Abstract

Business analytics continues to be an explosive competitive advantage for many companies. Universities are under pressure to prepare undergraduate students with the proper skills to compete in today’s “big data” work force and to help their students create value by effectively performing their jobs using business analytics skills. In this paper, we address the demand for business analytics talent for undergraduates from business schools and describe how Michigan State University has provided the appropriate skill level and breadth of knowledge required for business school graduates to be successful using business analytics skills. This paper highlights a breadth of changes being made to the undergraduate curriculum and focuses primarily on two undergraduate classes at Michigan State University’s College of Business, which were redesigned to emphasize the necessary skill development associated with business analytics.

Introduction

The integration of business analytics into the business college undergraduate curriculum is the direct result of the demand for business analytics skills from a significant number of employers in today’s workplace. Business schools have been challenged to increase the business analytics skills across all of their degree areas including supply chain management, accounting, marketing, and finance.

Michigan State University has responded to the increased demand for analytics talent and the challenge of integrating business analytics into the undergraduate business college curriculum. Aided by the
In partnership with IBM and other key companies, Michigan State University has invested in curricular redesign and has aggressively made changes to two of its core undergraduate classes.

This paper describes the increasing demand for business analytics skills for college graduates. Michigan State University’s response to this demand for business analytics talent is then discussed. Key functional majors and the need for business analytics skills within each functional area are then described. Finally, the plan for future enhancement of the curriculum is discussed.

Demand for Business Analytics Skills

The demand for employees with business analytics skills has increased greatly as business analytics capabilities have demonstrated their value in organizational decision making. Unfortunately, the supply of new college graduates with analytics capabilities has not kept up with the demand and this talent gap has become one of the main challenges of the effective use of business analytics in organizations. In a recent survey by Bloomberg Businessweek Research Services, only one quarter of the respondents felt their organization had the right business analytical talent in place (Bloomberg, 2013).

In another recent study by the Accenture SAS Analytics Group, more than half of the respondents reported that their organization had some sort of business analytical talent deficiency while the vast majority of respondents reportedly planned to upgrade their business analytical talent during the following year by either training current employees or hiring new talent (Accenture, 2011). These studies demonstrate the need for employees with business analytical skills and that there exists an opportunity for business colleges to help bridge the supply and demand gap.

Michigan State University’s College of Business works closely with its Advisory Boards to continuously enhance the curriculum to meet employer hiring needs. Within the realm of business analytics, the College specifically asked key employers for the skills and capabilities needed for undergraduates to be competitive in today’s job market. These business analytics skill requirements span the spectrum of all business college majors and are summarized by Rao [2014]. Five dimensions or key skills for the business analyst or data scientist are discussed. Note that the phrase “data scientist” may be replaced by the job descriptions associated with “data mining”, “business intelligence”, “business analytics”, or “statistician” as these phrases all capture the five expertise or skills areas.

First and foremost, a “data scientist” is a business or domain expert: Someone who has to have the ability to articulate how information, insights, and analytics can help business leadership answer key questions – and even determine which questions need answering – and make appropriate decisions. Second, a “data scientist” is a statistics expert: Someone who has to have the ability to determine the most appropriate statistical techniques for addressing different classes of problems, apply the relevant techniques, and translate the results and generate insights in such a way that the businesses can understand the value. Third, a “data scientist” is a programming expert: Someone who has the ability to determine the appropriate software packages or modules to run, the ability to modify them, and the ability to design and develop new computational techniques to solve business problems (e.g., machine learning, natural language processing, graph/social network analysis, neural nets, and simulation modelling). Fourth, a “data scientist” is a database technology expert: Someone who has a thorough understanding of external and internal data sources, how they are gathered, stored, and retrieved. Finally, a “data scientist” is a visualization and communications expert: Someone who has a thorough understanding of visual art and design. This is important because it enables those who aren’t professional data analysts to interpret data.

Accordingly, the data scientist should be able to 1) take statistical and computational analysis and turn it into graphs, charts, and animations; 2) create visualizations (e.g., motion charts, word maps) that clearly show insights from data and corresponding analytics; and 3) generate static and dynamic visualizations in a variety of visual media (e.g., reports, screens – from mobile screens to laptop/desktop screens to HD large visualization walls, interactive programs, and – perhaps soon – augmented reality glasses). Last, but not least, a ‘data scientist’ should be able to engage with senior management, talk their language and translate the data-driven insights into decisions and actions.

