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Academic Analytics in the Future of Higher Education

Management means in the last analysis the substitution of thought for brawn and muscle, of knowledge for folklore and superstition, and of cooperation for force.

—Peter F. Drucker

Winter Semester, 2011

Still awash in the mild adrenaline aftertaste from Farber's exciting victory over Wazamatta U., Jared planted himself in front of his computer. It was high season for registration, and Jared was a bit unprepared. He was partially finished with the second semester of his freshman year. While he still didn't know what he wanted to major in, he was thinking more and more of pharmacy school. Pharmacists make a good living, he thought, and can work pretty much wherever they want to. He knew that the college had a good pharmacy program. Six years—ouch! He'd gotten a B in first semester general chemistry but figured he hadn't worked too hard and could pick up the pace (and his grade point average). Of course he was really off the rails this semester, if you could call cheerleading for the #1 Huskies, getting a girlfriend, and rushing for a fraternity "off track."

Jared plowed through the online catalogue. He figured he'd better start working on his pharmacy prerequisites in earnest. Organic chemistry, calculus...yikes! After a couple of hours he was tired and a bit frustrated. When he tried to register over the Net, he kept getting notices suggesting that he sign up for some primer classes. He had to admit that the system was pretty smart,

but he didn't like hearing that students who got a B- in general chemistry often get a C or lower in organic chemistry. Was this Amazon or Farber College? He knew he'd just have to work harder and perhaps cut back on his extracurricular activities next year. He toggled through the registration system's alerts and pressed "Enter." The adrenaline was all but gone and it was getting late. Maybe he could borrow his roommate's new Xbox 360.¹ Before he could get up to see, he got an IM from his advisor, Professor Gregory. The note just said, "Let's get together this week to discuss your course schedule next year. How about Tuesday at 3:00 p.m.?" Of course, Professor Gregory knew Jared's schedule, so...

Geoff Gregory had been ready to hit the hay. He had delivered a lecture and administered two labs today and was bone tired. He was about to close his e-mail when a notification from the college's advisor network dropped into his in-basket. He smiled and wondered, does e-mail really drop into in-baskets? The alert advised him that Jared Taylor was skating on academic thin ice. His 2.8 GPA, work-study track record, and extracurriculars might sustain Jared over the long haul, but Geoff knew that Jared would need to make major adjustments if he wanted to take the course load that he had just regis-

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tered for—especially if he wanted to be admitted to the pharmacy program. The college’s new advisor management system was sure nice. Based on a lot of consultation with the faculty and some pretty tricky modeling advice from some of the statistics faculty, the system was able to use aggregate historical student academic performance data to model and predict an individual student’s likely success in a given course. The system factored in a student’s past grade performance, course load, work-study commitments, and other things. It wasn’t perfect, but the system could at least send red flags to overworked academic advisors so that they could intervene with at-risk students *before* they hit the wall. In the end, the decisions still remained with the students, but Geoff was pretty effective at helping students steer a path to success. Even better, Geoff could not remember the last time he was caught by surprise by a student who chose to leave the institution because of academic performance. You can’t keep all students in school, he thought, but you can help quite a few! He’ll see Jared next week. Geoff reminded himself how hard it was to be a freshman!

When Norma Denton got to her office at 7:45 that morning, she did what she did first thing every morning (after getting her morning coffee, of course): she logged onto Farber’s Financial and Accounting Notification System (FANS) to monitor and evaluate the prior day’s activity. FANS and its companion FADSS, the Financial and Accounting Decision Support System, made it possible for financial analysts like Norma to monitor the college’s financial health through activity, trends, and other indicators. It was pretty slick. This morning, FANS listed problem student accounts. On the one hand, FANS brought together student billing information from parking, the library, the bookstore, the bursar’s office, meal cards, and so forth. This was powerful. FANS made it possible to present students with a

unified electronic bill for all services provided on campus and made it easy for students to integrate this information with their loan information and to make payments online. On the other hand, in concert with FADSS, FANS made it possible—using sophisticated financial models—to understand when a student (or vendor, donor, or other) was at risk of becoming financially overextended. Norma knew all too well that students arrived at the college with widely divergent experiences with money and that despite the college’s best efforts, some students got themselves into financial trouble. The student module of FADSS was primarily there for the students’ benefit. The system would provide them with alerts when spending levels appeared to be risky and then allowed easy what-if calculations to give students better understanding and control of their finances. FANS notified financial and academic advisors, making it possible to intervene before problems could snowball. Norma also knew that many of the college’s dropouts left for financial reasons. Of course the underlying logic of FADSS and FANS also gave the controller’s office a great handle on financial activity in other areas as well. “Forewarned is forearmed,” Norma was fond of saying.

