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Training Data-Savvy Managers: An Analysis of Graduate Business Analytics Programs

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Abstract

The purpose of this study is to investigate the current state of graduate level business analytics education in the United States. The goal of this research is twofold. The first goal is to understand how higher education institutions are addressing the growing demand for analysts and data-savvy managers in the job market. To achieve this aim, the researchers carried out a detailed investigation of 82 programs focused on graduate business analytics education. Using publicly available curricula, they collected data and performed thematic and statistical analysis on topics covered, formats, tools, and techniques. The study found that programs related to training data-savvy managers exhibit a high degree of variability. This variability can manifest in various ways, such as the course content, program structures, required credits, and the tools and techniques being used.

The second goal of this research is to provide a competency framework for data-savvy managers and a blueprint for those institutions looking to create a graduate BA program to train technically proficient and analytically skilled managers. As such, based on current program offerings and anticipated industry demand, a model BA graduate program curriculum is developed and provided.

Keywords: Business Analytics Education, IS Education, Graduate Programs, Data-Savvy Managers, Data-Driven Decision Making, Technology-Savvy Managers

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1. INTRODUCTION

In today's fast-paced digital era, businesses are focusing on the intersection of technology and operations to remain competitive. The integration of business analytics (BA) into corporate strategy has become crucial for companies to leverage data for their advantage. The significance of data analysis and information management in contemporary business strategy and operations cannot be overstated. The ability to gather, interpret, and use data effectively is no longer a specialized skill but a fundamental requirement for managers across various sectors. This has led to an increased demand for managers who can analyze complex information sets and make strategic decisions based on them. As this demand grows, educational institutions are feeling the pressure to adapt and innovate their graduate programs to meet this need.

The issue posed for higher education institutions interested in offering programs at the graduate level in business analytics (BA) is what is the status of existing programs and what are the next steps to take? Our investigation seeks to shed light on the current state and future trends of graduate programs in BA education in the United States.

The goal of this research is twofold and includes two research questions. First, we will be focusing on how BA graduate programs are adapting to meet the needs of the modern job market. Are current BA graduate programs covering the appropriate topics such as tools, techniques, skills and knowledge? Both the US Bureau of Labor Statistics and the World Economic Forum show strong demand for job seekers with BA skills (BLS 2023, World Economic Forum, 2020). In the next section we will list some of the specific industry skills in demand. Our aim is to provide a comprehensive overview of the educational landscape in this critical field and identify how academic programs are responding to the industry's demand for technically proficient and analytically skilled managers.

The second goal of this research is to provide a competency framework for data-savvy managers and a blueprint for those institutions looking to create a graduate BA program to train managers and domain experts in analytical skills. What competencies are required for analytically skilled managers? What should the format and curriculum of a graduate BA program look like? It is our hope that the findings of this research can help guide those institutions looking to embark on the journey to create a graduate BA program.

2. LITERATURE REVIEW

In the USA, the projected job market for business analytics related occupations remains stronger than average well into the future, according to US Bureau of Labor Statistics (BLS) (*Employment Projections*, 2023). BLS data shows both statisticians and data scientists occupations (with a median income of 95k and 100K in 2021, respectively) are expected to be in the top ten of fastest growing jobs through 2031. This trend is not isolated to the US and is also expected at a worldwide level (World Economic Forum, 2020).

According to the World Economic Forum (WEF), Data Analysts and Scientists, Software and Applications Developers, and E-commerce and Social Media Specialists are set to experience increasing demand enhanced by the use of technology; and there is an accelerating demand for emerging specialist roles in: AI and Machine Learning Specialists, Big Data Specialists, Process Automation Experts, Information Security Analysts, User Experience and Human-Machine Interaction Designers, Robotics Engineers, and Blockchain Specialists.

There is a large body of literature (both academic and occupational based) detailing what specific BA related skills are currently in demand now as well as predicting into the future. O'Connor (2020) lists seven must-have skills for data analysts. Those skills include Structured Query Language (SQL), Microsoft Excel, critical thinking, R or Python statistical programming, data visualization, presentation skills, and machine learning. According to O'Connor, SQL is the ubiquitous industry-standard database language that is most important for data analysts to know. The author notes that although programming languages like R or Python are better at handling large data sets, advanced Excel methods such as Macros and VBA lookups are commonly used for quick analytics.

