The Current State of Business Intelligence in Academia: The Arrival of Big Data

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http://aisel.aisnet.org/cais/vol34/iss1/1/

Abstract:

In December 2012, the AIS Special Interest Group on Decision Support, Knowledge and Data Management Systems (SIGDSS) and the Teradata University Network (TUN) cosponsored the Business Intelligence Congress 3 and conducted surveys to assess academia's response to the growing market need for students with Business Intelligence (BI) and Business Analytics (BA) skill sets. This panel report describes the key findings and best practices that were identified, with an emphasis on what has changed since the BI Congress efforts in 2009 and 2010. The article also serves as a "call to action" for universities regarding the need to respond to emerging market needs in BI/BA, including "Big Data." The IS field continues to be well positioned to be the leader in creating the next generation BI/BA workforce. To do so, we believe that IS leaders need to continuously refine BI/BA curriculum to keep pace with the turbulent BI/BA marketplace.

Keywords: Association for Information Systems | Business Intelligence (BI) | Business Analytics (BA) | key findings | best practices

Article:

I. BUSINESS INTELLIGENCE AND BUSINESS ANALYTICS

> *Big Data refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyze.*
>
> McKinsey Global Institute [Manyika 2011]

Big Data emerged in 2011 as the latest chapter of Business Intelligence (BI) and Business Analytics (BA), representing new and unusual sources of data (e.g., sensors, social media),

advanced technologies (e.g., Hadoop architectures, visualization, predictive analytics), and rare combinations of user skills (e.g., data scientists). Some predict, however, that Big Data's popularity will plummet as rapidly as it soared [Sicular, 2013]. This prediction is based on the realization of Big Data's true complexity [Sicular, 2013] and a shortage of qualified workers [Boutlon, 2013]. Regardless, businesses continue to explore and invest in Big Data initiatives. In fact, the Big Data market is projected to reach $47.5 billion by 2017 [Floyer, 2013]. Our own research shows that 89 percent of employers believe that their organization's need for Big Data skills will rise in the future [Wixom, Ariyachandra, and Mooney, 2013].

Since 2009, a growing number of academics from business schools throughout the world have met at pre-ICIS Business Intelligence Congress (BIC) events to learn about advances in business intelligence, business analytics, and data warehousing from industry leaders and each other.1 Attending industry leaders represent vendors, professional services providers, and practitioners who work in the BI/BA marketplace across a wide range of industry sectors. The industry leaders in attendance at the December 2012 BI Congress 3 (BIC3) had specific expertise in Big Data.

At each BIC event, attendees learn from each other in sessions devoted to sharing teaching resources and methods, research findings, and real-world best practices. The intent is to surface gaps between academic efforts and marketplace needs and to identify next-generation workforce priorities. Well-armed with this knowledge of gaps and priorities, academics can then return to their universities with the intent of refining their BI/BA pedagogical and programmatic efforts.

In December 2012, BIC attendees were particularly interested in understanding the implications of Big Data for academia. Given our roles as faculty who teach and research business intelligence and business analytics, we wanted to better understand what academic action is needed to meet the needs of practice regarding emerging trends and innovations in the BI/BA space. A summary of our approach and what we learned are described in the following sections.

II. BUSINESS INTELLIGENCE CONGRESSES

BI Congress Events

A unique feature of the Business Intelligence Congress series has been the active collaboration between academia and industry to advance the teaching and use of business intelligence and analytics [Wixom, Ariyachandra, Goul, Gray, Kulkarni, and Phillips-Wren, 2011]. In 2009, BIC12 identified the current and desired state of BI research, curricular programs, and industry practice. In 2010, BIC23 focused on the future of BI and advancing the next generation of BI practices and products. Responding to continued industry interest in analytics and the successful partnerships established in BIC1 and BIC2, faculty from the AIS Special Interest Group on Decision Support, Knowledge and Data Management Systems (SIGDSS)4 and the Teradata University Network (TUN)5 sponsored BIC3 in 2012 with the goals of:

1. Assessing progress in research and curricular program offerings
2. Identifying best practices and gaps in BI/BA research and teaching, with a focus on Big Data