Norma was really proud of FANS and FADSS, since she had led the project team in the controller’s office that had worked with the Department of Information Technology (IT) to develop it. But Norma couldn’t really take credit for the idea. Bob Brown, the college’s dean of admissions and enrollment management, was the real pioneer. Back in 2005, Brown responded to President Farnsworth’s goal of elevating the academic reputation of the college by essentially reinventing the admissions process. Bob persuaded Elliot Jones in the statistics department to develop a mathematical model to predict which high school students in the college’s market were likely to apply to Farber, to accept

the college's offers of admission and financial aid, and to graduate within six years of their initial enrollment. Elliott brought some of his senior graduate students to the modeling exercise, and over time, they produced some rather remarkable models by using large quantities of historical prospect, admissions, and retention data. Since implementing these models, the college has been able to target its admissions efforts in a more focused and personalized fashion. This kept the college's admissions costs level while making it possible for the number of applications to rise in just three years. Farber's admissions selectivity rose noticeably. The yield of applicants who actually enrolled has steadily risen, and retention rates for the class of 2012 appear to be on track for considerable improvement from past years. Yes, Bob simultaneously earned the respect of the college's president, trustees, provost, and the business officer!

While the work that Bob did for Farber admissions was not easy, it was not as hard as implementing the enterprise resource planning (ERP) system had been. In fact, having a relatively current student information system made the work much easier. The most interesting thing about Bob's work was that the logic of this approach caught fire at the institution. It didn't hurt, of course, that the president loves data (or that Bob was now the College's executive vice president)! Today, most administrators at Farber talk about analytical models, alerts, scorecards, data warehouses, online analytical processing, and other tools and activities that are making it possible to manage important elements of the institution's mission more effectively.

Higher Education in Context

Long the envy of the world, higher education in the United States begins with the establishment of the College of William and Mary and of Harvard University in the 17th

century. While initially the sinecure of the economic and social elite of the colonies, American higher education evolved quickly much in the way the United States evolved. And that is no surprise, due to the pivotal role played in both evolutions by Thomas Jefferson. Jefferson wrote to David Harding in 1824, "In a republican nation whose citizens are to be led by reason and persuasion and not by force, the art of reasoning becomes of first importance." Jefferson believed that diffusing education and knowledge would be the preeminent method of establishing the roots of the democratic ideal and of elevating the human condition.

Jefferson was most certainly right, and both the successful spread of democracy and the rise to preeminence of U.S. higher education are testimony. Higher education's recent past in the United States has been breathtaking. The participation of high school graduates in U.S. postsecondary education is at record levels. More than 30 percent of the Nobel Prizes since 1904 have been awarded to graduates of—or practitioners at—American universities. U.S. higher education has enjoyed more than a decade of increasing research funding from its major research sponsors, the National Science Foundation, and the National Institutes of Health. U.S. colleges and universities have enjoyed rising enrollments over this same decade and remain the educational destination of choice by for students from other nations who seek a postsecondary education in another country.

Higher Education Trends in 2005

Despite this illustrious history, many believe that a perfect political and economic storm is forming around U.S. higher education. The educational landscape overall is becoming more complex. Changes in institutions, markets, and the environment of higher education are all contributing to the stormy conditions facing U.S. higher education.

Noncredit instruction is growing, presenting new competition, new sources of revenue, and new business pressures. By 2014, student enrollments in every U.S. higher education market are expected to decline. While demand for scarce spots at U.S. “medallion” institutions becomes more and more frenzied, private institutions below this level of prestige wage a quiet price war, and fewer and fewer students pay the “sticker price” for a college education. Financial support at the state level—long the backbone of public postsecondary education—has eroded steadily, and many public universities are renegotiating their state governance compacts to recognize a deep transition from “state” universities, to “state-assisted” universities, to “state-located” universities. Most state research universities now derive less than 30 percent of their funding from their respective state governments. As baby boomers begin to retire to reduced incomes, the gifts to universities are likely to slow until this generation begins to plan for bequests. And the giving patterns of the so-called me generation are not yet known.

