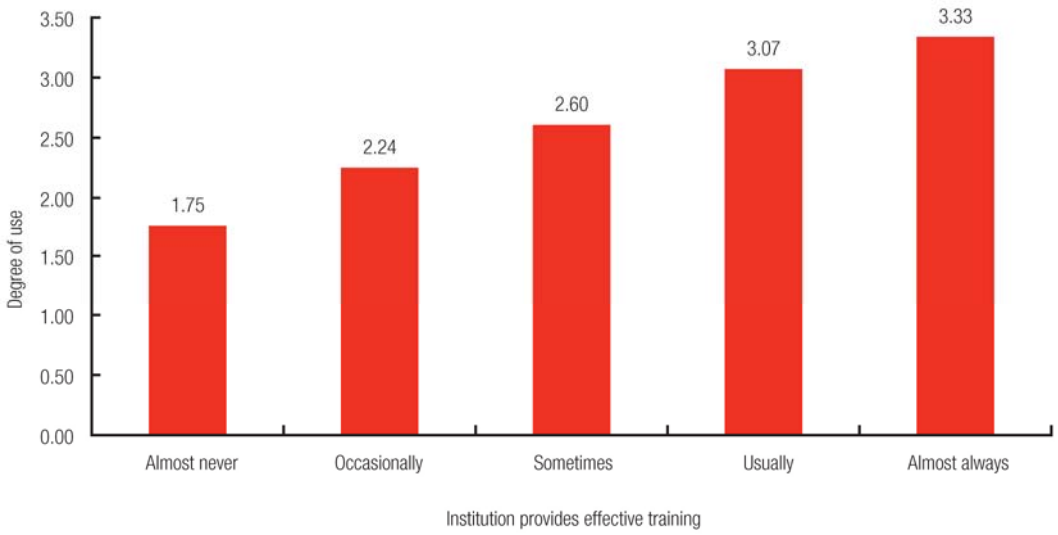
Deployment of Academic Analytics

Respondents differ in how they deployed academic analytics. Some have achieved broad distribution of their analytical platforms but have relatively basic applications of it. Others have narrower distribution but deeper, more advanced applications. Few have achieved both broad and deep usage. Using the same five-point scale, we asked respondents to indicate their level of agreement with a statement that their deployment was institution-wide. The mean response of 3.39 indicates slight agreement with the statement.

The use of academic analytics also varies within institutions. Some functional areas appear to be more active users of their institution's analytical platforms than others. This was true regardless of the type of technology platform. Respondents most frequently reported that central finance, central admissions, and institutional research were there most active users. The least active user areas were department chairs and their staffs, deans and their staffs, and central human resources. Respondents also indicated that central research administration was an infrequent user of academic analytics. Even among doctoral institutions, 16.5 percent reported that research administration was among their three least-active users of academic analytics.

The effectiveness of institutional training programs has a significant impact on how actively academic analytics is used. As one would expect, we found that respondents who reported that their training was effective also reported more active use of their analytical capability. As Figure 2 shows, respondents who said they usually or almost always provide effective training also reported greater agreement that their academic analytics platforms are used actively by the majority of users.

Figure 2. Degree of Use of Academic Analytics, by Effectiveness of Training



Q: *Reporting, modeling, analysis, and decision support tools are used actively by the majority of eligible user departments. (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)*

Interviews revealed that institutions face a two-part challenge in providing effective training. The first is to assist users to learn how to use the technology tools themselves. The second is to help them understand the underlying data and to envision how the analytical tools could be applied. Many institutions succeed at the former but not the latter.

Applications of Academic Analytics

To explore the depth of an institution's use of academic analytics, we defined five stages of application:

- Stage 1—Extraction and reporting of transaction-level data
- Stage 2—Analysis and monitoring of operational performance
- Stage 3—What-if decision support (such as scenario building)
- Stage 4—Predictive modeling and simulation
- Stage 5—Automatic triggers of business processes (such as alerts)

Our hypothesis was that most institutions use their academic analytics for either transaction reporting (stage 1) or operational reporting (stage 2). Among survey respondents this held true. The majority of respondents (70 percent) reported that their institution's primary use of academic analytics is for reporting transaction data. Only 8 percent of respondents reported their primary use was at stage 3 or higher. There did not appear to be a relationship between the primary application of academic analytics and the type of technology platform (levels 1 to 3) that a respondent uses. However, the small number of respondents with advanced applications of academic analytics makes it impossible to conclude with certainty that there is no relationship between technology platform and application.