3. Understanding current capabilities of BI/BA technologies, with emphasis on advanced technologies
4. Understanding the role of BI/BA in organizational innovation
5. Facilitating and extending social networks of BIC attendees to provide a foundation for knowledge sharing

BIC3 brought together 148 faculty and industry partners in a 1.5 day, pre-ICIS congress with the theme "Driving Innovation through Big Data Analytics." The event was attended by representatives from 119 universities and fifteen companies, representing twenty-three countries. Sessions facilitated significant interaction between the attendees and included inspiring industry keynote talks from Deloitte, IBM, SAS, and Teradata; a distinguished keynote speaker from AT&T Bell Labs; a panel investigating the next generation Big Data workforce; a research track organized as panel presentations and round table discussions that intermingled academic and industry participants; a teaching track featuring best practice pedagogical resources and program development experiences from multiple countries; awards for Big Data academic innovations in research and teaching; and social opportunities for networking.

BIC3 was dedicated to Dr. Paul Gray for his decades of contributions to the decision support field, including his founding leadership of SIGDSS and his recent executive leadership of the Teradata University Network. Paul helped establish and build the first two BIC events. He is deeply appreciated by our community.

BI Congress Survey

In preparation for BIC3, a survey was conducted in the fall of 2012 to gather information about university BI and BA courses and programs, student viewpoints, and BI/BA recruiter perspectives. The survey provided input for discussions at BIC3 and served as a snapshot of the "state of the field." Three audiences participated in the survey: faculty, students, and industry practitioners. A total of 319 professors in forty-three countries responded, along with 614 students from ninety-six universities. In all, 446 practitioners responded to the survey, with 308 of the group directly involved in hiring people to fill BI/BA jobs. This survey represents the third survey administered by the BIC since 2009.

BI Congress Industry Content on Big Data

Four industry speakers communicated leading-edge Big Data ideas from Deloitte, IBM, SAS, and Teradata, respectively. All four speakers reinforced that Big Data represents a sea change in the volume, velocity, and variety of data that organizations need to manage. The change is occurring because of new sources of data, much of it being generated by machines and devices.

New advanced technologies are being used to address Big Data, and they are significantly different from legacy data technologies. The old approach of moving the data to the computational systems is being replaced with an approach of moving the computational system to the data—for example, Map/Reduce and Hadoop. Further, in- memory analytics is an increasingly viable option; a number of companies are using in-memory analytics for specific analytical applications.

In general, five key observations emerged from the industry speaker presentations:

1. The era of Big Data is unique, primarily because the volume, velocity, and variety of data have changed. Data governance, privacy, and security challenges are generating a new level of concern from business leaders.
2. New analytical tools and platforms are needed to solve complex optimization problems, to support data visualization of large masses of new kinds of data and relationships, and to explore and automate real-time and multifaceted decisions. Big data intensifies the need for sophisticated statistics and analytical skills.
3. Big Data is creating an architectural paradigm shift in data movement. Organizations are moving from bringing data to the computation (server) to pushing the computation to the (distributed) data. In-memory data analysis with distributed, massively parallel processing (MPP) architectures is gaining momentum.
4. Robust database management and data streaming management capabilities are critical for analyzing streaming data in motion due to the rise of large, continuous streams of data sources, of which a large portion may not be valuable. Better tools and methodologies are needed to extract insight.
5. Other shifts regarding data include moving from transactions to interactions, from known data structures to structures that are recognized on the fly, from structured to multi-structured data.

III. BUSINESS INTELLIGENCE CONGRESS FINDINGS

The Business Intelligence Congress 3, its companion surveys, and insights provided by industry representatives resulted in five notable findings that can help inform university curricular action:

1. The number and depth of BI/BA program offerings has dramatically increased since 2010.
2. Access to and use of BI/BA pedagogical teaching resources has increased.
3. Demand for BI/BA students continues to outpace supply.
4. In a world of Big Data, foundational skills remain most critical.
5. Employers are not satisfied with the practical experience of university graduates.