The consumer context for higher education is changing deeply. Two key higher education stakeholders—government and industry—are demanding greater accountability and transparency from higher education. These demands surface in the form of pressures to redefine accreditation processes, the triumph of rankings of all kinds, the increasing linkage of funding with variety of report cards, and so forth. At the direct consumer level, change is also apparent and dramatic. Students, particularly those in community college, are said to “swirl”; that is, to customize and personalize their undergraduate education by grazing on the offerings of anyone and everyone who offers instruction, credit, credentialing, and certification in cyberspace. These students are assembling their own degrees, and creating institutional loyalty amidst the swirl is

not an easy thing to do. For-profit educators like the University of Phoenix grow at rates five times that of conventional institutions by focusing on

- ◆ easy transfer of prior coursework,
- ◆ mastery of the accreditation process,
- ◆ targeted curricula that are focused on employment skills,
- ◆ strong links with students’ corporate employers, and
- ◆ standardization and continuous process improvement.

The conditions that create a possible storm are also perfect for stimulating the growth of new capabilities among colleges and universities (see Table 9-1). In these storm settings, colleges and universities will likely:

- ◆ Focus on new sources of revenue. Non-credit instruction is likely to continue to grow as institutions seek to establish and secure niches like executive education, continuing legal and engineering education, and so forth.
- ◆ Place more importance on “time-to-market” issues and hence practices that affect the velocity of decision making.
- ◆ Adopt sophisticated technical capabilities for collecting, mining, analyzing, simulating, and presenting information.
- ◆ Place a higher premium on analysis in general and on quantitative analysis in particular, especially in revenue centers such as admissions, sponsored research, development, continuing education, and so forth.
- ◆ Develop leadership cadres that are more focused on institutional economic performance and that, in turn, will foster cultures of evidence focused on evidence-based decision making, accountability, and information transparency.

Colleges and universities, like most cultural institutions, are political organizations. Described by many as adhocracies, or organized anarchies, higher education is characterized

Table 9-1 Key Shifts Ahead

PAST	PRESENT	FUTURE
Canned reports	Online data	Real-time, personalized data
Pro forma reports	Interactive spreadsheets	Models
Just-in-case data	Just-in-time data	Scenarios in advance
No data	Opaque data	Transparent data and systems
Political culture	Professional culture	Culture of evidence
Institutional accounting	Institutional controls	Institutional accountability

by problematic goals, unclear technology, and fluid participation (Weick, 1984). Leaders in higher education are political leaders who traditionally “discover preferences through action more often than [they] act on the basis of preference” (Cohen & March, 1974).

The complexity of the current and evolving environment is likely to overwhelm organizations and governance that are based on problematic goals, unclear technology, and fluid participation. While fluid participation in higher education governance is likely an immutable and beneficial idiosyncrasy of higher education, the future is likely to witness a shift in the business and IT infrastructure from one that is based largely on what data you have to one based on what you know. Concurrently, this infrastructure and culture will likely shift (or perhaps has already shifted) from being organized around amassing data and capabilities just in case something happens to one that provides services and data just in time. Indeed, the longer-term shift will move further, from just-in-time capabilities to those that anticipate change and are either predictive or self-actuating (autonomic). In the same vein, complexity in the higher education environment has generally resulted in complexity in our data and systems. If the watchword of the current regulatory environment is transparency, higher education data and systems for analytics and planning are opaque. Answering basic questions about

the sizes of our workforces or student bodies too often results in time-consuming ad hoc projects and eventually in footnoted reports. To accent this problem, one noted higher education executive answers the question, “How many people work at the university?” by stating, “About half!”

The business and academic literature and this study’s quantitative and qualitative data suggest that higher education may be ripe for a near-term breakthrough in this arena. Factors promoting a breakthrough include:

- ◆ A great many colleges and universities have implemented new enterprise transaction systems. This effort not only results in new technologies that are better able to interact with academic analytics systems and tools but also in improved data. Indeed, the data and research suggest that the costs of advanced analytics are dominantly in staff training and in data administration, and some of these costs have already been incurred.
- ◆ The technologies associated with advanced institutional analytics are mature and robust. They are commercially supported at prices well below those of the enterprise transaction systems that they lever. While these capabilities demand staff expertise and technical resources, these requirements are smaller by far than those associated with enterprise transaction systems.

