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ISSUES IN THE DEVELOPMENT OF AN UNDERGRADUATE BUSINESS ANALYTICS MAJOR

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ABSTRACT

Universities are scrambling to develop business analytics curricula. In the process of planning, developing and implementing such a program at our AACSB-accredited business college, we have gained some insights. We have reviewed research, attended symposia and examined college of business websites to benchmark options for our minor, concentration and major in business analytics. In this paper we review literature that propose business analytics models. We report on a study we conducted to examine business analytics programs at private, Midwestern, AACSB-accredited business colleges. We share our recommendations for business analytics curricula.

Keywords: Business Analytics, Business Intelligence, Data Analytics, Data Science

INTRODUCTION

Business analytics, data analytics, and data science are related terms that have been the topic of much discussion since 2010. Watson (2014) describes analytics as "an umbrella term for data analysis applications" (p. 1250). In the college of business, we view it broadly as data analysis for organizational decision making and solving business problems. There are several factors that have led to increased interest in business analytics: businesses have placed a greater value on data-based decision making than in the past; the ability of firms to collect more data (volume) of more types (variety), and with more frequency (velocity); and the availability of new tools, technologies, and methods to analyze data for decision-making. The desire for organizations to better use data has led to a need for employees equipped with these skills.

The need to prepare employees who can use business analytics for decision-making has recently received much attention. A study by the McKinsey Gobal Institute (Manyika et al., 2011) predicted that one and a half million managers and analysts would be needed by 2018 to analyze big data and employ it for decision-making, and that there would be a shortage of 140,000 to 190,000 people with deep analytical skills. Watson, Wixom and Ariyachandra (2013) report that in a survey from the Business Intelligence Congress in 2010 no schools reported offering Business Analytics degrees to undergraduates; the December 2012 survey found that 22 universities offered undergraduate programs in Business Analytics. Akalin (2017) studied 543 AACSB-accredited business schools in the United States and Canada and found that less than 14 percent of them (74) have Business Analytics and related programs at the undergraduate level. Although the number of undergraduate programs has increased significantly, there are not enough graduates to meet the demand in business. The MIS faculty in our college recognized the need to better prepare our students for business analytics positions and modified courses to include business analytics content. This was the beginning of what we hoped will become an undergraduate program in business analytics.

The goal of this research is to better understand the current state of business analytics programs and how they are being developed through the use of a literature review and an exploratory study.

CURRICULUM CONTENT OF BUSINESS ANALYTICS PROGRAMS

Similar to other business colleges, our college has been working on developing an undergraduate program in business analytics. However, defining the curriculum content of an undergraduate business analytics program is currently not a straightforward task. As part of our efforts to develop courses, minors and majors that focus on business analytics, we identified four major issues that have made this effort difficult and somewhat confusing:

1. It is difficult to determine under which business discipline the domain of business analytics falls.
2. There currently is not a widely accepted model curriculum defined as business analytics.
3. There is no professional organization with a policy group tasked with developing a model curriculum.
4. There is not clear delineation at academic institutions among programs in business analytics, data analytics and data science.

ISSUE #1 - IT IS DIFFICULT TO DETERMINE UNDER WHICH BUSINESS DISCIPLINE THE DOMAIN OF BUSINESS ANALYTICS FALLS

In reviewing prior research on this topic, we find the literature has made efforts to describe how different academic institutions are addressing business analytics in their curricula (Gorman & Klimberg, 2014; Wilder & Ozgur, 2015; Phelps & Szabat, 2017; Akalin, 2017). The subject areas where business analytics is taught varies. It can be found in statistics (Horton & Hardin, 2015), operations research (Cegielski & Jones-Farmer, 2016), management information systems (Chiang, Goes, & Store, 2012), supply chain management (Akalin, 2017), accounting (Borthick, Schneider, & Viscelli, 2017), strategic planning (Klatt, Schlaefke, & Moeller, 2011), human resource management (Barrett, 2013), marketing (Mintu-Wimsatt & Lozada, 2018) and economics (Şerbănescu & Necşulescu, 2013). Several of these subject areas apply business analytics within their discipline and do not necessarily teach the base knowledge needed to perform business analytics. This finding suggests to us that any business analytics program or major should include an application course within each discipline that uses business analytics. Business analytics majors could practice their craft within a secondary business subject as a minor, a second major, or simply their interest in a subject area. This would also allow each discipline to offer their majors and minors the opportunity to experience the application of business analytics within their field. Yet, this doesn't directly address the question of where to house the business analytics program. For that we reference an article written by Klimberg and Miori (2010). They argue that the base knowledge needed for academic programs in business analytics includes the fields of information systems, statistics, operations management and research. They go on to surmise that business analytics can be classified as a combination of business statistics intelligence and business modeling intelligence. But they also point out differences among business analytics and business intelligence and business information intelligence. They are quick to point out that these are not black and white distinctions and the differences between these viewpoints can become muddled. Their breakdown of the three viewpoints is shown in figure 1. The framework illustrates the breadth of knowledge, skills and abilities that span viewpoints that represents business intelligence and analytics (BI & A). Our interpretation of this framework is that a single undergraduate program in business analytics couldn't cover the knowledge, skills and abilities in both breadth and depth. Furthermore, various types of programs could emerge from this model that could all be called business analytics or business intelligence.