Stanton and Stanton (2020) determine that prior experience is the single most important credential employers seek in entry-level data science and analytics positions.

Markow and Sederberg (2020) at Burning Glass Technologies analyzed over 17,000 unique skills demanded among over one billion historical job listings in their database to identify "disruptive technology skills," which include those emerging skills that would have the most disruptive impact on an organization's workforce. The authors detailed those skills in AI and Machine Learning, Cloud Technologies, Connected Technologies,

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Fintech, IT Automation, Natural Language Processing (NLP), Parallel Computing, Proactive Security, Quantum Computing, and Software Development Methodologies, with many of those seeing triple digit growth in job openings.

According to the WEF, there will be a significant gap between analytics skills required by industry and the skill set of the current workforce (*World Economic Forum*, 2018). Paul and MacDonald (2020) also identify this gap in the realm of analytics skills and present analytics curricula to close the gap. Stanton and Stanton (2020) conclude that developing curriculum that address specific industry skill set requirements combined with opportunities for students to gain industry experience and certifications may present the best path for preparing students for future industry needs.

Mills, Chudoba and Olsen (2016) gathered data in 2011, 2015, and 2016 from randomly selected AACSB undergraduate programs in US universities, based on course catalogs and interviews with academic advisors. Most of the programs had added data science-related courses during the period surveyed; specifically, there was a 583% increase in big data analytics, a 300% increase in visualization, a 260% increase in business data analytics and a 236% increase in business intelligence. The authors noted the 2011 International Conference on Information Systems (ICIS) Panel Report, which found a disconnect between academia and industry needs and called for additional coursework in business analytics, data mining, SQL, and big data. Based on recent studies, the authors also noted the increase in industry demand over one year in 2014, for employees with these skills, which was nearly 90%; accordingly, there is a projected shortage of 1.5 million managers with big data experience.

Kang, Holden and Yu (2015) designed a master's degree program based on the four pillars of analytics: 1) Data Preprocessing, Storage & Retrieval, 2) Data Exploration, 3) Analytical Models & Algorithms, and 4) Data Products. Prerequisites for the program, provided through bridge courses, if necessary, included skills in object-oriented programming, database theory, web concepts and statistics. The three core required courses in the curriculum focused on projects which required students to apply what they learned in their classes to real-world problems of practical significance. For example, a student used natural language processing (NLP) to create an information retrieval system for searching holiday destinations based on specified criteria. After completing foundation and concentration coursework, students were required to produce a thesis, a project, or enroll in a capstone course.

Wilder and Ozgur (2015) provided a model identifying the "output of business analytics programs," i.e. industry needs for personnel in the field. They identified the data scientist, the data specialist, and the data-savvy manager as potential graduates of business analytics programs. While a data scientist requires a foundation in mathematics and computer science, a data specialist functions more as a traditional information technology (IT) worker and a data-savvy manager must know how to identify suitable questions to be answered through data analysis and how to frame these questions. Based on this research, they proposed six required courses: Data Management (tools such as SQL), Descriptive Analysis (statistics), Data Visualization (key indicators, scorecards, dashboards), Predictive Analytics (advanced statistics), Prescriptive Analytics (Spreadsheet Models), and Data Mining (CRISP-DM).

Meyer (2015) stated that there was no defined curriculum for data analytics. He described the subject as multi-disciplinary and developed a cross-college program with the potential to earn a degree in either the College of Arts and Sciences or the College of Business. Meyer concluded that the elements of data analytics are: data/database, statistics, operations research, computer science, and managerial strategy. Because these courses already exist, it is only necessary to add courses such as Data Visualization, Programming in R, or Customer Sentiment Analysis to initiate a program in data analytics.

Burns and Sherman (2019, 2022) reviewed numerous undergraduate BA programs and subsequently developed a model curriculum for a BA minor. That curriculum included prerequisite courses that covered statistics, IT foundations, and Excel, required courses that covered BA foundations and management science, and a buffet of electives that include options for marketing based courses, econometrics, or technology specific courses such as data visualization, statistical programming, database management, or specific BA applications.

The skills mentioned above are often not covered in traditional curricula for managers and industry specialists. Graduate programs such as Business Analytics can equip managers and analysts with the necessary skills to work with data effectively and can fulfill the demand for managers capable

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of analyzing intricate data sets and making strategic decisions based on their insights.