- ◆ The state of the practice in this arena *outside* higher education is impressive. Consumer sites like Amazon demonstrate how the acquisition and management of customer information can be used to personalize interactions with the organization and to broaden and deepen consumer choices and loyalty. Similarly, political campaigns mine and analyze voter data impressively to target prospective campaign supporters. All of this suggests that the expertise needed to place new capabilities in the service of higher education exist—perhaps in abundance.
- ◆ Presidents, provosts, business officers, registrars, and trustees are increasingly comfortable with data and may become impatient when access to comprehensible information or sophisticated analysis is limited, constrained, or nonexistent.

The Future Is Now

The remarkable thing about the story of academic analytics seems to be that the time for the future is really now. It is clear that the next generation of faculty, staff, and students will enter the academy with heightened expectations for data access. They will want more data, will want it faster, and will want to be able to manipulate data themselves. It is also likely that higher education, like all organizations and institutions, will be expected to place more and more information into the public domain in the spirit of openness, transparency, and accountability. This pressure may manifest itself as a press for a continuously available (and up-to-date) annual reports and for Web sites that provide data and tools so that public policy makers, regulators, parents, marketers, and others can kick the institution's virtual tires. These external and internal pressures for information are conspiring with the increasing robustness and usability of the tools of analytics to increase the number of potential users of these capabilities who pos-

sess the skills needed to perform meaningful analyses. In this kind of future, at least two things must happen:

- ◆ The institution's leadership must itself become respectful of data and astute in using data to inform institutional decisions; and
- ◆ Institutions must devote time, effort, and resources to *information architecture*, to *workflow*, and to *data management*. Institutional leaders, working with IT, will need to grapple with greater standardization of data sources and definitions. This activity is substantial and includes defining an *information ecosystem* and philosophy that reconciles central systems and so-called shadow systems; rethinking the need for *information intermediaries* whose primary tasks are to reconcile and interpret complex and often contradictory data sources; and resolving in a meaningful way the age-old question of whose data is authoritative.

To a great extent, the future environment for academic analytics is likely to look much like today's idealized vision (see Figure 9-1).

To some extent, the promise of a robust environment for academic analytics is a promise that is within reach. In general, higher education has performed much of the heavy lifting and has made many of the required investments in contemporary transaction systems. The implementation of new ERP systems, of Web access, and of portals necessitated some degree of grappling with the institution's data model and with the data itself. While horror stories abound of institutions with more than 20 different definitions of students or FTE residing in institutional systems, many colleges and universities are slowly rationalizing these environments. New and exciting technologies such as role-based authorization will add purpose to this effort, as will less exciting but more pressing issues like IT security.