These ideas are developed further in the following sections. Survey data used as support for ideas in the following sections were collected by the 2012 BIC surveys.6

The Number and Depth of BI/BA Program Offerings Has Dramatically Increased Since 2010

> *We have continued to evolve the content in our courses to match the evolving nature of the BI field, particularly with regard to big data and predictive analytics.*

We introduced an MBA concentration in Business Analytics. As part of this concentration, we created a new course called Emerging Analytics Technologies, Platforms, and Applications.

We currently offer a Masters in BI and are introducing a new Masters in Data Science.

We started the undergraduate specialization in Business Analytics and Intelligence in fall 2011. The graduate degree in Master of Science in Applied Statistics with a specialization in Business Analytics also started in fall 2011.

We're introducing a new course in "data analytics and visualization" in the spring.

BIC3 Professor Survey Respondents

BI/BA degree programs and BI/BA courses and course content have grown since the BIC conducted its last survey in 2010. The BIC3 survey identified 131 full-time BI/BA university degree programs, up from fifteen. These include forty-seven degree programs at the undergraduate level, as compared to three just two years earlier. Additionally, 41 percent of professors report that their universities increased the number of BI/BA courses since 2010. This growth aligns well with the fact that over 75 percent of employers preferred to hire students with formal BI/BA degrees or majors.

The BIC3 teaching track discussions identified a challenge with developing these new programs: the dearth of existing guidelines and model curricula. Fundamental questions remain unanswered and need to be explored; these include:

- How many courses should be offered in a BI/BA major or minor?
- Should BI/BA programs be integrated with other majors inside and outside of IS?
- Should IS BI/BA programs include courses from Statistics and Computer Science?
- What prerequisites should be required of students entering BI/BA programs?
- What is the best way to begin and then evolve BI/BA programs at our university?

BI/BA course content continues to represent different things to different people, as evidenced by the myriad BI/BA courses offered (see Figure 1). Eleven unique disciplines commonly teach these courses, ranging from IS and Statistics to Marketing and Finance. This suggests that many programs likely cut across traditional academic silos to include faculty from different departments and schools. This interdisciplinary approach is becoming commonplace, especially in MBA programs where the introductory BI courses are increasingly being taught by Marketing professors. The BIC3 teaching track discussions identified the fact that interdisciplinary programs successfully attract students from varied backgrounds who are interested in BI/BA applications.

Growth in BI/BA programs and course content coincides with increased student excitement about the area. In 2010, most students enrolled in a BI/BA class because "it was required,"

whereas, in 2012, students primarily enrolled in BI/BA because "the content was interesting." This bodes well for near-term BI/BA course enrollments.