3. RESEARCH METHODOLOGY

This research was conducted using a "grounded theory" approach. Grounded theory was developed by the sociologists Barney Glaser and Anselm Strauss in the 1960's. In the grounded theory approach, conclusions are drawn and theories are produced by analyzing a body of data. In essence, the theories that are produced are "grounded" in the data (Glaser & Strauss, 1967).

For this project, the Graduate Management Admission Council (GMAC)'s program finder tool was used to identify the body of data whereby the grounded theory would be applied. The tool was used to search for non-MBA graduate programs in business analytics in the US, yielding an initial count of 192 programs. However, some of them were duplicates since some universities offer similar online and on-campus programs separately. We examined the websites of each program and removed duplicates and programs that were not relevant to this study.

The investigation focused on graduate programs in business schools that aimed to train managers and analysts with expertise in data. Therefore, any program that only focused on a specific area of analytics such as marketing, healthcare, supply chain, etc., was excluded from the investigation. Additionally, the study's scope was limited to programs that connected data science or analytics with business applications; as the GMAT tool also returned some non-business programs, programs exclusively focused on data science or analytics were not included. Furthermore, programs with limited data available on their public websites were also eliminated as required information could not be obtained. A total of 82 graduate programs in the United States that emphasize business analytics were examined. Appendix A shows a list of schools that were included in the study. During the grounded theory analysis, the researchers visited the website of each program and noted down the number of prerequisites, required courses, elective courses, and the total number of credits. They also took note of the class style and delivery mode. Whenever possible, the researchers recorded the required and elective courses, tools, and techniques taught in each program.

4. FINDINGS

In our investigation of 82 business analytics graduate programs, we found a wide range in the number of required courses. Figure 1 provides a detailed analysis of the total credits, required credits, and elective credits in these programs. While the total credits varied from 30 to 52, the most common range was 30-34 credits. The number of required and elective credits showed even greater variation, with the number of required courses ranging from six to 46 credits. However, the most common range of required credits was 26-31. Finally, Figure 1 shows that the total elective credits ranged from 2 to 25, with 6 to 11 electives being the most frequent category.

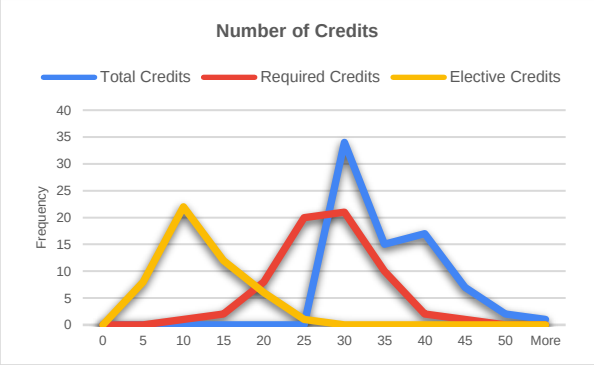

Figure 1 - Counts of Total, Required, and Elective Credits in BA Graduate Programs

Graduate programs in BA cover a range of topics. To determine the areas of coverage, the course titles and descriptions were analyzed using thematic analysis. A researcher analyzed the frequency of topics in each area across the BA programs. The results showed that the most common prerequisite course required was statistical analysis. The top five required courses are capstone project/practicum, database/data management, various analytics techniques, business analytics/data science, and data mining/machine learning. Figure 2 summarizes the top ten required courses and the top three elective courses in BA graduate programs based on the frequency of occurrence and classification in the programs

In most BA graduate programs (83%), students are required to complete a capstone project. Additionally, analytics techniques are covered in one or more specific courses in the majority of BA programs (73%). These analytics techniques include exploratory data analytics, predictive analytics, prescriptive analytics, probability and

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data modeling, forecasting, optimization, risk management and simulation, spreadsheet modeling, time series modeling, decision modeling, multivariate data analytics, and data streams analytics.

