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ARE DECISION SCIENCES INCORPORATED SUFFICIENTLY INTO BUSINESS SCHOOL PROGRAM DESIGNS IN THE RECENT SURGE OF BUSINESS ANALYTICS FIELD?

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Abstract
In this article, we research 543 AACSB accredited business schools in the US and Canada to understand if Decision Sciences including Supply Chain and Operations Management have adequate coverage in current curriculum designs of Business Analytics programs, to summarize skill sets covered in a typical Business Analytics degree and concentration, and to give perspective to business schools that are at the early stages of designing their Business Analytics programs. This study is unique in the sense that it is the first time a general study is conducted over the entire spectrum of AACSB accredited programs and this study is timely since there are many Business Analytics programs at their early design state that can benefit from this study.
Keywords: Business Analytics, Decision Sciences, Curriculum Design, Operations Management, Supply Chain Management.

1. INTRODUCTION

For the last decade, there has been an increasing interest in Business Analytics and related areas such as Big Data and Data Science in academia, industry and consumers alike (Dubey et al., 2016; Ghazal et al., 2013; Provost & Fawcett, 2013). According to the survey conducted by Gallup for the Business Higher Education forum, by 2021 up to 69% of employers will be looking for data science and analytics skills in recent graduates, while only 23% of higher education faculty states all of their graduates will have these skills (PwC, 2017). Moreover, according to the PwC's 6th Annual Digital IQ survey, a significant percentage of the 1400 survey takers among business leaders, placed firmly data analytics as the second most important strategic technology for their firms (PwC, 2011). At the same time, another report by McKinsey Global Institute projects up to 40% growth in collected data per year for the foreseeable future (McKinsey, 2011). In a similar fashion, a MIT Sloan Management Review and IBM Institute for Business Value large-scale survey of more than 3000 executives from 30 industries and 100 countries showed that top achieving firms used analytics five times more heavily than the least achieving firms (LaValle et al., 2011). Apparently, there will be more data, more applications and greater need of qualified human capital in the field of Business Analytics, yet there will be a shortage of graduates with necessary skills unless the higher education gears up and supplies the demand in time.

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Perhaps, in a response to the increasing corporate interest in Business Analytics, many higher education institutions have been redesigning their existing programs and introducing new ones in the last couple of years. Out of 543 business schools located in the US and Canada with the Association to Advance Collegiate Schools of Business (AACSB) accreditation studied in this paper, 74 have undergraduate level Business Analytics and related programs, 102 have at least one graduate level Business Analytics and related programs, and 97 have Business Analytics and related concentrations in their MBA programs. These are significant numbers. Most of the programs we analyzed are recently minted programs that were launched in either the last 3 to 5 years, or are about to start enrolling their first students in the upcoming year. Even though, AACSB accreditation is voluntary, it has become a "gold standard" for the US business schools (Hunt, 2015; Jantzen, 2000; Lindsay & Campbell, 2003; White et al., 2008). According to AACSB, the accreditation process involves multiple steps and assessments of "a school's mission, faculty qualifications, and curricula" and requires rigorous "self evaluations, peer reviews, committee reviews, and the development of in-depth strategic plans" (AACSB, 2017).

The question remains however, how many of these recently developed Business Analytics programs actually cover skills and knowledge in the traditional areas of Decision Sciences including Operations Management and Supply Chain Management. In this paper, we investigated the current status of their coverage in the Operations and Supply Chain Management and related subjects among peer organizations accredited by AACSB in the US and Canada. By focusing our study in the US and Canada with similar education systems and employment markets, we are able to minimize the risk of leaving out any unpredictable factors that may influence the program designs in other countries, which we are not familiar with. By limiting our study to the AACSB accredited business schools, we still have a large group of programs that are top-tier and that follow certain rigorous guidelines set by a single accreditation body. Our sample size of 543 schools located in the US and Canada is significant compared to the total number of 1653 business schools in the US and 82 in Canada (Akalin, et al., 2016; Farmer & Abdelsamad, 2014).