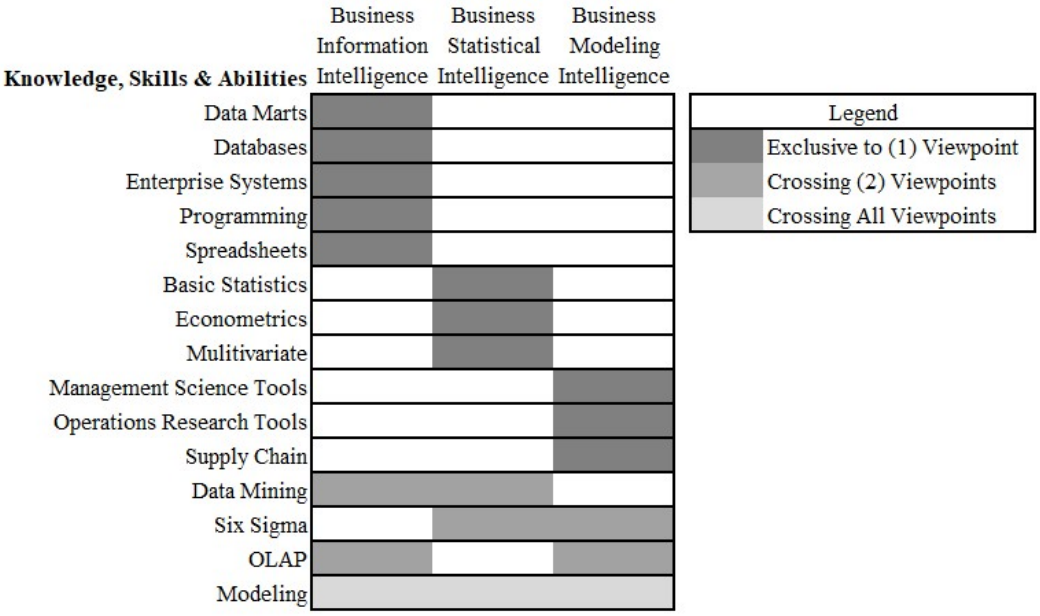

Figure 1. Three Viewpoints of Business Intelligence & Analytics

In our college, the MIS faculty drove the effort to create a business analytics curriculum that includes all disciplines. Our approach includes business information intelligence (data management and software tools), business statistical intelligence (statistics and modeling) and business modeling intelligence (decision analysis and application). This made us raise the question of whether other similar institutions are designing and building business analytics curricula. We identified four articles to address this question: (Gorman & Klimberg, 2014; Wilder & Ozgur, 2015; Phelps & Szabat, 2017; Akalin, 2017). The following paragraph describes them in the chronological order of publication.

Gorman and Klimberg (2014) found only ten undergraduate programs housed in the college of business and that these programs were typically hosted in departments of management information systems (MIS) or decision sciences (DS), such as operations management, operations research, management science, etc. In one of the ten cases, the Business Intelligence and Analytics (BI & A) major was hosted in a marketing department. These ten programs were only found in large, public, research oriented universities. For several graduate programs, they found there was no host department because the programs were multi-disciplinary in nature. They found that undergraduate programs were being driven by MIS and DS departments. Gorman and Klimberg (2014) noted that the undergraduate programs were tailored toward the host department with some multi-disciplinary aspects but largely focused on either MIS or DS. Wilder and Ozgur (2015) reported finding 49 graduate programs in business analytics which was a significant increase over the findings of Gorman and Klimberg (2014) who only identified 17 such programs. Wilder and Ozgur don't provide numbers for undergraduate programs but they do note the growth of such programs. Phelps and Szabat (2017) conducted a survey of SIGBIG (Statistics in Business Schools Interest Group of the American Statistical Association) and DASI (Data Analytics and Statistics Instruction) members and found 16 undergraduate programs associated with business analytics. The most comprehensive study we found was Akalin (2017) who studied a population of 543 AACSB accredited business schools across Canada and the U.S. He found that 74 (14.6%) schools had undergraduate business analytics programs. If the numbers collected from 2014 to 2017 are accurate, they demonstrate the rapid growth we might expect with expectations of firms who want to hire business analytics professionals.