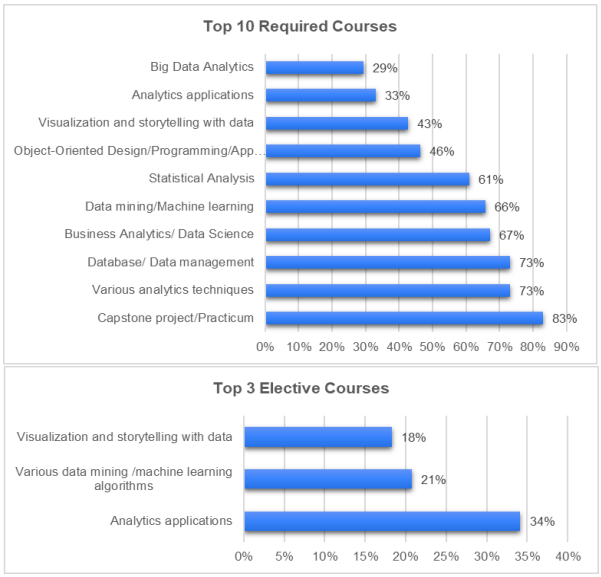

Figure 2 - Top Required and Elective Courses in BA Graduate Programs"

The required courses had less diversity and repetition compared to the elective courses. As illustrated in Figure 2, the most commonly offered electives were focused on specific applications of analytics, courses on particular data mining or machine learning algorithms, and visualization and storytelling with data. While specific applications of analytics were the most frequently offered elective course, programs provided a broad range of analytics applications, such as supply chain analytics, marketing analytics, accounting analytics, financial analytics, healthcare analytics, data analysis for security, government data and analysis, transportation informatics, climate and ecosystem monitoring, sports analytics, management analytics, data-driven quality management, HR and people analytics, game data analytics, fraud analytics, entertainment analytics, internet customer analytics, customer relationship management analytics, and competitive analytics, based on their program's focus and faculty specialties.

In the investigation conducted, it was found that only 60% of the programs examined stated their program format. Of the 50 programs that did list their program format, the online format was the most common with a percentage of 41%, while the on-campus format was the least common with a percentage of 21%. Furthermore, only 56% of the programs mentioned the tools and platforms that they cover. Python and R were the most frequently mentioned tools/platforms, however, other tools such as SQL, Tableau, SAS, SPSS, and Excel were also utilized in different programs as either an elective or a required course. Figure 3 provides a comparison of the percentage of different program formats and the usage of tools in BA programs.

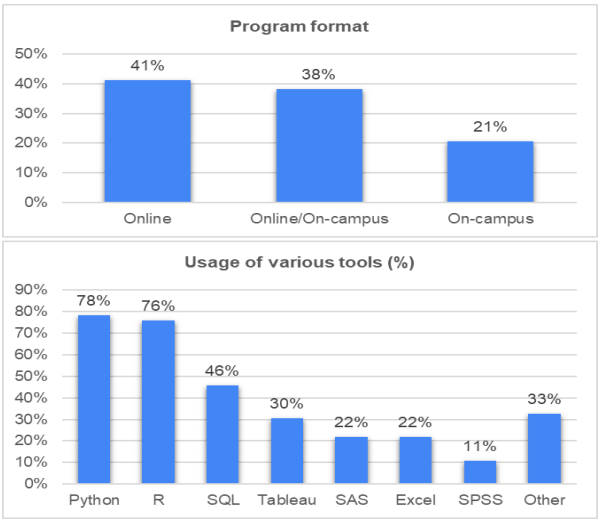

Figure 3 - Program Format and Usage of Tools of BA Graduate Programs Who Listed This Information

5. A COMPETENCY MODEL FOR DATA-SAVVY MANAGERS

The first goal of this research is to review the current state of BA graduate programs and to determine if they are, in general, competent and meeting the needs of industry. Hindle et al, define the field of Business Analytics as "the intersection of a variety of disciplines" including Information Systems (Hindle et al 2020). In addition, the Business Analytics discipline is frequently housed with and taught in conjunction with Information Systems. For this reason, a tool that can be used to test the competency of BA graduate programs is the ACM/AIS Competency Model. Appendix B shows the ACM/AIS Competency Model (Leidig and Salmela, 2020). The model was developed to "provide guidance regarding the core content of the curriculum". Here, the model is applied to the findings of the research in order to gauge the aggregate competency of the programs.

Figure 4 shows the percentage of programs that cover different areas of the ACM/AIS Competency

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Model. Not surprisingly, all programs cover Data, while most programs cover Integration and Foundation. However, Technology and Organizational Domain were the least covered competencies. Appendix C provides more details on the topics covered by BA graduate programs and the frequency of them.