The use of academic analytics does vary by functional area. We asked respondents to evaluate their use of academic analytics in seven functional areas:

- Advancement/fundraising
- Business and finance
- Budget and planning
- Institutional research
- Human resources
- Research administration
- Academic affairs

As Table 1 illustrates, transaction reporting is the most commonly reported activity. More advanced applications, such as predictive modeling or decision support, are more prevalent in the institutional research office or in the central budget office. Respondents also confirmed that advancement, research administration, and human resources were among the least-active user areas of academic analytics. In the case of advancement and research administration, the sophistication of use does not appear to have a significant relationship to Carnegie class. Even among institutions whose institution type suggests that research or fundraising are more important, the use of academic analytics is still primarily at stage 1 or 2.

Table 1. Primary Application of Academic Analytics, by Functional Area

Use	Advancement/ Fundraising	Business and Finance	Budget and Planning	Institutional Research	Human Resource	Research Administration	Academic Affairs
Stage 1: Extraction and reporting of transaction-level data	56.9%	68.4%	49.6%	48.8%	62.2%	45.0%	52.8%
Stage 2: Analysis and monitoring of operational performance	11.0%	17.0%	19.6%	28.4%	7.8%	10.3%	18.2%
Stage 3: "What-if" decision support (e.g., scenario building)	2.3%	1.9%	13.5%	4.1%	0.6%	0.9%	4.7%
Stage 4: Predictive modeling and simulation	3.1%	3.0%	9.6%	11.6%	1.1%	1.7%	5.2%
Stage 5: Automatic triggers of business processes (e.g., alerts)	3.7%	2.5%	0.6%	7.1%	1.9%	1.1%	2.2%
Not active users	22.9%	7.1%	7.2%	0.0%	26.4%	41.0%	16.9%
Total	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**

Expansion Plans

Regardless of their current technology platform or application of academic analytics, most respondents forecasted that they will significantly expand their capacity in the next two years. The changing demands of accrediting bodies and the rising need for more data to support the measurement of learner outcomes or to improve student retention are just two of the trends increasing the demand for academic analytics. Among respondents with analytical capability that already exceeds transaction reporting, 62.9 percent plan to significantly upgrade their capability in the next two years. The need to expand capacity was reported even more strongly by those respondents with limited capability. Among institutions that only report from their transaction system, only 11.5 percent plan to continue the status quo.

Advanced Application of Academic Analytics

While the majority of respondents use academic analytics primarily for transaction reporting, there are greater instances of more advanced applications within individual functional areas. Advanced applications included what-if analysis, scenario building, predictive modeling, and automated triggers (alerts). To further our understanding, we asked respondents to evaluate the frequency with which they employed advanced applications of academic analytics in four areas:

- Finance
- Grants management
- Advancement
- Student services

The most frequent instances of advanced applications were found in student services. Grants management reported the least-frequent instances.

Finance

ECAR asked about two aspects of academic analytics in the finance area. First, we asked if academic analytics were used to monitor budget-to-actual performance. Second, we asked if respondents automatically generate alerts to appropriate officials if a financial indicator falls outside a desired range. The majority of respondents (57.4 percent) agreed that they sometimes or usually use academic analytics to monitor budget-to-actual performance. Fewer respondents (22.1 percent) reported that they usually or almost always generate automatic alerts tied to financial indicators.