Figure 1. What Are the BI/BA Courses Your University Offers?
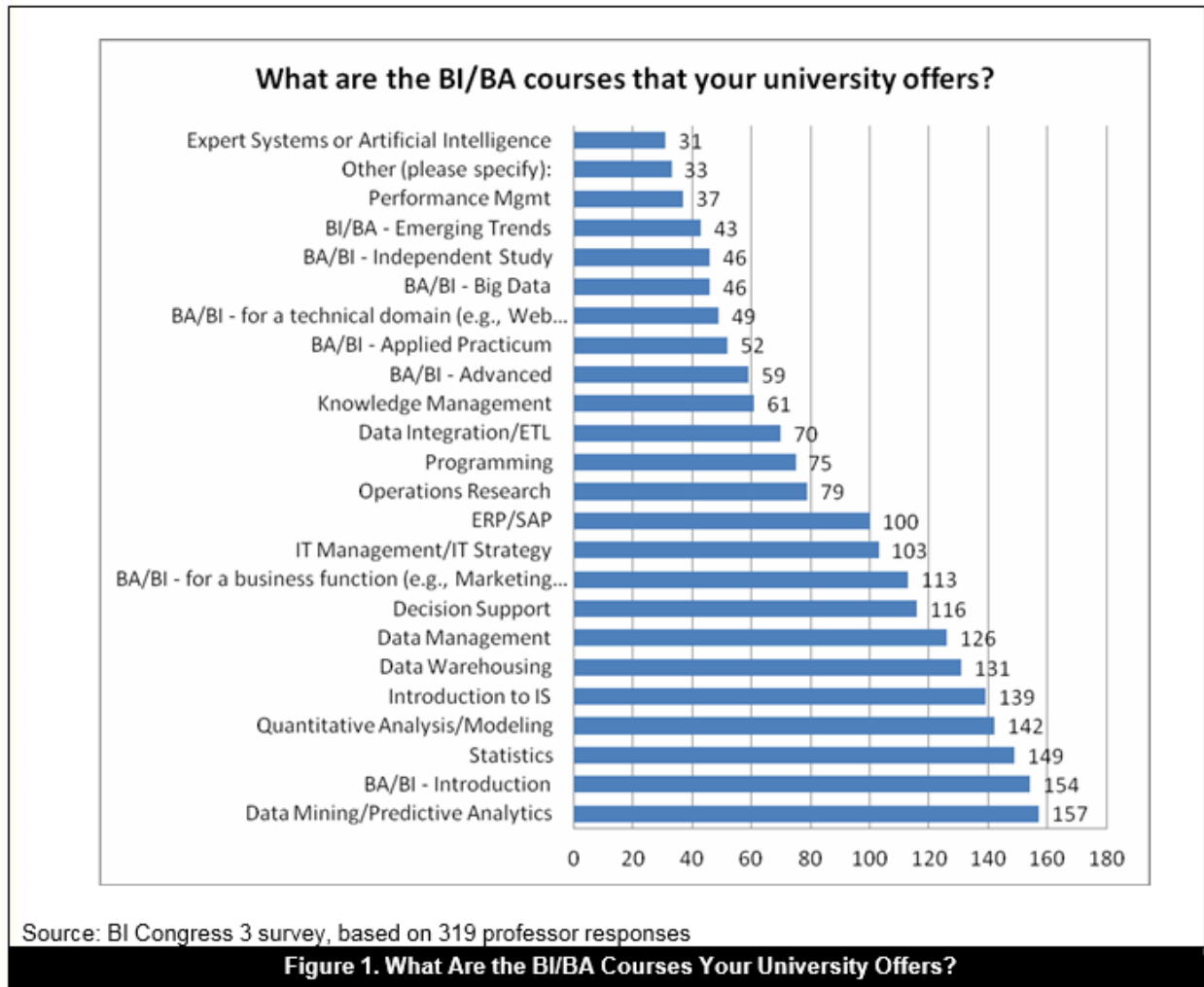
Access to and Use of BI/BA Pedagogical Teaching Resources Has Increased

> *[Professors need] help with pre-configured cases, tutorials, and examples more targeted towards the level of BS (and MS) students in a class rather than professionals, ideally more integrated with the curricula (conceptual material connected to the cases, tutorials, and examples) and not just cookbook examples.*
>
> *I have created customized learning experiences for my students based on my work in industry. I do not use a textbook. The course may be taught as a synchronous or asynchronous learning experience.*
>
> BIC3 Professor Survey Respondents
>
> *The enormous power of the current software products is truly stunning. I have enjoyed exposure to multiple software solutions and platforms and have been*

> *encouraged to engage and explore through class (and out of class) activities and assignments.*

<div align="right">

BIC3 Student Survey Respondent

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The BIC3 survey reports that 296 out of 319 professors are leveraging one or more BI/BA academic alliance programs to teach BI/BA classes (see Figure 2). This coincides with increased investments by large vendor organizations, such as IBM and SAS in university teaching resources. Further, most vendors now offer their resources to academics at no charge to reduce adoption hurdles.

Although the number of professors who leverage academic alliance program resources has increased, professors express some dissatisfaction with the offerings. One complaint is that vendors need to improve teaching resources by supplying more and better case studies and data sets. In fact, the need for data sets continues to be the number- one challenge for professors who teach BI/BA (a problem cited by 45 percent of BIC3 survey respondents). Further, professors likely need these data sets to contain Big Data. This request reflects the need to teach students using real-world business problems. In this way, professors can prepare students to "hit the ground running" when they start work after graduation. Professors also request that vendors offer more faculty training opportunities, reflecting the fact that a top challenge to universities is finding faculty who can teach BI/BA content.