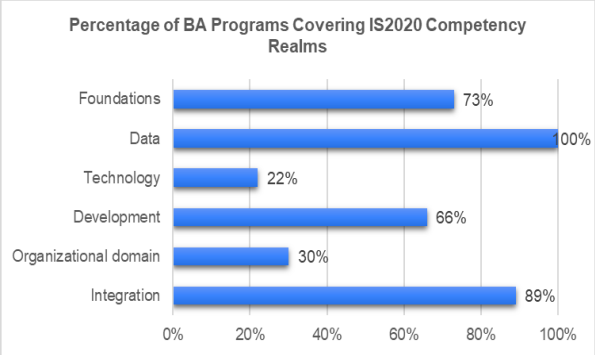

Figure 4 - ACM/AIS Competency Model Area Coverage by BA Graduate Programs

Some observations can also be made when comparing the material covered by graduate BA programs to the current and projected needs of industry. Comparing industry needs to the typical curriculum can give us a measure of how well BA programs are doing in preparing students for careers in the workforce. It appears that most programs are doing a decent job of preparing students for current high-demand jobs, with most programs covering foundational analytics, data, and integration topics in the BA arena. These are all important skills currently high on the list of industry needs. However, the research shows that there may be a shortage of coverage of topics and skills needed for new and advancing technologies such as AI, machine learning, process automation, user experience and human-machine interaction, robotics, and blockchain.

In pursuit of the second goal of this research, Figure 5 illustrates a BA competency framework tailored for technically proficient and analytically skilled managers. The framework draws inspiration from the high-level ACM/AIS Competency Model and encompasses six main competency areas: foundation, data, technology, development, organizational domain, and integration. However, the details of each area have been customized and expanded to encompass specific competencies for data-savvy managers.

Figure 5 - Competency Model for Data-Savvy Managers

6. A MODEL GRADUATE CURRICULUM IN BUSINESS ANALYTICS

To complete the second goal of this research, Figure 6 presents a model curriculum for a graduate BA program. The model curriculum is a 30-credit program comprised of seven required courses and three electives. The model also includes an additional six credits of prerequisite foundation courses that can be waived based on the background of the student. The program is intended as a standalone Master of Science (MS). The purpose of the model is to introduce a curriculum that prepares the student for the job market needs outlined previously in the literature review. The model is meant to represent the ideal

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graduate BA program based on what the programs included in the study are doing.

The role of the prerequisite courses would be to prepare the student for the program. The prerequisites include Basic Statistics, and Data & Technology Literacy. The Basic Statistics course would cover statistical theories and techniques commonly used in the analysis of business data. Emphasis is on descriptive measures, probability theory, estimation techniques and forecasting methods, hypothesis testing, and time series analysis. The Data & Technology Literacy course is designed to cover basic IT foundational topics for students with no academic or experiential technology experience. Topics would include computer hardware and software architecture, fundamental data concepts including organizing data, telecommunications and networks, types of systems and their development, and the role of information technology in business and society. In addition, students will learn to navigate Microsoft Excel software and become familiar with Excel's features and capabilities.