2. LITERATURE REVIEW

2.1 Terminology

The term "Business Analytics" has similarities with multiple subject names including Data Science, Data Analytics, Big Data, Business Intelligence and etc. (Chen et al., 2012). Some of these terms can be used interchangeably such as Data Analytics and Business Analytics, some of the terms are continuation of each other such as Business Intelligence and Business Analytics, and some of them show closely related content with a different domain or emphasis such as Business Analytics and Big Data. The term "Business Intelligence" was popularized by business and academia in the 1990^{th} followed by the current trend of using Business Analytics in the late 2000^{th} to encapsulate what was covered in Business Intelligence and more recent additions to the subject (Chen et al., 2012; Mortenson et al., 2015; Pascual & Ribas, 2015). The term "Data Science" may refer to a systematic approach and guidelines in order to bring information and knowledge from existing data, whereas the term “Data Mining” refers to the literal process of unlocking knowledge from data (Provost & Fawcett, 2013). “Big Data” refers to increased volume, velocity and variety of data collection and processing (Russom, 2011). There are multiple sources of data collection. For instance, big data can originate from human and non-human data collections such as through web usage of customers, social networks, mobile platforms (George et al., 2014). In fact, up to 95% of big data is unstructured such as images, pictures, videos, text and audio (Gandomi & Haider, 2015). As a result, terms like “Web Analytics” and “Text Analytics” are introduced to focus on certain data sources such as web sources or text sources. Similarly, a new field of “Supply Chain Analytics” is emerging to capitalize a broad set of new and existing analytics tools to create additional business value for the firm throughout the supply chain (Chae et al., 2014). In this context, Supply Chain Analytics refers to application of business analytics techniques in answering questions or problems related to the SCM (Trkman et al., 2010). In the case of Supply Chain Analytics, data sources can be through web, text or other sources but they are being used in the same field that is Supply Chain (Chae, 2015).

Since there is tremendous amount, variety, and velocity of data, harvesting data, analyzing it, and making right and timely decisions based on analyzed data is becoming even more important than before (Lamba and Singh, 2016; Schoenherr & Speier-Pero, 2015). However, the lack of data quality and substandard data collection may create tremendous problems and represent loss of opportunities for supply chains and other fields (Hazen et al., 2014; Kache & Seuring, 2017). Information technology, knowledge sharing and relationship networks are three drivers of service innovation (Hsiao, 2010; Kandampully, 2002), and once again Business Analytics provides tools for them. The relationship between Big Data, Business Analytics and Decision Making is an interesting area that has not been fully explored. There is a strong case that data driven decision-making leads to improved business performance (Debortoli et al., 2014; Provost & Fawcett, 2013). As a result, Business Analytics will have an increasing impact on decision-making and operations management for many organizations (Liberatore & Luo, 2010).

2.2 Connection of Business Analytics to Traditional Decision Science Areas Such as Supply Chain and Operations Management

Evans and Lindner describe Business Analytics as the next frontier for Decision Sciences, and universities follow the trend by offering new degrees in Business Analytics and even change their departments’ names to better suit the new environment (Evans & Lindner, 2012). This is not surprising, since data collection and its analysis are the necessary preconditions of better decision-making, hence increasing profitability for the firm (Huisman, 2015; Popovič et al., 2012; Waller & Fawcett, 2013). The application list of Business Analytics is already long and promising including in healthcare, marketing, financial, human resources, supply chain, manufacturing, strategic decision making and many other areas (Al-Sakran, 2015; O’Donovan, 2015; Roden et al., 2017).

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The ever growing consensus further confirms the relevance of Business Analytics tools in traditional areas of decision making such as Supply Chain and Operations Management (Hahn & Packowski, 2015; Hazen et al., 2016; Lamba & Singh, 2017; Trkman et al., 2010). Supply Chain Management can benefit from Business Analytics since understanding the inefficiencies throughout the supply chain is achieved by using Business Analytics tools, which creates opportunities for better designing and managing of supply chains (Chae & Olson, 2013; De Oliveira, 2012; Trkman et al., 2010; Waller & Fawcett, 2013; Zhong et al., 2016). Similarly, firms use Business Analytics tools to better understand and manage certain supply chain management risks (Mani et al., 2017; Tsao, 2017). In general, better forecasting, production and distribution planning and information processing help to mitigate and manage operational risks in supply chains (Das & Lashkari, 2017). For instance, using real-time decision support systems in their procurement, firms optimize their supply chains (Barbosa et al., 2017; Formby & Malhotra, 2016). Such decision support systems heavily rely on Business Analytics tools, for instance in forecasting, planning and information processing (Meriton & Graham, 2016). Additionally, Business Analytics is used in managing supply chains in reducing and optimizing inventory and shortages (Davenport, 2006). Supply chain is not necessarily a new field for Data Analytics providing that supply chain encompasses manufacturing field with a long history of quantitative approaches (Davenport & O'Dwyer, 2011; Olson, 2015). But there is further need of research in bringing more insights about how to further benefit Business Analytics tools in Supply Chain Management (Arunachalam et al., 2017). Considering, ever-increasing data production and need to access real-time information produced within supply chain echelons (Beamon, 2008), the necessity of Business Analytics is apparent.