Academic alliance programs are getting better about offering pedagogical resources, such as syllabi, assignments, and presentations. Much of this kind of content needs to be developed by or with academics to make them consumable by professors and students. The BIC3 event showcased a wide variety of such faculty-created content that ultimately are posted and disseminated to others through the academic alliance platforms, such as the Teradata University Network.
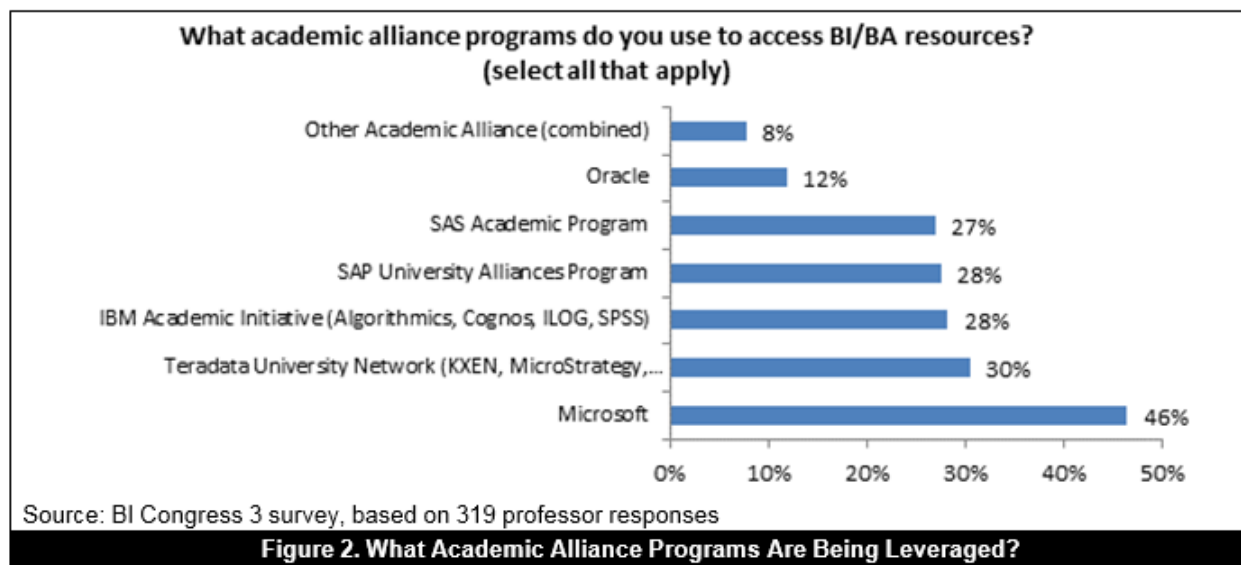
Figure 2. What Academic Alliance Programs Are Being Leveraged?

Demand for BI/BA Students Continues to Outpace Supply

The demand for hires with BI/BA skills shows no indication of slowing down, with close to 50 percent of employers strongly agreeing that their needs for BI/BA skilled recruits will increase in the future; this number rises to 89 percent if employers who simply agreed are included. Students are aware of the growth of BI/BA-related employment opportunities. When compared to the 2010 data, student confidence in the availability of job opportunities was higher than their opinion on the relevance of class material and software or the overall relevance of the BI/BA space (see Figure 4).

Fortunately, student sentiment appears to be highly favorable toward BI/BA, based on BIC3 survey comments. One student stated, "It's exciting to learn and discover insights that were just before your eyes all along but you never knew they were there." Another commented, "BI is very current, and I think I will be valuable and competitive in the job market with these skills. It is also very interesting." This reinforces the BIC3 survey finding mentioned earlier that students are increasingly taking classes in BI/BA because they "want to" instead of because they "have to."

It is interesting to note that the need specifically for students to fill roles as data scientists came up often in the BIC3 survey comments by employers.