ISSUE #2 - THERE CURRENTLY IS NOT A WIDELY ACCEPTED MODEL CURRICULUM DEFINED AS BUSINESS ANALYTICS

While the Klimberg and Miori (2010) model can be used as a framework for designing a business analytics program, we are unable to find evidence of a widely accepted model curriculum. Gupta, Goul and Dinter (2015) developed a

model curriculum for business intelligence and big data programs in business schools. The model curriculum was developed over a number of years and used considerable feedback from both faculty and industry experts. They use the term BI & A (business intelligence and analytics) to represent a broad perspective of the field. Examining their model with regard to the Klimberg and Miori (2010) framework, we find the Gupta et al. model is a combination of the three viewpoints illustrated in the Klimberg and Miori framework. Although, Gupta et al. (2015) do not reference the Klimberg and Miori framework, they seem to have independently reached similar conclusions on how to define the field. However, the model they develop is anchored in only one of the three viewpoints described by Klimberg and Miori, Business Information Intelligence, rooted mainly in the field of information systems. Gupta et al. provide curricula for undergraduate, MS and MBA programs. At the undergraduate level, the model curriculum includes DBMS (database management systems), dimensional modeling, OLAP (online analytic processing), data mining, data security, and performance management. There are 18 BI topics illustrated in the undergraduate model. There is real value in the model because it represents one possible approach to building curriculum around BI & A. It is an approach that builds depth in one of the three viewpoints from the Klimberg and Miori framework. It represents one of the few significant efforts toward creating a model curriculum we found in our research.

Since there are three distinct viewpoints within BI & A according to the Klimberg and Miori (2010) framework, there are at least four different BI & A models that could be developed: three that build depth from one of the three viewpoints, and one that builds breadth across all three viewpoints with less depth in each one. Wilder and Ozgur (2015) argue that it is important not to separate the quantitative skills associated with business analytics into specialized courses but to embed quantitative topics in a business context. In other words, BI & A courses must both simultaneously teach and apply the tools of business analytics. In their proposed BI & A curriculum, Wilder and Ozgur (2015) discuss seven distinct multidisciplinary courses that should comprise the BA major: (1) Data Management, (2) Descriptive Analytics, (3) Data Visualization, (4) Predictive Analytics, (5) Prescriptive Analytics, (6) Data Mining and (7) Analytics Practicum. Additionally, they recommend a variety of course electives across business disciplines that apply business analytics. This approach seems to fit the fourth variation of the Klimberg and Miori framework, one which builds breadth across all three viewpoints with less depth.

It isn't clear whether the models proposed by Gupta et al. (2015) and Wilder and Ozgur (2015) have gained traction as business colleges develop BI & A curricula. It is important for business colleges to include BI & A in their curricula. However, disjointed efforts that result in a variety of different models will create confusion. We argue that students who enroll in different colleges' programs should get roughly the same core BI & A knowledge. Employers who hire students with BI & A skills should not get employees with widely inconsistent preparation. An organized effort needs to be established to develop a model curriculum.

ISSUE #3 - THERE IS NO PROFESSIONAL ORGANIZATION WITH A POLICY GROUP TASKED WITH DEVELOPING A MODEL CURRICULUM

The Association for Computing Machinery (ACM) and the Association for Information Systems (AIS) developed model curricula for information systems at both the undergraduate and graduate levels. These models are generally widely accepted in the field and are often used to develop or redevelop information systems programs within the colleges of business (ACM/AIS, 2010). IS2010 is the most current version of the undergraduate guidelines. The guidelines offer domain fundamentals but also detail knowledge and skills related to those fundamentals. Key specializations within the domain are discussed and one of those is the evaluation of business performance including business intelligence and analytics. But, no specific effort is made to include the domain fundamentals for the various specializations.

Business intelligence and analytics is a broad field that includes multiple disciplines. A single discipline is likely to have a professional organization creating model curricula. But, with BI & A, there is no unified body that is widely accepted across disciplines. One of the conclusions from our research is that such an organization should be created for BI & A. Faculty from different disciplines who need to come together to design and implement a business analytics program need more guidance. And, that guidance needs should be continuously updated as the field progresses and changes.