2.3 Application

Business Analytics education can be studied in business schools within traditional areas such as operations research, management science, econometrics and etc. (Holsapple et al., 2014). However, that is a narrow view; in fact, Business Analytics can be studied considering its multiple dimensions in terms of domain such as Web Analytics, Marketing Analytics and Supply Chain Analytics; in terms of orientation such as prescriptive and descriptive analytics or in terms of technique such as data mining and regression analysis (Holsapple et al., 2014). The Supply Chain Management discipline and its education have changed drastically over the years (Fawcett & Rutner, 2014). Business schools are racing to include more analytics through their curriculum. Our paper investigates if they include accompanying Decision Sciences such as Operations Management and Supply Chain Management adequately as well.

3. METHODOLOGY

3.1 Data Collection

This research is focusing on AACSB schools located in the US and Canada. At first, we acquired the list of accredited schools from the official website of the AACSB. Based on this list of hundreds of schools, we looked at the ones that offer Business Analytics programs in undergraduate and graduate levels including MBA programs.

Based on the official, publicly available data from the Association to Advance Collegiate Schools of Business (AACSB) as of April 2017, there are 521 AACSB accredited business schools in the US. Additionally, there are 22 AACSB accredited business schools in Canada. In total there are 255 business schools AACSB accredited outside of the US and Canada.

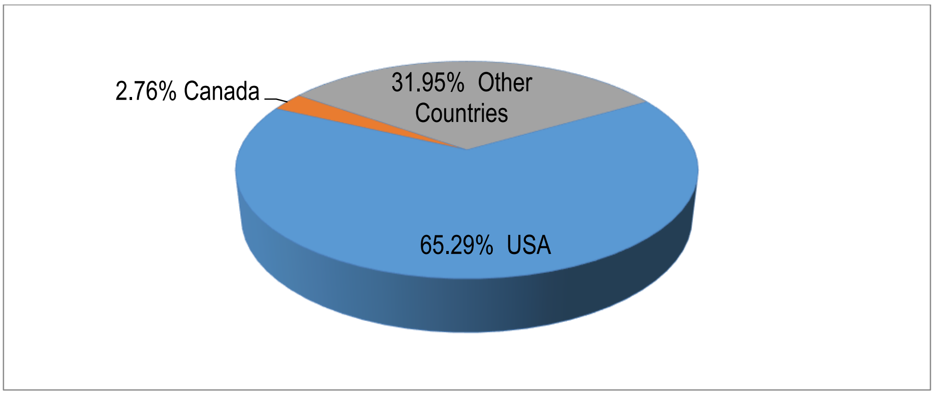

FIGURE 1 - PERCENTAGE OF GEOGRAPHIC DISTRIBUTION OF AACSB ACCREDITED BUSINESS PROGRAMS

As it is highlighted in the Figure 1, the vast majority of the AACSB accredited schools are located in the US with 65.29%. This is not a surprising result given that the AACSB has originated in the US and university programs in other countries except for the US and Canada may or may not need such accreditation since there is potentially another accreditation body or bodies in their countries. The reasons why universities in other countries except for the US and Canada may opt to add AACSB accreditation are beyond the scope of this paper. However, a previous study listed the percentage of the US schools compared to the general accredited population in the world at 71% in 2015 (Akalin et al., 2016), the current 65.29% represents more wide spread distribution of AACSB accreditation in the world.