Source: BI Congress 3 survey, based on 614 student responses

Figure 3. Student Opinions of BI/BA
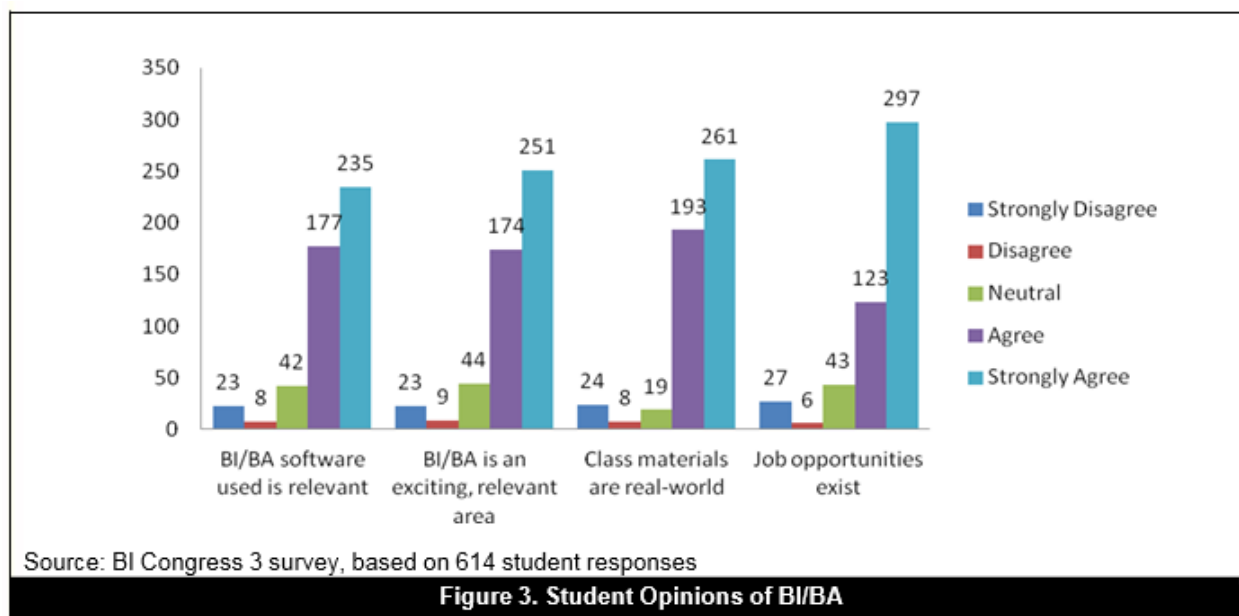
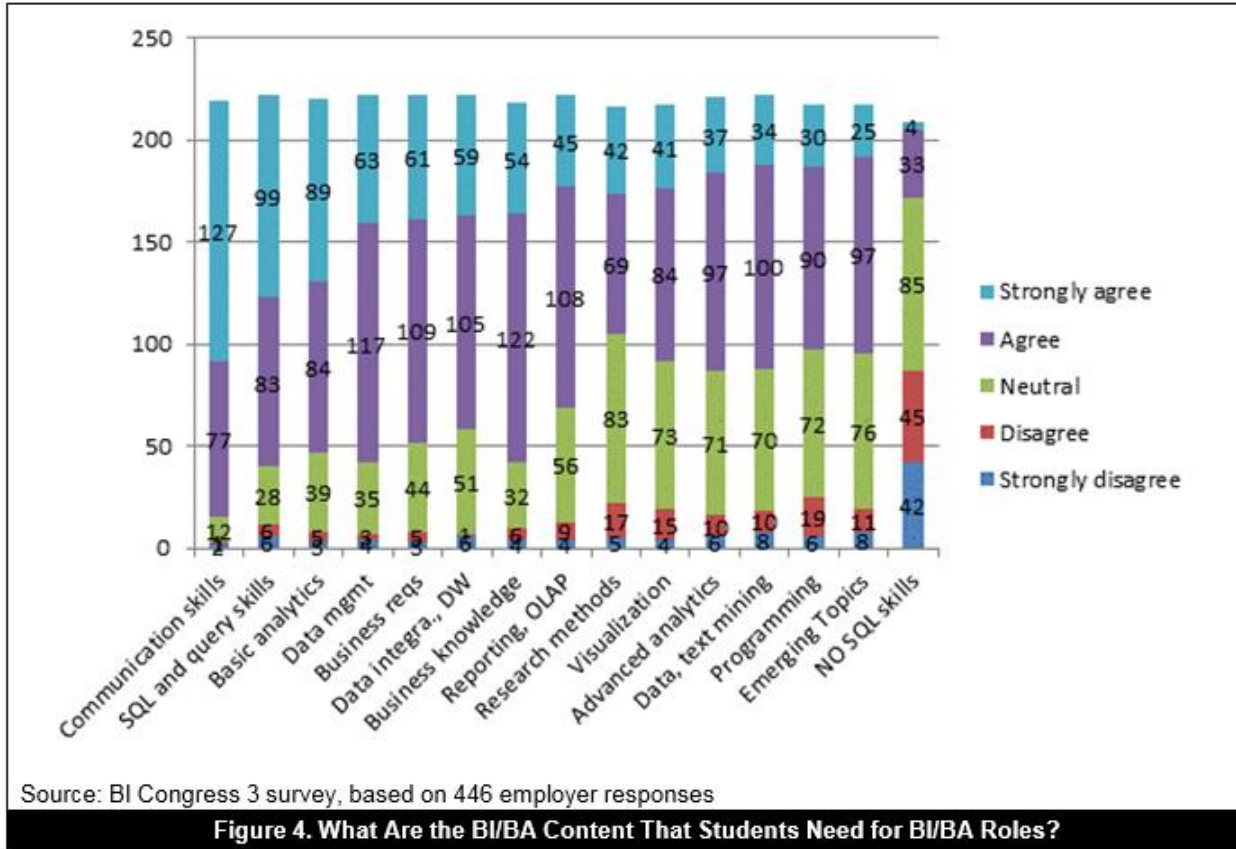**In a World of Big Data, Foundational Skills Remain Most Critical**