IBM’s recent annual technical trends report states that IBM’s first strategic imperative is too make markets by transforming industries and professions with data (IBM, 2014). IBM estimates the market for
data and analytics to be $187 billion in 2015. Two thirds of IBM Research’s work is now devoted to data, analytics and cognitive computing and IBM has earned 4,000 analytics patents. The IBM Institute for Business Value studies depict a huge skills demand for business analytics in the workplace based on survey feedback from IBM’s clients (2012 IBM Tech Trends Report and 2014 IBM Business Tech Trends Report). These client results depict how important for these business analytics skills to be taught and reinforce the need for tools, such as Cognos, for educators to bring in the classroom [Hassan, 2014].

IBM is assisting universities, like Michigan State University, by providing access to a breadth of software tools to support analytics including its SPSS statistical and predictive modeler suite and Cognos toolset. Beyond the software tools themselves, IBM has provided in-depth training to support skill development and by providing support for experiential projects where students apply analytics to real-world business problems. This collaboration between IBM and Michigan State University is part of an ongoing effort to expand and strengthen student skills and understanding of big data and analytics in order to meet the growing demand for highly skilled analytics workers. Two required undergraduate courses within MSU’s College of Business were targeted for students to gain an understanding how technology like cognitive computing can be put to work in data intensive industries. These curriculum enhancements are discussed in the following section.

**Efforts to Integrate Business Analytics into the Undergraduate Business Curriculum**

Michigan State University’s College of Business has embraced the effort to integrate business analytics into its undergraduate curriculum. The College of Business and MSU more broadly, have invested in developing students’ analytics capabilities as a strategic priority. Consistent with our strategy, we have partnered with industry, and specifically with IBM, to deliver a state-of-the-art educational experience for our students. MSU recognized that a multi-college effort would be needed to deliver on the disciplinary breadth of data management, business and statistical/analytical modeling. While some of the key learning objectives were established by faculty by benchmarking other programs, we also asked for industry input into the data scientist skills needed for the workplace. This resulted in the redesign of two core courses, an entry level freshman course and a core business information technology course, to assure the students receive the proper instruction in business analytics.

**Entry Level Freshman Course**

The College of Business at Michigan State University has offered an entry-level freshman course on the Concepts of Computing for a number of years. This course served the students well, however, the undergraduate program at the Broad College was undergoing a number of changes that had implications for course structuring and curriculum design. Four major changes of sophomore admits into the Business College, changes of class structure and sequencing, focus on business analytics, and the creation of a new IT minor—necessitated a rethink of the concepts and curriculum needs of the entry level freshman course.

The curriculum review committee identified a few perceived gaps and needs for changes in the class based on the feedback from multiple stakeholders. As a first step, the recommendation is that since this class is going to be a screening class for admits to the business college, we need to increase the business focus of the class by aligning concepts taught in class to real-world business concepts. From a pedagogical perspective, we need to increase student engagement through more problem-centered learning including the focus on business analytics.

A new course title of “Problem Solving with Data Analytics” was recommended along with following new learning goals for the course:

- Students should be able to systematically apply tools of quantitative analysis and modeling to make recommendations and business decisions.
- Students should be able to use database tools and spreadsheets to calculate and analyze data to solve a given business problem.
• Students should be able to understand the business problem, be aware of the tools to solve a problem, and where the data comes from.

The course focuses on problem solving using business analytics as it was understood that modern technology allows businesses to collect and analyze vast amounts of data. Being able to interpret, understand and use that data requires business analytics and problem solving tools. This hands-on, interactive course introduced a range of tools and techniques that help future business leaders uncover important information and make better decisions based on data.

Students in this class follow these course objectives:
• Learn to use data analytics to solve real-world business problems; and
• Become skilled users of the data analytics tools that employers need
• Understand how computers/data/IT are used in real world businesses today

To support these three learning objectives, students solve a series of real business problems. For each problem, the course will address the following questions:
• How can I translate this business problem into something I can solve?
• What are some business analytic tools to solve business problem?
• How do I use the tools to develop a solution to a problem?
• How can I get the data I need to answer this problem? What if the data changes?
• How can I communicate my results most effectively to the relevant audience (e.g., stakeholders, business leaders, customers etc.) and thereby assure that my recommended solution to the business problem is implemented?
• What is the right tool for this problem? Once students have an introduction to the basic concepts, and understand what type of business problems they have to solve, students should be challenged to suggest which tool would be best to apply to a given problem and why.
• What skills beyond what I have learned in CSE 101 will be helpful in solving more complex versions of this problem?

**Business Information Technology Course for Sophomores/Juniors**

The College of Business at Michigan State University has offered a business information technology core required course for many years. This information technology course has evolved over the years to assure the skills taught were in alignment with recruiter hiring needs. The business information technology course for sophomores/juniors continues to seek this alignment with a focus on business analytics. The new course title is “Business Analytics and Information Systems”.