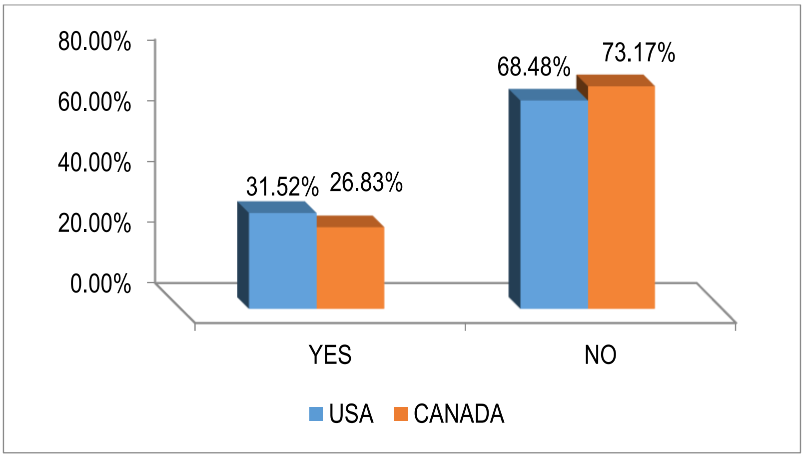

FIGURE 2 - AACSB ACCREDITATION IN THE US AND CANADA

Out of 1653 business schools in the US, 521 are accredited by AACSB. In a similar fashion, out of 82 business schools in Canada, 22 are AACSB accredited. As it is highlighted in the Figure 2, slightly higher percentage

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(31.52%) of business schools in the US are accredited by AACSB compared to business schools in Canada (26.83%). Again, this is not surprising since AACSB originated in the US. Both percentages of accreditation show how rigorous the AACSB accreditation is, and still our study is able to capture a significant portion of the US and Canada "universe" of the business schools. We were able to access 532 schools located in the US and Canada. Only 11 schools could not be reached through web search and other methods of contacting. These schools are mainly located at few non-English speaking parts of the US and Canada, namely Puerto Rico in the US and Quebec in Canada; or have not properly functioning websites or websites under construction, and do not have any clear contact information. As it is highlighted in the Figure 3, this represents 98% of school coverage in this study, which is remarkable.

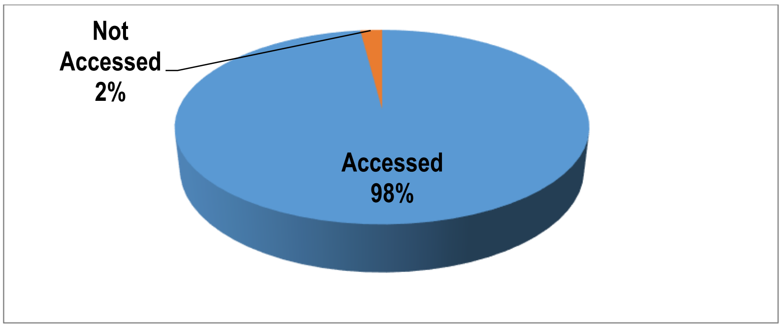

FIGURE 3 - PERCENTAGE OF BUSINESS SCHOOLS STUDIED IN THE PAPER

In terms of demographics of the programs each university offers, all of them offer either a graduate business program or an undergraduate business program. However, not all of them offer both undergraduate and graduate programs. In fact, as it is highlighted in the Figure 4, only 24 of them (4.5%) do not offer any undergraduate business program; and only 40 of them (7.5%) do not offer any MBA program; 160 of them (30%) offer a PhD program whereas 409 of them (76.9%) have a separate MS/MA program other than their MBA programs.

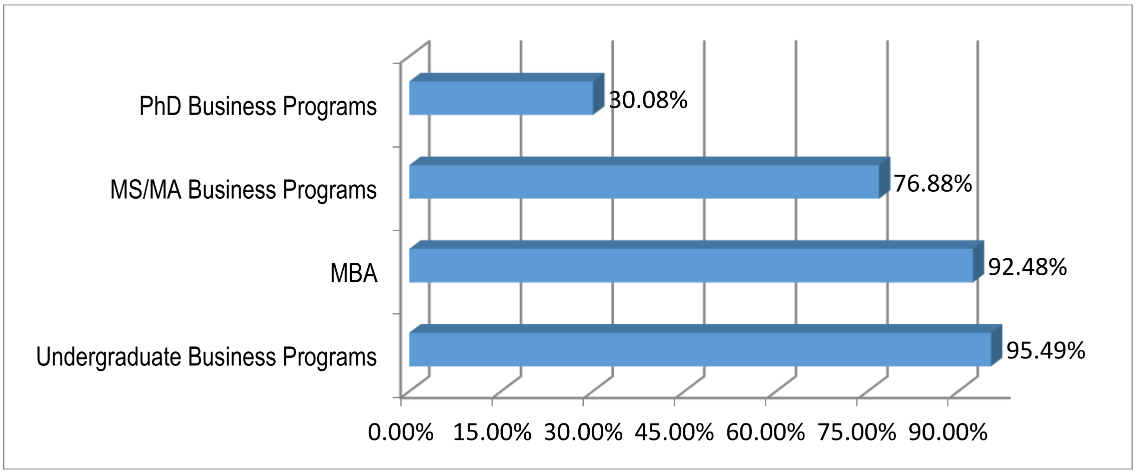

FIGURE 4 - PROGRAM OFFERINGS BY THE PROGRAM LEVEL

In order to understand, how widespread Business Analytics programs and concentrations are among business schools in the US and Canada, we looked at each business school's curricular offerings related to Business