We have continued to evolve the content in our courses, to match the evolving nature of the BI field, particularly with regard to big data and predictive analytics.

BIC3 Professor Survey Respondents

While big data is currently the leading topic of interest within BI/BA, the BIC3 survey results suggest that employers do not see big data skills as a strong requirement when making hiring decisions. The top five skills desired by employers in descending order include: (1) communication, (2) SQL and query, (3) basic analytics, such as descriptive statistics, regression and ANOVA, (4) data management, and (5) business knowledge (see Figure 4). Similarly, educators appear to be focusing on teaching core, foundational skills to skills over emerging trends. Big data content, for example, is most often incorporated within BI/BA courses rather than as a separate program, major, or course.

The BIC3 Teaching Track observed several new trends in BI/BA offerings, which suggests that professors are moving beyond foundational skills in class. First, professors are augmenting traditional business application content, such as supply chain improvement with more advanced areas, like crisis management, and specialized applications within healthcare and entertainment. Second, there is growing interest in the analysis of text and other semi- structured or non-structured data. Also, professors are increasing coverage of prescriptive approaches (what should be done) in addition to descriptive and predictive (what happened in the past and what is likely to happen in the future). Finally, we believe it is significant that 13 percent of professors report that their universities offer a course specifically on Big Data.

When compared with the 2010 BIC survey, three types of skills rose in importance: basic analytics, advanced statistics skills, and research methods. This may be occurring because of the increased interest by employers in hiring for data scientist roles.

Source: BI Congress 3 survey, based on 446 employer responses

Figure 4. What Are the BI/BA Content That Students Need for BI/BA Roles?

Employers Are Not Satisfied with the Practical Experience of University Graduates

The biggest problem that I have seen with hiring college students is the lack of real-world experience. We compensate by providing training when we hire them. Universities can better prepare their students by providing opportunities for them to work in simulated industry projects instead of just teaching programming and database skills.

BIC3 Employer Survey Respondent

I have conducted a study with ABC Corporation, a $10B private retailer, to decide whether to host a specialty department in its stores. As a result [of my students' work], they introduced the department. This was a study to demonstrate the ease and effectiveness of data mining versus traditional statistics. The data set consisted of two million transactions.

BIC3 Professor Survey Respondent

Collectively, BIC3 survey employer respondents were persistent in their comments about the importance of increasing university students' BI/BA practical experience. Consistently, employers identified internships, report and dashboard development experiences, and hands-on classroom practicums as the most important student experiences relevant to the hiring process.