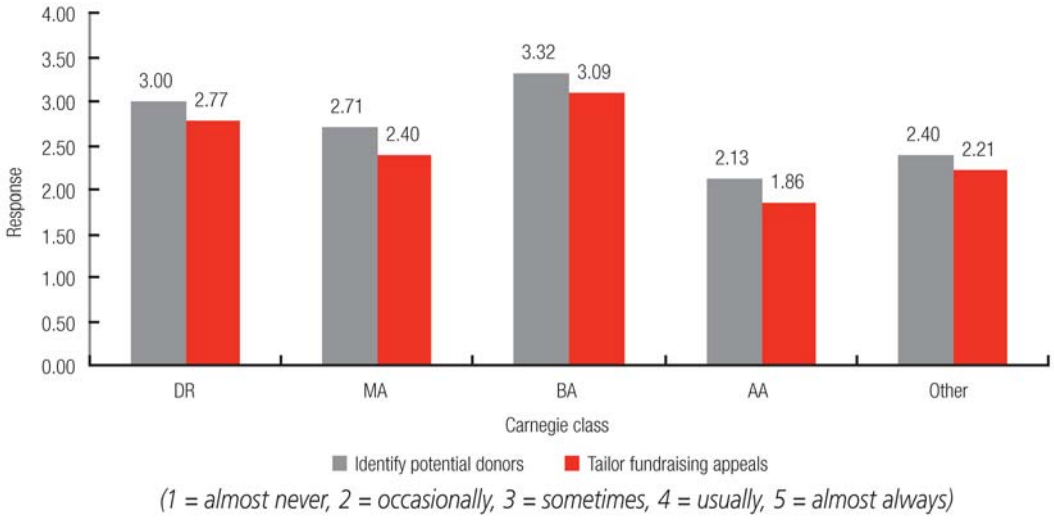
Grants Management

As discussed previously, few respondents reported that their grants management staff are active users of academic analytics. Therefore, we expected to find relatively fewer instances of advanced applications in this functional area, and this is in fact the case. Fewer than 10 percent of respondents reported they usually or almost always generate automatic alerts tied to either pre- or post-award performance metrics. Even fewer reported that they usually or almost always generate an alert if a new grant opportunity becomes available. There is not a significantly different response from institutions that are more research-intensive.

Advancement

In the advancement area, we probed on the extent to which institutions are using academic analytics to tailor and monitor their fundraising strategies or to model donor behavior. One-third of respondents reported that they sometimes or always use their analytical capability to identify potential donors. Somewhat fewer (24.2 percent) use analytics to tailor their fundraising appeals. The use of these capabilities is greater among institutions that rely more heavily on fundraising as a significant revenue stream (private bachelor's and master's institutions or large doctoral institutions). As Figure 3 shows, BA institutions (the majority of which are private institutions) reported the highest frequency of advanced applications of analytics.

Figure 3. Use of Advanced Analytics in Advancement, by Carnegie Class



(1 = almost never, 2 = occasionally, 3 = sometimes, 4 = usually, 5 = almost always)

Student Services

We asked respondents about their use of academic analytics in both student recruitment and retention. Using a five-point scale (1 = almost never, 2 = occasionally, 3 = sometimes, 4 = usually, 5 = almost always), respondents reported the frequency with which they use advanced academic analytics to improve admissions results, plan retention strategies, and forecast demand for courses. Table 2 shows the mean response to each example of an advanced application in the student area.

Table 2. Use of Academic Analytics in Enrollment Management and Retention

Enrollment Management (N = 356)	Mean	Std. Deviation
Automatically alert appropriate officials when an enrollment metric falls outside a desired range	2.75	1.449
Forecast future demand for courses	2.50	1.176
Identify potential students who are the strongest prospects for admissions	2.95	1.312
Tailor a recruiting strategy for an individual prospective student	2.38	1.283
Retention (N = 362)	**Mean**	**Std. Deviation**
Identify students who may be at risk academically	3.14	1.217
Alert an appropriate official when an academic intervention with a student is warranted	2.56	1.319

(1 = almost never, 2 = occasionally, 3 = sometimes, 4 = usually, 5 = almost always)

In the enrollment management area, respondents reported using academic analytics most frequently to identify students who are the strongest prospects for admission. Similarly, in the retention area, respondents use academic analytics most frequently to identify students who may be at risk academically. While most of the mean responses are below 3, the student enrollment and retention area had the highest overall mean responses. Among grants management, finance, and advancement, the student area reports the most frequent use of advanced applications of academic analytics.

Characteristics of Advanced Users of Academic Analytics

We examined a series of factors relating to institution type and size, management climate, and technology platform to see if there are any significant relationships between these factors and an institution's frequency of use of academic analytics in advanced ways. We found three factors that had significant relationships to the advanced application of analytics across all the functional areas. These factors were the effectiveness of an institution's training program, the commitment of leadership to evidence-based decision making, and the presence staff skilled at analysis. All three of these factors were more closely associated with the frequency of advanced use of academic analytics than were factors such as Carnegie class, institutional size, or the type of technology platform in use.