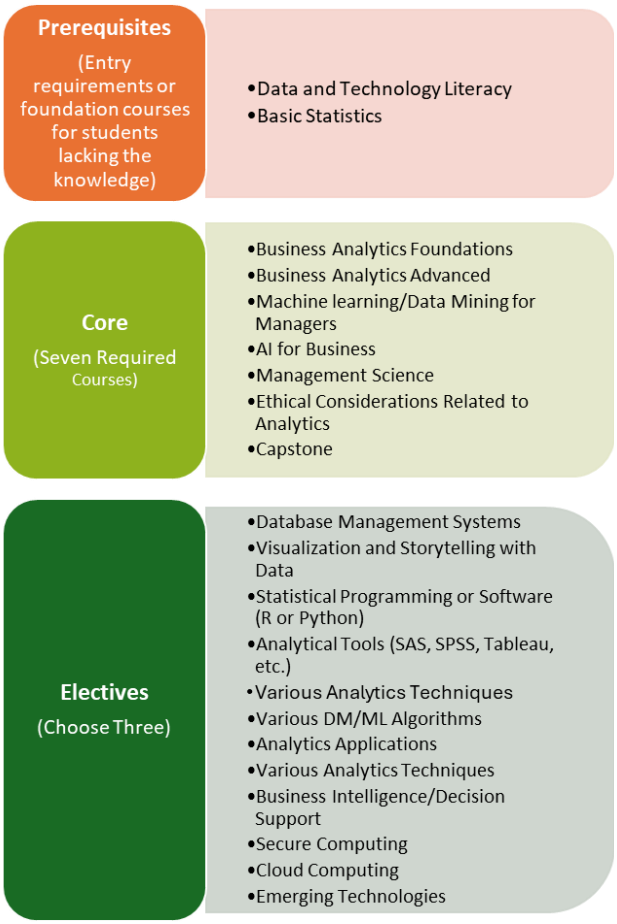

Figure 6 - A Model Curriculum for a Graduate BA Program

Once students have fulfilled the prerequisites, the model curriculum suggests seven required courses: Business Analytics Foundations, Business Analytics Advanced, Machine Learning/Data Mining for Managers, AI for Business, Management Science, Ethical Considerations Related to Analytics, and a capstone course.

The Business Analytics Foundations course would provide students with the fundamental concepts and tools needed to understand the emerging role of business analytics in organizations. The course would cover managerial statistical tools in descriptive analytics and predictive analytics, including probability distributions, sampling and estimation, statistical inference, and regression analysis. Students would also learn how to communicate with analytics professionals using basic data visualization techniques to effectively use and interpret analytic models and results for making better business decisions.

The second required course, Business Analytics Advanced, would provide students with advanced concepts and tools needed to understand the role of data analytics in organizations. Topics would include forecasting, risk analysis, simulation, data mining, and decision analysis. Emphasis is on applications, concepts and interpretation of results as well as conducting statistical analyses.

The third required course, Machine Learning/Data Mining for Managers, covers two important topics for BA graduate students. Data mining involves analyzing large blocks of information to identify meaningful patterns and trends. Those patterns and trends are then used to provide valuable insights. Machine learning techniques can play a key role in data mining when used to identify patterns and trends. This course would cover the various machine learning techniques and how they can be applied to data mining in order to recognize important insights into large datasets.

The fourth required course, AI for Business covers the fundamentals of AI and its various subfields. Students will also gain insight into real-world applications of AI in different industries and functional areas. Furthermore, students will develop the ability to formulate AI strategies for organizations, including selecting appropriate AI technologies and implementation approaches. They will learn how to collect, clean, and preprocess data for AI projects and gain practical experience building AI models and algorithms.

The fifth required course, Management Science, involves strategic conceptualization, decision-making and analysis of processes within the business and its environment. This course introduces quantitative and computing techniques that contemporary managers use to create models representing the business problems they need to solve. The emphasis of this course will be on the integration and development of modeling skills including problem recognition, data collection, model formulation, analysis, and communicating the results. Building logical thinking and quantitative skills are among the objectives of this course.

The sixth course, Ethical Considerations Related to Analytics, would cover the ethical implications of business analytics. Using the ethical frameworks of utilitarianism, deontological ethics and virtue ethics, students will investigate some of the more common areas in which ethical conflicts arise in the business analytics setting and propose a number of methodologies for addressing them.

The final required course is a capstone course. This would be a project based course. Alternative capstone projects could include research papers, case studies, creative works, internships, and field placement projects. The projects are designed to challenge students to think critically, solve complex problems, and demonstrate their readiness for work in the BA field.

The elective courses in the model curriculum help the students develop skills that increase their knowledge of a specialized area within their field. The model curriculum suggests three electives, many of which are "technology based". These courses help to define the utilization of analytical tools. For instance, Statistical Programming (R or Python), Database Management Systems, SQL, Machine Learning, Data Mining, Data Visualization (any effort to help people understand the significance of data by placing it in a visual context), and Statistical Software are all courses that help the student understand technologies important to the analytics process. Additional technology based courses such as Secure Computing, Cloud Computing, and Emerging Technologies could also be included.

The model curriculum also suggests that application based courses should be included as electives. Appendix D provides a list of potential application courses. Appendix D is not intended to be exhaustive given the pervasive nature of analytics. However, some examples of such courses would include marketing based courses, such as e-commerce or e-marketing, financial based courses such as Econometrics , healthcare analytics, sports analytics, security analytics, etc. The list is endless given that analytics can be applied to potentially any discipline.

7. CONCLUSION

The purpose of this study was to investigate the current state of graduate level business analytics education in the United States by presenting how higher education institutions are addressing the growing demand for analysts and data-savvy managers in the job market. A detailed investigation of 82 programs focused on graduate business analytics education was conducted and the findings were subsequently reported. The study found that programs related to training data-savvy managers exhibit a high degree of variability and that this variability can manifest in various ways, such as the course content, program structures, required credits, and the tools and techniques being used. The findings were summarized and tabulated to show the typical number of credits, the typical required courses, and the typical electives included in a graduate business analytics program.