One employer stated, "Students have a lack of real-world knowledge. They lack perspective on how data enters, what its purpose is, or what the business value of data is."

Certifying students in real-world software is not the answer. In fact, less than 25 percent of employers consider software and hardware certification when recruiting for BI/BA positions. When specifically asked about certifications that matter, only 15 employers provided input—with most suggesting that technical or vendor certification was merely an added bonus rather than a requirement when recruiting.

IV. PRACTICES TO CONSIDER

The BI Congress 3 events and surveys identified a number of practices that offer promise to BI/BA education. In this section, we describe a subset of these practices.

Create an Advisory Board

Table 1: A Typology of BI-Savvy Professionals		
	BI Generalist	BI Specialist
Focus	Apply general BI concepts and techniques, i.e., "data literacy" to functional area, e.g., marketing, logistic, finance, etc.	Generate creative BI solutions across disciplines, i.e., "data expertise."
Typical background	Functional, e.g., marketing, logistic, finance, etc.	Technical, e.g., information systems, operations research, computer science, statistics, applied mathematics, etc.
Size of the population	Very large—typically every business major or MBA student, as well as non-business major in professional fields such as medicine, design, and production	Small—needs to grow
Emphasis on BI skills	Problem domain (business) and analytical (quantitative)	Analytical and technical
Current offerings	BI course, BI components in a generic IS or operations class, or BI minor	BI concentration or dedicated BI program
Future prospects	Employment by traditional employers, yet better value proposition from graduates	Employment in large organizations (such as the federal government) and Fortune 1000 companies, consulting firms, software developers, and academia

Table 1: A Typology of BI-Savvy Professionals – Continued		
Next steps for academia	Make BI an integral part of every business curriculum, ideally through a dedicated course that covers the basics of data warehousing, data mining, basic statistics, and business strategy. Target business and non-business majors in traditional academic programs, as well as professional and certificate programs.	Develop more BI concentrations (minors and majors) with emphasis on quantitative skills, (big) data management proficiency, systems integration, and broad understanding of organizations and their strategy. Emphasize nontraditional application areas such as healthcare management, sports management, and urban planning.

V. CONCLUSION

The BI Congresses and companion surveys confirm the growing interest by students and practice, and action by academia in business analytics and business intelligence. Notable findings of the BIC3 events include:

1. The number and depth of BI/BA program offerings has dramatically increased since 2010.
2. Access to and use of BI/BA pedagogical teaching resources has increased.
3. Demand for BI/BA students continues to outpace supply.
4. In a world of big data, foundational skills remain most critical.
5. Employers are not satisfied with the practical experience of university graduates.

The intellectual exchange facilitated by the BIC3 suggests that universities throughout the world should augment existing foundational BI and BA concepts with Big Data topics and learning objectives. A portfolio of decision support tools, techniques, and processes represent the toolkit of the next generation BI workforce. Kenneth Cukier, data editor for *The Economist,* supports this when he described the imminent change in the way medical doctors make diagnoses:

> *Today, doctors make diagnoses based on their judgment. Sounds reasonable? In time, this will probably be considered as barbaric as bloodletting. Why not use big data? We could enshrine the experience of all doctors, and of hundreds of millions of patients over decades, to identify the best treatments to achieve the best outcomes and spot hidden adverse drug side effects. After all, the sum of all medical knowledge isn't in the possession of any single physician. But if we aggregate vast troves of healthcare information, we may learn what works best.... This will mark a revolution in how society uses information.*

"Big data…," *Media Network,* 2013

Given the vast number of important decisions made each day, a transformation of this scale is baffling. It suggests a sea change in the fundamental ways that managers will scan their business environments, recognize opportunities, problems and crises, diagnose problems, search for solutions, and establish the criteria to select among alternatives. The emerging BI/BA concepts—particularly Big Data concepts—will impact some or all of these phases. That being said, it is important to view Big Data as the recent chapter of BI/BA because much of what we know about BI/BA from decades of research and teaching still holds true. The BIC3 helped us appreciated what we know about BI/BA while motivating exciting changes to adapt to a future characterized by new Big Data technologies and ideas.

ACKNOWLEDGMENTS

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
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