Analytics. As it is presented in the Figure 5, 14.6% of business schools that have undergraduate degree have a separate degree or concentration related to Business Analytics so far. The numbers are a bit better for the graduate level: 24.9% of business schools that have at least one MS/MA degree have a separate MS/MA degree in Business Analytics, and 19.7% of business schools with a MBA degree have a specialized concentration in Business Analytics. The higher percentage in graduate degrees may indicate either higher demand by students or business partners, or it may indicate that business schools consider Business Analytics fitting more to a graduate standing for one reason or another.

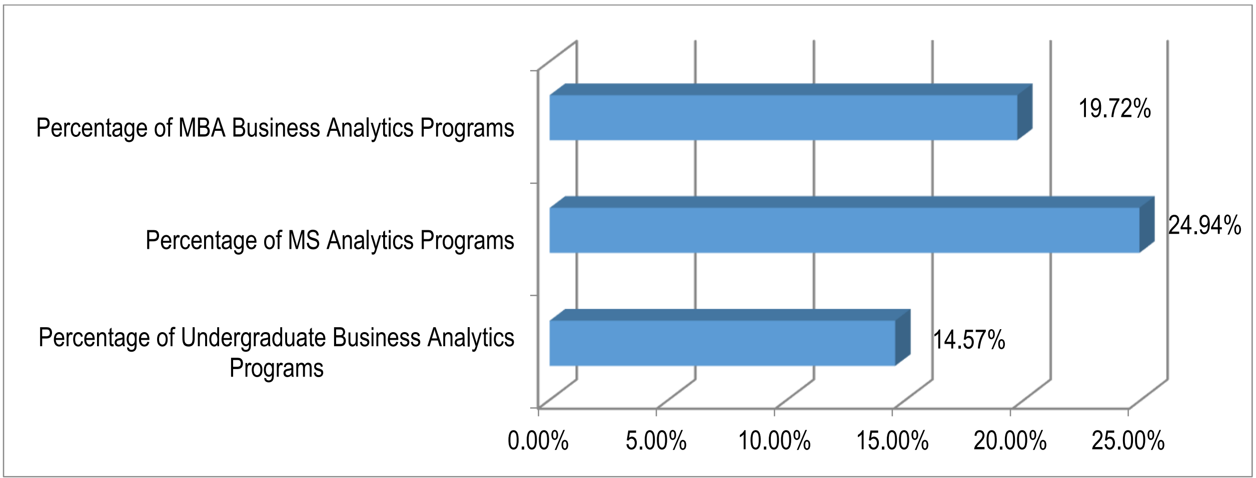

FIGURE 5 - SPREAD OF BUSINESS ANALYTICS PROGRAMS AND CONCENTRATIONS IN BUSINESS SCHOOLS

3.2 Data Analysis

Our main interest in this study is to understand, which courses a typical Business Analytics program includes in studies. This is important by the following reasons:

- To understand if current Business Analytics curriculum designs provide adequate coverage of Supply Chain, Operations Management and Decision Making.
- To summarize skill sets covered in a typical Business Analytics degree and concentration, so that other studies can compare them with skills firms are looking for.
- To give perspective to those business schools that are at the early stages of designing their Business Analytics programs.

We do not limit ourselves by undergraduate, graduate, MS/MA or MBA levels. Being not limited by a certain degree or certain level, can help to draw a larger picture. Obviously, a MS/MA degree in Business Analytics would cover more breadth and depth than an undergraduate concentration in Business Analytics can offer, since the number of classes is much limited because of the other graduation requirements an undergraduate student has to complete in other areas such as in general education, business core, major classes and etc. However, because of the very same limitation, programs can only cover certain skills, and we are interested in understanding these "core" skills business schools choose to include. Similarly, by covering MS/MA programs on the other end of the spectrum, we can understand the breadth of programs in terms of their coverage. Additionally, in our analysis, we studied the program content separately for the core classes and for the entire program. Core classes are the classes business schools require each student to complete in their program (undergraduate major, undergraduate concentration, MBA concentration and MS/MA majors in Business Analytics and related programs). There are cases for instance, where a MBA program offers a Business Analytics concentration with two core classes and two electives from a pool of classes, whereas another program lists all of their courses in the Business Analytics program as required courses. By extending the coverage of our study and including multiple programs in multiple schools, on multiple levels, we are able to distinguish, what are core skills schools consider each student needs to take, and what are the rest of the classes available to them to see the breadth of the program.