The objectives for the business information technology course help students develop strategic thinking and experiential skills about the use of information systems and business analytics in meeting business needs and objectives. The course objectives rely upon the following information technology principles that organizations are increasingly complex as they transact and collaborate with a diverse set of customers and vendors. Products and services are created with shorter life cycles using a distributed workforce where employees, customers, vendors all may be located anywhere around the globe.

The course helps students develop systems thinking—the ability to understand the complexity of a business enterprise by systematically examining the business processes underlying the enterprise and the flow of information within and between such processes. Specifically, the course objectives are:

• To develop strategic thinking and experiential skills for the course focus on the use of information systems and business analytics in meeting business needs and objectives.
• Learn about the role of information systems in improving business performance.
• Understand the different types of information technologies and how they are used in business organizations.

• Understand the principles of effective information technology management and use by individuals and organizations.

The information technology skills taught in the course will enable students to:

• Be able to model business processes and simulate financial and operational effects of a technological change on a company’s business process.

• Be adept at extracting and analyzing data from a database to enhance managerial decision making.

• Be adept at organizing and analyzing data for business decisions using business intelligence and data analytics tools.

• Develop stronger skills in learning how to understand emerging information technologies.

The course relies upon 1) lectures which provide students with real world examples of emerging technology, 2) guest speakers, such as IBM Watson leaders and other private sector information technology leaders, which reinforce the need for enhanced skills of business analytics, 3) technology skill assignments which focus on business analytics, and 4) a comprehensive team project which focuses on information technology enablers and business analytics.

Several technology skill assignments for the course focus on integrating information technology, business analytics, and business skills development. Business process modeling using Arena, business intelligence using Microsoft Access, and business analytics using Cognos Insights are several of the technologies students learn during the assignments. The Cognos Insights software is the key component for the business analytics focus of the course.

The course also utilizes a comprehensive team project, which focuses on the many aspects of how information technology is used to improve business performance. The team project is based on an integrative case which utilizes a business analytics focus to facilitate student learning of creating business value with information technology.

Following is the outline of major topics for the course:

• Globalization, innovation and digital trends
• Business processes and competitive advantage
• Strategic decision making using information technologies
• eBusiness
• Databases, data analytics, and data warehouses
• Business analytics and business intelligence
• Enterprise wide systems technologies
• Mobility and social media technologies
• Systems development and IT project management
• Ethics and information security

Functionally Specific or “Major Specific” Business Analytics Skills

Business analytics skills by college of business major or functionally specific business analytics skills are now explored. The fields of supply chain management, accounting, marketing and finance are reviewed to assess the key business analytics skills by functional area and to assess the common business analytics skills which span all majors.

Schroenherr and Pero [2015] highlight skills desired for successful data scientists in the field of supply chain management and provide illustrations of how predictive analytics can be implemented in the curriculum. In their forward thinking article they discuss the results of a recent large-scale survey on these topics among supply chain management (SCM) professionals, complemented with our experiences in developing, implementing and administering one of the first master degree programs in predictive
analytics. The authors report on the current use of predictive analytics in SCM and the underlying motivations and highlight skills desired for successful data scientists, and provide illustrations of how predictive analytics can be implemented in the curriculum. Their summary of skill sets required for data scientists in supply chain management are noted below:

- Understanding application of qualitative and quantitative methods of forecasting
- Numerical methods of optimization
- Broad awareness of many different methods of estimation and sampling
- Determining opportunity cost
- Using numerical methods to estimate functions relating independent variables to dependent variables
- Using probability theory with actual data to estimate the expected value of random variables of interest
- Quick design and implementation of discrete event simulation models
- Capital budgeting
- Managerial accounting
- Marketing science

PWC [2015] highlighted data driven skills desired for successful employees in the field of accounting and provided illustrations of how business analytics can be implemented in the curriculum. Their summary of data driven skill sets for accountants is summarized for the areas of audit, tax, risk management, and consulting. Key business analytics skills required for audit include research and identify anomalies and risk factors in underlying data, mine new sources of data (must possess a base level of programming knowledge) and use insights to bring new value to the business, understand databases that are relational (a data structure that allows linking information from different types of data buckets) and non-relational (data stored without structured mechanisms to link data from different buckets to one another), use exploratory multivariate statistics, inferential statistics, visualization tools, optimization methods, machine learning, and predictive analysis tools, and process-mine using new data analysis techniques and algorithms, to isolate and investigate specific processes that might have led to changes to the data/accounting ledgers. Key business analytic skills required for tax include gather a large amount of data in many forms and use it to help make tax department business decisions, consider after-tax performance insights in decision-making, visualize accounting data, like credits, debits, and tax thresholds, use technology to verify that remedial actions or calculations introduced are within regulations and compliance limits, and help minimize accounting pitfalls using new data software and visualizations (much like tax planning software has revolutionized income tax filing). Key business analytics skills required for risk management include use simple vendor risk dashboards and filters to minimize inefficiencies and human error, perform data and process mapping from a regulatory and risk-assurance view, understand and apply advanced query languages; programming languages like R, SQL, and SAS; and data discovery and visualizations techniques. And key business analytics skills required for consulting include identify and frame key business decisions and their related metrics to make these solutions more effectively and efficiently, extract the right data from different sources, then select and run the most appropriate analytics solution to generate insights, visualize and translate insights into concrete actions that businesses can take, communicate the decisions and actions needed in a way that highlights the business value to the client, and create proprietary analytics solutions that capture the unique data analytics that the consulting organization builds over time.