The findings were then analyzed through the scope of the ACM/AIS Competency Model (Leidig and Salmela, 2020). That analysis showed that the while some core competencies (data, integration, foundation) are typically covered, other areas such as technology and organizational domain were covered less often. The findings were also compared to the literature review on current and projected needs of industry. This exercise showed that most programs are doing a decent job of preparing students for current high-demand jobs by covering foundational analytics, data, and integration topics in the BA arena. However, the research showed that there may be a shortage of coverage of topics and skills needed for new and advancing technologies such as AI, machine learning, process automation, user experience and human-machine interaction, robotics, and blockchain. Based on these results, a competency model was developed to measure BA graduate programs used to prepare data-savvy managers.

Finally, a model BA graduate program curriculum was developed. The model suggests two prerequisite courses, seven required courses, and three electives. The model was developed based

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on the research data collected and subsequent findings. The model is presented in order to inform and guide institutions looking to develop a BA graduate program to train technically proficient and analytically skilled managers. It should be noted that how an academic unit goes about designing the graduate BA program that best fits its institution will be subject to many variables such as workforce needs, faculty expertise, student demographics and backgrounds, institutional resources, and industry collaborations. Ultimately, the goal of a graduate degree, to prepare students for a career in their chosen field, must serve as a driving force in curriculum development.

As the field of Business Analytics continues to expand and the demand for skilled workers in the discipline grows, it is expected that more and more institutions will introduce graduate programs in BA. It is the hope of these researchers that this project will aid in that effort.

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Appendix A - Schools Included in the Study

American University	Seton Hall University
Arizona State University	Shepherd University
Babson College	Southern Illinois University
Bentley University	St. Peter's University
Boston University	Stevens Institute of Technology
Brandeis University	Syracuse University
California Polytechnic State University - San Luis Obispo	Tufts University
Carnegie Mellon University	Tulane University
College of William & Mary	University of Alabama-Huntsville
Columbia University	University of California - Davis
Drexel University	University of California - Irvine
Duke University	University of California - Los Angeles
Emory University	University of Colorado Boulder
Fairfield University	University of Connecticut
Florida State University	University of Dallas
George Washington University	University of Hartford
Georgetown University	University of Illinois at Chicago
Georgia College	University of Illinois at Springfield
Georgia Institute of Technology	University of Indianapolis
Hult International Business School	University of Iowa
Iowa State University	University of Louisville
Kent State University	University of Maryland
Loyola Marymount University	University of Massachusetts - Amherst
Loyola University of Chicago	University of Massachusetts - Lowell
Mercer University	University of Miami
Montclair State University	University of Michigan - Dearborn
New Jersey City University	University of Minnesota
New York University	University of North Carolina - Charlotte
North Carolina State University	University of San Diego
Northeastern University	University of Southern California
Northwestern University	University of Texas at Dallas
Pennsylvania State University - Great Valley	University of Tulsa
Purdue University	University of Utah
Rochester Institute of Technology	University of Washington - Seattle
Rutgers University	University of Washington - Tacoma
Saint Joseph's University	University of Wisconsin - Superior
Saint Mary's College of California	Villanova University
San Francisco State University	Virginia Polytechnic Institute and State University
Santa Clara University	Washington University in St. Louis
Seattle University	West Virginia University
	William Paterson University
	Yeshiva University