When we created subject categories for the list of classes, we looked at the title of classes and other available information such as course descriptions, syllabuses, and program information sheets. Using cluster analysis, we came up with a fairly large number of subcategories. From there, we further grouped them into larger categories so they can be used to generalize the core and elective courses. The list with course title examples for each category is provided in the Appendix A. The Table 1 lists names of the categories without course title examples.

TABLE 1 - LIST OF CATEGORIES FOR BUSINESS ANALYTICS PROGRAM COURSES

Accounting Related Courses	Information Management and Information Technology
Application and Practicum	Information Security
Artificial Intelligence / Machine Learning / Computational Learning	Internship / Capstone / Fieldwork / Professional Seminar
Big Data	Marketing Related Courses / Marketing Analytics
Data Mining	Operations Management / Operations Research / Spreadsheet / Decision Making /Simulation /Supply Chain Management / Quality Management
Data Visualization and Communication	General Business Analytics / Data Analysis
Database and Data Management	Predictive and Prescriptive Analysis /Analytics
Economics Related Courses	Software and Enterprise Systems
Finance Related Courses	Specialized Analytics Courses
General Business Intelligence	Statistical and Research Methods and Data Collection
General Management Related Courses	Web / Text Mining
General Statistics	Other
Health Science Related Courses	

There are many courses that fall into multiple categories. Since business schools can only offer certain number of courses in their programs, it is logical for them to combine multiple categories into a single class. In that case, however, the coverage is likely to be less for a class covering multiple categories compared to the one that covers a single category. When we calculated the coverage of each program core, we divided the score by the number of categories each class is trying to cover. We calculated the core and the entire program coverage scores using this adjusted score method.

4. RESULTS

We started with investigating the core classes of all Business Analytics and related programs (BS, MS, and MBA) in AACSB accredited schools. We were particularly interested in the composition of their program (both core and electives) to assess their content. After careful analysis of more than 532 business schools and their programs, we could finally assess the content of their Business Analytics programs. In the Table 2, we summarized the results for the core classes. Percentages in the Table 2 refer to what percentage of the core classes is under the certain category.

TABLE 2 - LIST OF CATEGORIES RANKED BY THEIR CONTENT SHARE IN THE CORE CLASSES

Categories	Percentage	Categories	Percentage
Operations Management / Operations Research / Spreadsheet / Decision Making /Simulation /Supply Chain Management / Quality Management	14.85%	Big Data	2.92%
General Business Analytics / Data Analysis	13.68%	Information Management and Information Technology	2.06%
Database and Data Management	9.48%	Economics Related Courses	1.85%
Data Mining	7.61%	Internship / Capstone / Fieldwork / Professional Seminar	1.61%
Marketing Related Courses / Marketing Analytics	5.35%	Finance Related Courses	1.59%
Specialized Analytics Courses	4.82%	Web / Text Mining	1.44%
Software and Enterprise Systems	4.61%	Accounting Related Courses	1.27%
Data Visualization and Communication	4.58%	Application and Practicum	0.92%
General Management Related Courses	4.47%	Artificial Intelligence / Machine Learning / Computational Learning	0.81%
General Statistics	4.07%	Health Science Related Courses	0.45%
Predictive and Prescriptive Analysis /Analytics	4.00%	Information Security	0.14%
General Business Intelligence	3.91%	Other	0.00%
Statistical and Research Methods and Data Collection	3.51%		

Surprisingly, the top category in the Table 2 is what we can call as the broader sense Decision Sciences and related areas group. Quantitative methods can be used to describe the group as well. The reason we grouped Operations Management, Operations Research, Supply Chain Management, Quality Management, Spreadsheet Modeling, and Decision Making under the same umbrella term is because often these classes are taught by the

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same faculty. In many business schools, they are under the same discipline units. The initially surprising result is that the Decision Science group looks like it provides the most content even more than the one provided by the "General Business Analytics". However, we need to remember there is still no general consensus on how to name the field; in fact, from our observance Business Analytics and Business Intelligence may mean the same content in different universities even though we group them separately. If we group these similar categories under a single large category, we perhaps may have a different result. In the Table 3, we provide the list of the eight categories we used to regroup previous categories.