Bhandari, et. al. [2014] discuss how business analytics can be used in the field of marketing to drive superior growth. They stress the need to anchor business analytics to the marketing strategy whereby the users need to understand the power and potential of analytics to drive strategy. Another key skill for marketing majors using business analytics is business judgment or creativity to develop new ways of using data or to identify new opportunities for unlocking data. These “soft” skills are particularly useful because data availability and quality can be unreliable. Marketing majors also need to be quantitatively minded as companies need to evaluate the pros and cons of each of the many available tools and quantitative methods to determine which best support their strategy. Marketers must possess business skills and work closely with data scientists, marketing researchers, and digital analysts to question assumptions, formulate hypotheses, and fine-tune the math. Companies also need to cultivate “translators,” individuals who both understand the analytics and speak the language of business. The pressure on marketing
leaders to demonstrate return on investment from a diverse portfolio is increasing and hence marketing majors need to have the skills to take on an integrated analytics approach to uncover meaningful insights and drive above-market growth for brands.

Bloomberg Businessweek Research Services conducted a global survey of director-level or above executives at midsize and large companies from around the world. The survey provided insights into the use of business analytics in the **field of finance**. A large majority of the executives surveyed regard decision support as a strategic lever, with the vast majority citing increased investment in IT to reduce costs, increase productivity and uncover new revenue opportunities as important to them. Half of the respondents are using dedicated analytical tools to enhance financial planning, forecasting and reporting, and are involved in big data projects to utilize surging volumes of information. Key business analytics skills cited include risk management, strategy integration, and quantitative methods.

Table 1 summarizes the business analytics skills by function or major. Note that the business analytics skills of data mining, statistics, quantitative methods and business acumen span across all majors for the college of business. Some business analytics skills, such as business process mapping for supply chain management, tend to be major specific. Finally, the requisite data management and programming skills highlighted in the table can be delivered by the information systems area within the college of business and we are seeing increased demand for such content in our courses. The focus of this paper was to address the key business analytics skills required for an undergraduate enrolled in the business college curriculum and hence the focus was on skills which span across all business college majors.

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<thead>
<tr>
<th>Business Analytics Skill</th>
<th>SCM</th>
<th>ACC</th>
<th>MKT</th>
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<td>Systems Thinking</td>
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Table 1: Business Analytics Skills Summarized for Each Business College Major
Expected Outcomes and Plans to Further Integrate Business Analytics into the Undergraduate Curriculum

The advance of big data shows no signs of slowing and companies will continue to seek talent to address this wave of technology advancement. The demand for employees with business analytical skills will continue to increase as business analytics practices become more and more popular in organizations. Michigan State University's College of Business recognizes that the demand for business analytics skills will continue to evolve as more and more companies advance in these areas. Hence, there is a need to continually refresh the curriculum to remain current and competitive in the fast moving business analytics field. The College of Business will continue to invest in analytics capabilities as a strategic priority. Consistent with our ongoing strategy, we will continue to partner with industry, and specifically with IBM, to deliver ongoing state-of-the-art educational experience for our students.

The education goal and expected outcomes of this business analytics curriculum redesign are for our undergraduate students to first receive the necessary contemporary skills in big data and business analytics to be competitive and then next provide the demanded talent for our recruiters to hire the resources with the necessary skills. This partnership of meeting recruiters hiring needs by providing undergraduates with the necessary skill sets is an ongoing process and we envision to be constantly updating the curriculum to meet the evolving business analytics needs of the business partners. The list of business analytics skills continues to grow and the list is long. Thus, there is a need to work with recruiters and prioritize the most important skills which are desired in the workplace and will thus be integrated into the business analytics curriculum. Information technology courses are under constant redesign pressures to assure undergraduate students have the best set of skills to compete in the evolving business analytics workplace and thus a true partnership between the recruiters and the faculty is essential for mutual success.

Acknowledgements

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REFERENCES