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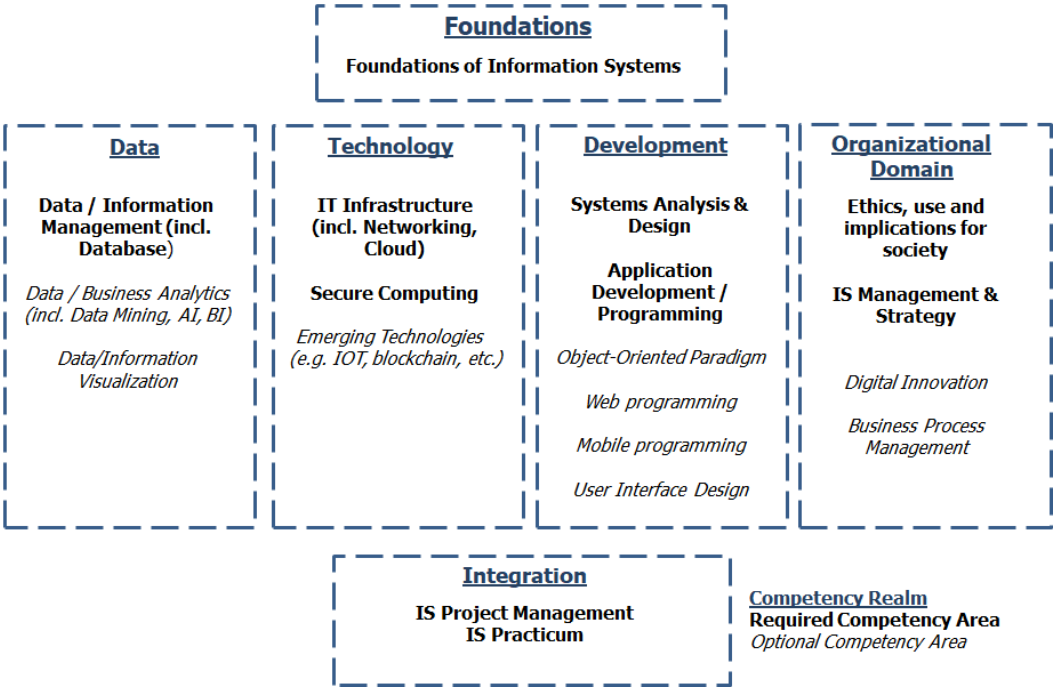
Appendix B - ACM/AIS Competency Model (Leidig and Salmela, 2020)



Appendix C – Percentage of Topics Covered With At Least One Course

Category	Topic	Pre-Req.	Req.	Elec.
Foundations	Statistical Analysis	6%	61%	2%
	IS Intro/Managing Digital Organizations/MIS	1%	11%	2%
Data	Business Analytics/ Data Science		67%	
	Database/ Data management		73%	4%
	Data mining/Machine learning		66%	6%
	Various DM/ML algorithms		16%	21%
	AI		6%	6%
	BI/Decision support		12%	5%
	Knowledge management		1%	1%
	Visualization and storytelling with data		43%	18%
	Big Data Analytics		29%	12%
	Various analytics techniques		73%	13%
	Analytics applications		33%	34%
	Special Topics in Data Analysis		7%	12%
Technology	Infrastructure (network)		4%	
	Cloud computing		4%	10%
	Secure computing		2%	9%
	Emerging technologies (IoT, Blockchain, etc.)		4%	5%
Development	System analysis & design		7%	1%
	Enterprise systems		2%	7%
	Object-Oriented Design/Programming/App Dev.	2%	46%	7%
Organizational Domain	Ethics, use & implications for society		17%	6%
	Management & strategy		1%	
	Digital innovation			
	Business process management		5%	4%
Integration	Project management		11%	12%
	Capstone project/Practicum		83%	2%
Others	Mathematical Modeling		1%	
	Operations Research		2%	1%
	Special Topics in IS			1%
	E-Commerce			2%
	Leadership and change management		13%	5%
	Strategy and analytics		16%	6%
	System Administration/IT operations		1%	1%
	Research Methods		4%	6%
	Communications		18%	1%
	Experimental Design		2%	1%
	Cognitive Computing			1%
	Data and Information Quality		1%	2%
	Multivariate Statistics		5%	2%
	Game Theory and Strategic Decision Making		1%	4%
	Operation Management	1%	9%	9%
	Accounting	4%	7%	9%
	Economics or Finance	5%	12%	13%
	Economics Models		6%	10%
	Organizational Behavior		4%	2%
	Marketing	5%	6%	5%
	Business Essentials/Fundamentals	2%	2%	
	Negotiation		1%	

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Appendix D – Potential Analytics Application Based Electives

Accounting Analytics
Climate and Ecosystem Monitoring
Competitive Analytics
Customer Relationship Management Analytics
Data Analysis for Security
Database Marketing
Data-driven quality management
Entertainment Analytics
Financial Analytics
Fraud Analytics
Game data analytics
Government Data and Analysis
Healthcare Analytics
HR and People analytics
Internet Customer Analytics
Management Analytics
Marketing Analytics
Social Network Analytics
Sport Analytics
Supply Chain Analytics
Transportation Informatics