TABLE 3 - FURTHER AGGREGATION OF CATEGORIES

Categories	Greater Category	Categories	Greater Category
OM/OR/ Spreadsheet / Decision Making /Simulation /SCM/ Quality Management	Decision Sciences	Big Data	Business Analytics
General Business Analytics / Data Analysis	Business Analytics	Information Management and Information Technology	Information Technology and Security
Database and Data Management	Information Technology and Security	Economics Related Courses	Accounting, Economics and Finance
Data Mining	Business Analytics	Internship / Capstone / Fieldwork / Professional Seminar	Internship /Capstone /Fieldwork /Professional Seminar /Application and Practicum
Marketing Related Courses / Marketing Analytics	Marketing	Finance Related Courses	Accounting, Economics and Finance
Specialized Analytics Courses	Business Analytics	Web / Text Mining	Information Technology and Security
Software and Enterprise Systems	Information Technology and Security	Accounting Related Courses	Accounting, Economics and Finance
Data Visualization and Communication	Business Analytics	Application and Practicum	Internship /Capstone /Fieldwork/Professional Seminar /Application and Practicum
General Management Related Courses	Management	Artificial Intelligence / Machine Learning / Computational Learning	Information Technology and Security
General Statistics	Business Analytics	Health Science Related Courses	Health Science
Predictive and Prescriptive Analysis /Analytics	Business Analytics	Information Security	Information Technology and Security
General Business Intelligence	Business Analytics	Other	Other
Statistical and Research Methods and Data Collection	Business Analytics		

In the Figure 6, we provide the coverage percentage for each of these greater categories. Now the Business Analytics group is at the top of the list with 49.10%, followed by the Information Technology and Security group with 18.55%. Decision Sciences group is at the third place with 14.85%. Furthermore, this result is in line with our expectations that Business Analytics in fact provides almost half of the content in a typical Business Analytics program. However, Decision Sciences group still has a significant coverage just after Information Technology and Security group. Three of the top categories provide 82% percentage of the core class content. Next, we look at the entire program content including the electives.

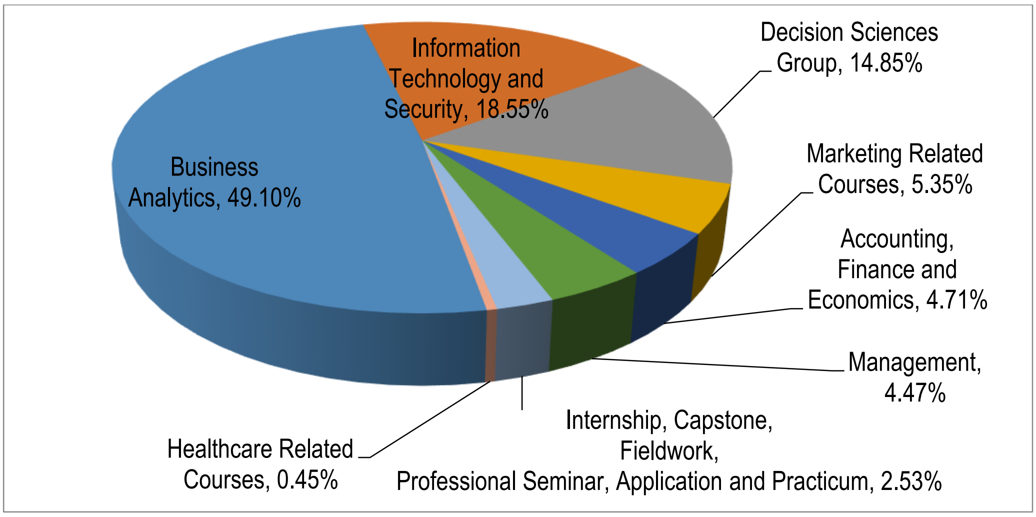

FIGURE 6 - CONTENT COVERAGE OF CORE CLASSES BY CATEGORIES

In terms of the entire program coverage, we use the same large categories we used to analyze the core classes namely, a large category for all classes related to Business Analytics, Information Technology and Security, Decision Sciences, Marketing, Accounting/Finance and Economics, Management, Internship, Healthcare related course and others. In the Figure 7, we can observe that the main category of "Business Analytics" for the entire programs dropped to 41.71% from 49.10% in the core classes alone. This is anticipated since business programs are less likely to cover the main subject for their degree, Business Analytics, as their electives. Rather they would cover Business Analytics related subject as a part of their core classes. Electives by virtue are taught as the application of the core knowledge, in this case Business Analytics, to other areas, or they can be a continuation of the basic class coverage into much deeper coverage, or simply introduction of related new areas on top of the basic coverage in the core.