Impact of Academic Analytics

To understand if the use of academic analytics was having an impact on institutions, we asked respondents to evaluate several different measures of outcomes, including institutional outcomes, business process or functional-area outcomes, and individual outcomes.

Institutional Outcomes

Respondents have had the most success using academic analytics to improve institutional decision making and to help meet strategic institutional objectives. Conversely, they have had the least success leveraging their investment in academic analytics to reduce the presence of shadow systems. Interestingly, respondents that have implemented performance dashboards for reporting have had greater success eliminating shadow systems than those using other technologies.

Business Process or Functional Area Outcomes

Within functional areas, respondents reported the most success using academic analytics to improve outcomes in student retention and enrollment management. Respondents reported the least success using academic analytics to affect outcomes in grants management. Using a five-point scale (1 = strongly disagree to 5 = strongly agree), respondents on average agreed that academic analytics helped them improve enrollment results (3.43) and improve student retention (3.16). Improving financial results was the only other functional-area outcome respondents agreed they were improving through the use of academic analytics. Table 3 shows the mean response for each business process or functional-area outcome.

Table 3. Improved Outcomes from Academic Analytics, by Function

Outcome	Mean	Std. Deviation
Improved the institution's financial results	3.09	0.928
Managed its workforce more productively	2.78	0.928
Managed grants effectively	2.61	0.984
Improved ability to obtain grant funding	2.47	0.962
Improved admissions/enrollment management results	3.43	1.012
Improved fundraising results	2.93	1.087
Improved student retention results	3.16	0.952

(1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)

Individual Effectiveness

The last category of outcomes addresses how individuals are impacted by their institution's use of academic analytics. Specifically, we wanted to understand if respondents felt that users of academic analytic solutions make better decisions than those who do not use such systems. In fact, we found that most respondents agreed that staff skilled at using their academic analytics solutions make better decisions than those who do not. Although these individuals may make better decision, respondents did not feel it was creating better career opportunities for them at their institutions. Respondents on average disagreed that staff skilled at using academic analytics receive more opportunities for career advancement. The one exception is at institutions whose leadership is strongly committed to evidence-based decision making. Respondents from these institutions agreed slightly that staff skilled at academic analytics receive greater opportunities for career advancement.

Characteristics of Institutions with Successful Outcomes

Finally, we looked to see what relationships exist between institutions that reported successful outcomes and institution type, management climate, technology platform, and the ways in which they use academic analytics. Across these categories, the most significant relationship is between aspects of the respondent's management climate and successful outcomes. In fact, there are three attributes of management climate that all have strong relationships with each of the institutional outcome measures:

- Institution provides effective training
- Staff are skilled at academic analytics
- Leadership is committed to evidence-based decision making

Each of these factors is associated with positive institutional outcomes. In addition, institutions that use their academic analytics to tailor student recruiting strategies also reported more frequent positive institutional outcomes.

Summary

It is likely that we are in the initial stages of higher education's use of academic analytics. Most institutions have spent the last five to ten years improving their technology infrastructure and transaction-processing systems. Now, more are ready to turn their attention to improving their infrastructure to support academic analytics. At the same time, users are increasing their demand for information and analysis. Assessment, accreditation, state and federal regulations, and increased competition are all driving the need for more information and analysis.

Our ability to achieve more through academic analytics is not likely to be limited by technology. The required technical solutions are available and, for the most part, represent stable technologies. While a lack of resources has limited progress to date, the cost of academic analytics is orders of magnitude less than ERP or campus networks. Given the potential for academic analytics to improve student retention, enrollment, and fundraising, institutions will likely succeed in making the case for investment.

If anything, the limiting factor may turn out to be the lack of sufficient numbers of staff skilled at analysis. Institutions that want to succeed at academic analytics need to build their staff's capacity to understand data and perform analysis. Learning to use the technology tools themselves is likely to be the easy part.

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A copy of the full study referenced above will be available via subscription or purchase through the EDUCAUSE Center for Applied Research (www.educause.edu/ecar/).