ISSUE #4 - THERE IS NOT CLEAR DELINEATION AT ACADEMIC INSTITUTIONS AMONG PROGRAMS IN BUSINESS ANALYTICS, DATA ANALYTICS AND DATA SCIENCE

Researchers have recognized the distinctiveness of business analytics in contrast to the general term data analytics or the more technical data science. Chiang et al. (2012) clearly illustrate the domain of analytics in business schools and argues that technical data science courses fall primarily in the domain of computer science and engineering. Business analytics professionals need to be able to take their knowledge of business and frame the appropriate analytical solution to business decisions and problems. These professionals also need business knowledge to properly interpret and communicate analytical solutions to other business team members including management (Watson et al. 2013). Chiang et al. (2012) state that business intelligence and analytics is different from general data analytics and data science because for business professionals, analytics is understanding the results of an analysis in order to strategize and take appropriate organizational actions to further the interests of the firm.

Business analytics programs should strive to serve the needs of business decision makers by providing courses that teach students how to use information systems that support analytics. These tools enable aspiring business professionals to data mine, text mine, and to perform social media analytics and predictive analytics. All of this is needed to support data driven problem solving and decision making. Yet, our investigation into programs at other universities similar to our own has revealed some unique approaches that further confuse the delineation between business analytics and data science. For example, one private, Midwestern university offers a data analytics major through their college of business that is a joint program with their college of arts and sciences. The curriculum for the major is primarily comprised of computer science courses, data science courses, and math and statistics courses taught in the college of arts and sciences. The business college portion of the program includes a database management course and traditional business courses where data analytics could be applied. It doesn't include any management science, operations management or supply chain courses. This is not a criticism of that school's approach, but it demonstrates an example of a program called business analytics that uses a hybrid data analytics/data science approach instead of offering a program with applications in a business context.

Cotter (2014) recommended the incorporation of analytics in engineering courses. In our review of data analytics at institutions similar to ours, we have seen examples of academic programs focusing on health analytics, public policy analytics and other areas of knowledge. And, as other fields of study such as biology, sociology and engineering start incorporating data analytics into their curricula, having a clear understanding of how business analytics is differentiated from general data analytics and data science will become even more important.

The literature review did not result in a consensus view of what components should be included in an undergraduate business analytics program in colleges of business. The following section describes an exploratory study we conducted to check for consensus on programs among colleges of business.

BENCHMARKING MIDWESTERN PRIVATE UNIVERSITIES

In an effort to understand the various approaches that colleges of business are taking to create programs in business analytics, we decided to benchmark universities similar to our own. We use the common interpretation of benchmark where we compare programs to one another and to our own attempting to understand if they fall within a common framework. We are a mid-sized, private university in the Midwest of the United States with comprehensive undergraduate programs across five distinct colleges. Our AACSB-accredited college of business represents 15 to 20 percent of the students enrolled at our university. We offer a variety of majors throughout the college of business. And, of course, we have had an ongoing interest in developing a business analytics program.

Methodology

Employing a simple exploratory design, we determined our frame to be institutions similar to our own geographically constrained to the Midwestern region of the United States. We began by identifying all AACSB accredited business programs at private universities in the Midwest (Iowa, Illinois, Indiana, Michigan, Missouri, Minnesota, Ohio and Wisconsin) which resulted in 24 schools similar to our own. We visited the websites of these universities to examine whether their academic programs included business analytics.

Using the Gorman and Klimberg (2010) framework, we developed four categories of programs: (1) deep focus on BII (business information and intelligence, (2) deep focus on BSI (business statistical intelligence), (3) deep focus in BMI (business modeling intelligence), or (4) a broader program that spanned two or more of the first three categories but with less depth. We classified each program of the twelve schools that had programs (regardless of the name of the program) into one of the four categories.

Findings

We found that 50% of the identified schools had some sort of data analytics program associated with business described on their websites. But only five (42%) of the 12 called their program business analytics. The rest called their programs data analytics or data science. Research published in the last year has found that roughly 15% of AACSB schools in the U.S. and Canada have developed undergraduate programs in business analytics (Akalin, 2017).

Our expectation for smaller private schools was that they would either develop a niche program with depth or develop a more generalized program that attempted to introduce a breadth of knowledge associated with business analytics. What we found is that the schools developed a wide range of programs. There seemed to be an effort among these schools to get some kind of program in place that could represent business analytics. We did not see any consistency across schools in their approach, program name, courses, required content or any other aspect of the programs. We attempted to place the programs into one of the four categories as shown in table 1. This was challenging as the academic institutions were not following a framework to develop their programs.