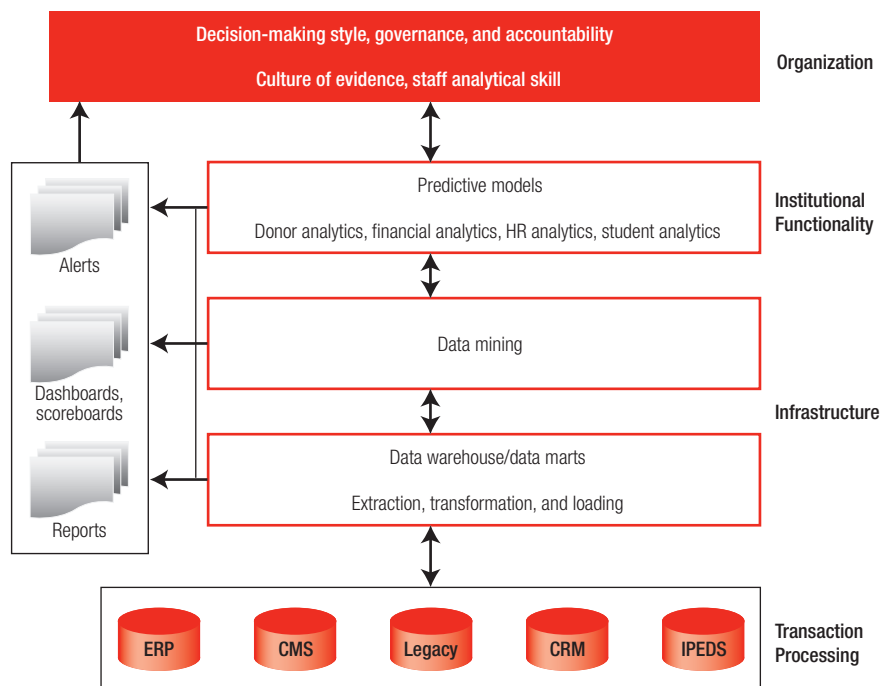


Figure 9-1
Elements of the
Future Academic
Analytics
Environment

With a contemporary or well-architected enterprise systems environment, broadly understood data models, clear business rules, and reasonably clean data, the promise of the future academic analytics environment is within reach. The technologies and techniques of academic analytics are well understood, mature, and financially and technically accessible. Quite simply, data from enterprise system can be extracted, transformed, and loaded into data warehouses and marts. These data can be mined using increasingly sophisticated enterprise data-mining tools and positioned for analysis using a variety of robust and well established analytical tools. Historical transaction data—including data from course management systems—can be used to develop models that can predict current and future stakeholders' behaviors and outcomes.

In this area of endeavor, the limits on the future appear to have less to do with the shortcomings or inaccessibility of a technical infrastructure than with a failure of imagination, user proclivity, or urgency. In the end,

the promise of academic analytics is bound up with institutional vision for and ideas about core institutional issues such as admissions selectivity, grants productivity, student success, academic persistence, retention, and so forth. Standing between higher education practice today and an agreeable vision are those who own responsibility for these institutional outcomes (process and outcome owners) and those who understand the capabilities of today's extraction, warehousing, mining, analytical, and reporting tools (process and outcome reformers).

In fact, what bars the door may be more basic:

- ◆ our legacy as institutions with problematic goals, unclear technology, and fluid participation; and
- ◆ our difficulty in organizing institutional effort around key institutional processes and outcomes.

Who at our institutions, for example, is administratively responsible for student success? Is this a faculty role? A counseling role? Is the dean of students responsible? What about

the provost? Could the Panhellenic Council be part of the issue? What about parents? The point is that institutional processes and outcomes like success, persistence, and retention are complex in the extreme and are inherently multifaceted. Likely at most institutions there is no one who will raise his or her hand to say, "I am responsible for this." It is difficult, therefore, to find a user for the IT organization to work with.

Compounding this complex organizational problem is the adhoc culture of the academy. In environments where anecdotes trump data, little time, money, or effort is spent developing data or developing sophisticated techniques for analyzing it. This may be in part a chicken-and-egg problem. Leaders who have spent a career in an industry bereft of good data, good tools, and good analysts have resigned themselves to leading by rushing to the front of the longest parade on campus or by responding to the institution's loudest voice. Staff, whose leaders seem indifferent to the facts or distrustful of data, are in no position to unilaterally ignite a new procedural and technical fire. The chicken-and-egg dilemma may explain why the successes we find in this area are often closely associated with an individual who owns a manageable piece of the institutional mission and who has a vision of using information in new ways to conduct that mission. Real progress in admissions at Baylor University or in managing student retention at the University of Minnesota or student success at the University of Connecticut began with an individual's vision and fanned out from there.

In any case, several essential messages about the future of academic analytics are clear:

- ◆ Our stakeholders will demand it.
- ◆ The tools are mature and financially and technically accessible.
- ◆ Success will have more to do with organizational capacity (analysis, model making, deci-

sion making) than with technical capacity.

- ◆ Our workforce and leadership need to be engaged and trained.
- ◆ Evidence-based decision making must be valued and modeled by our leaders.