Table 1. Program Placement by Category

No Analytics Program	Category 1 BII	Category 2 BSI	Category 3 BMI	Category 4 Spanning
12	2	0	2	8

We posit that departments/colleges that are still developing programs are not following a common model, and there doesn't appear to be another driver of the program design. Perhaps the program reflects areas of expertise of the hosting department or college in an attempt to leverage existing resources and talent? In general, these programs fall into category 4: attempting to build a program across category domains in a variety of different ways. Our own program was not included in the study. Our business analytics minor is comprised of only MIS courses. We plan for the major to include courses from other disciplines, including quantitative methods, modeling, supply chain, econometrics, and management which would place it in category 4.

CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of our research was to better understand the current state of business analytics programs and how they are being developed. We believed this research would provide some guidance on how to design an undergraduate business analytics program for our benefit and the benefit of others. This was a three-pronged effort: (1) review the published literature on the topic, (2) attend symposia on the topic of building BA programs where such research is presented and discussed, and (3) study what other schools are doing in the area of business analytics. Neither the literature review nor our exploratory study of programs offered a consensus view on what should be included in a business analytics program at a college of business. As a result of this research, we offer the following conclusions and recommendations:

- As an organization, it is not possible to simply decide to build a business analytics program, reference model curriculum, and then form a committee to design the program. The development of a business analytics program requires broad and deep understanding of this emerging field in order to make informed decisions about curricular content. There are multiple ways of approaching the design and implementation of these programs.

- Be aware that other academic units at the university may also be involved with data analytics or data science. This could be a political minefield that requires an explanation of the differences between business analytics and other programs such as data science. Be prepared to explain the distinctiveness of business analytics.

Also consider building bridges between those programs to share resources in offering a variety of analytics programs across campus.

- We found no consistent approach across the schools in our study as to how they are developing and implementing BI & A curricula. This is due to the fact that there appears to be at least four, if not more, approaches that can be taken to building a business analytics undergraduate major.

- Given the variety of programs that could be built, there is need to form a cross-functional, professional academic policy group to create model curriculum.

- Our sample indicates that half of the schools like our own have launched BI & A programs in their college of business. This represents an acceleration of the launching of new programs in contrast to broader studies previously published in just the last few years.

- Findings on table 1 indicate that for business schools in private Midwestern universities, the primary goal is to create programs that are designed to span across the discipline, avoiding niche programs that build depth in any particular category.

Furthermore, we provide the following recommendations based on our experiences in developing a business analytics program at our college of business.

- Even if the program is intended to build depth in one of the viewpoints that supports business analytics, there should be a multi-disciplinary effort. If the intent is to build a broad program that covers the breadth of analytics, it is critical that multiple stakeholders are included in the design and implementation.

- Even when the program is multi-disciplinary, the effort requires a champion to move the process forward. Typically, these programs are housed in a single department that has decided to lead the effort to build a business analytics program. And in the few cases where a special unit was created to house the business analytics program, an individual stepped-up to lead and drive the effort.

- To get buy-in across disciplines in the college of business, consider inviting other disciplines to create application courses for their discipline. Not all areas in the college will be directly involved in delivering a business analytics program, yet, you need their support. Management, marketing and finance faculty may recognize the value of business analytics to their disciplines and may want to offer application courses in their various fields. If you include these courses as part of your business analytics major, you get two benefits: (1) support across the college and (2) a better design that allows majors to practice their knowledge and skills in the context of real business decision making.

- Given the cross-functional nature of business analytics, there will need to be cross-functional interaction between faculty in the design and implementation of courses. The knowledge, skills and abilities necessary for a course requires careful consideration. Prerequisites and flow are critical to making the curriculum work.

- Our current design is a work in-process. It will need to evolve over time. The faculty delivering the courses will have the greatest impact on exactly how the program is implemented.

SUGGESTIONS FOR FUTURE RESEARCH

There are significant opportunities to develop a research stream around this topic. We provide four ideas that subsequent research should explore.

- Given the depth and breadth of the field and the limited capacity of undergraduate programs, such programs need to be designed with more data to guide their development. Research should be conducted to discover if there is any broad based consensus in terms of specific knowledge, skills and abilities required for business

analytics programs. Input and feedback provided by researchers, teachers and working professionals in a geographically disperse study should provide some guidance such that programs can be created based on rankings of importance.

- Validate the Wilder and Ozgur (2015) model that attempts to provide a curriculum based on the spanning category.

- Attempt to validate the Gorman and Klimberg (2010) framework to discover whether the knowledge, skills and abilities factor into the categories of the proposed frame. If not, present an alternative framework around which model curricula could be developed.

- In addition to exploring the details (knowledge, skills and abilities) associated with business analytics, a study should take a macro approach to the curriculum. The research should attempt to understand the strategy and tactics driving the development of such programs.

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