Fine Print for the Future

Academic analytics in all likelihood has an important and enduring place in the future of higher education. If necessity is the mother of invention, then growing stakeholder, economic, enrollment, and other pressures will inspire early adopters to seek market advantage through better data mining, analysis, and modeling. The application of so-called business intelligence and analytics in the private sector has been an important and steady source of success for many. The promise of this agreeable future is not without challenge or peril. Specific challenges will include:

- ◆ *Data governance.* At many colleges and universities, the responsibility for managing essential information is dispersed among central and local (school or college) units. Data are subject to differing standards of description, differing security standards, differing access policies, and so forth. Assembling and integrating models or profiles of students, alumni, suppliers, grantors, donors, and others will require the implementation of new federated data management practices and new technologies.
- ◆ *This is Skynet, I am John Connor.* While the future of academic analytics consists, in part, of a vision of institutional processes that are managed autonomously through a complex of technologies, models, data, and decision rules, we are all aware of the limits of these capabilities and of the reasoning that underlies them. British humorist Jeremy Clarkson tells an all-too-familiar story of analytics and autonomous processes run amok: "I recently bought something and then decided I

didn't want it. So I sent it back and the money was reimbursed to my credit card company. I then telephoned the credit card company and asked it to put the money back in my bank account. I even had the sort code to hand and everything. 'Yes,' said the girl, 'I can do that, no problem at all.' But there obviously was a problem because a couple of days later I attempted to buy some petrol. My card wasn't rejected but I was made to talk to someone at the credit card company who wanted to know my mother's maiden name and all sorts of other impertinent things. Then I bought some shoes and the same thing happened, so I telephoned the credit card company to ask why, all of a sudden, I'd become Osama Bin Laden. 'Aha,' said a man, 'it's because you are in credit with us.' This was baffling for two reasons. First, why was I in credit with them when I'd asked them to put the money in my bank, and why should being in credit cause them to think I needed a telephone frisking every time I bought a packet of fags? I therefore asked the man if he'd be so good as to move the money. I even made it plain that if he failed I'd come round to his place of work and insert something fairly chunky up his bottom. This obviously appealed because the next day, while using the card to buy some flowers, I was asked once again for my mother's maiden name. So I called the credit card company and spoke to someone else, who said I was in credit, a highly unusual situation and one that makes them think I may be laundering drug money. Yes, well, since I'm not Pablo Escobar, could they perhaps put the money in my bank account? 'Yes,' said the man, who I knew would not do any such thing. And could they stop asking silly questions every time I bought anything? 'No,' said the man. 'Your name's been flagged on the computer and I'm afraid I can't turn

that off.' 'Well, would you find someone who can turn it off?' It seems not. The whole thing is completely automated. And there is no one, not even the Queen, who can get into the program and make alterations" (Clarkson, 2005).

- ◆ *Privacy and access.* Higher education institutions, because of our role as arbiters of a culture, have a special responsibility to implement new capabilities self-consciously and responsibly. Genuine debate within the academy that strives to balance the possible with the desirable (or even the ethical) needs to occur. While it is unarguably valuable to use student, prospect, or patient data to tailor institutional offerings for them, is it appropriate or ethical to use the same information to tailor fundraising solicitations? Under what circumstances can or should variables like race and ethnicity factor into our models of student or prospect success? When is an autonomic process intrusive, and what are the protocols for ameliorating defects that will inevitably be uncovered? Where is an institution's locus of intervention? Are intelligent, autonomous systems to be organized as a part of staff-enabled processes (for example, counselors) or as a part of processes that serve the end consumer directly (self service)? These are open questions and philosophical questions that will likely cut quickly to the core of deeply held institutional beliefs.

Conclusion

The outlook for academic analytics in the future of higher education is exceedingly bright. The time for these capabilities is right. Colleges and universities need better data to make better decisions. The technical capacity to do this is here and within reach. The primary constraints on an agreeable future are in the cultures of our institutions and the behaviors and predispositions of our leaders. While most colleges and universities muddle through com-

plex problems with small changes to the status quo, notable exceptions are evident.

The technologies of academic analytics, in concert with a leadership that is committed to evidence-based decision making, a cadre of analysts who are trained in the technologies and in analytical techniques, and a culture that has debated and negotiated the rules of engagement surrounding the collection, modeling, and profiling of key stakeholder groups' data, are collectively in a position to dramatically and beneficially impact core institutional academic processes and outcomes. Information technologies are in a position

to help students succeed, boost academic persistence and performance, enhance our effectiveness in winning grants and gifts, and other key activities. And best of all, the potential to realize this vision is here today at a financial price most can afford. The challenge of change, as is often the case, is imbedded in our culture, our governance, and in our capacity to suffuse the technology with a vision and with our passion for our mission.

Endnote

1. Xbox 360 is a trademark of the Microsoft Corporation.