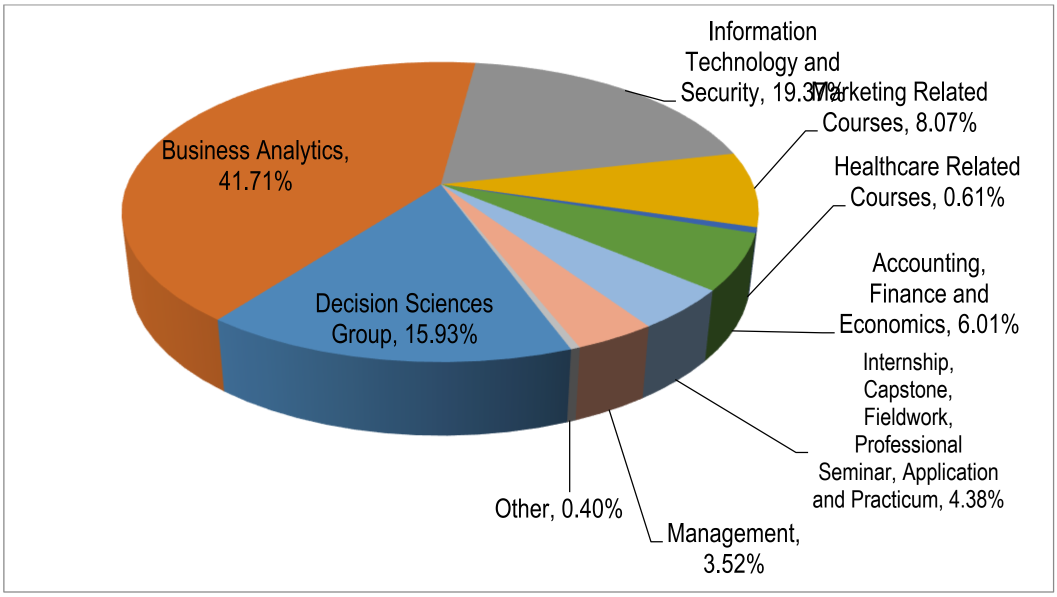

FIGURE 7 - CONTENT COVERAGE OF THE ENTIRE BUSINESS ANALYSIS PROGRAMS BY CATEGORIES

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When we looked at the percentages of coverage in the core classes compared to the entire program in the Table 4, we can make certain observations. While Business Analytics coverage drops significantly in the electives, other areas add coverage. Mainly, Marketing leads to the content addition with 2.72%, followed by Accounting/Finance and Economics areas with 1.30%. Information Technology and Security and Decision Sciences groups show more modest increases with 0.83% and 1.08% increase respectively. When we also take into consideration relatively high coverage numbers in both required core classes and the entire program, we can conclude that both areas Information Technology and Security and Decision Sciences groups are highly valued by the program designers; hence, they are included in both core classes and electives heavily. Marketing coverage and other categories, however, are considered mostly as primary elective categories that programs can offer for certain students but not as a required class for all students.

TABLE 4 - CONTENT COVERAGE PERCENTAGE CHANGE FROM CORE PROGRAM TO THE ENTIRE PROGRAM

Categories	Core	Entire Program	Delta (Entire Program –Core)
Business Analytics	49.10%	41.71%	-7.39%
Information Technology and Security	18.55%	19.37%	0.83%
Decision Sciences Group	14.85%	15.93%	1.08%
Marketing Related Courses	5.35%	8.07%	2.72%
Accounting, Finance and Economics	4.71%	6.01%	1.30%
Internship, Capstone, Fieldwork, Professional Seminar, Application and Practicum	4.47%	4.38%	-0.09%
Management	2.53%	3.52%	0.99%
Healthcare Related Courses	0.45%	0.61%	0.16%
Other	0.00%	0.40%	0.40%

5. CONCLUSIONS

From this study, we have found out that Decision Sciences group including the Supply Chain Management and Operations Management has a significant content coverage in a typical Business Analytics degree as of now. In fact, 14.85% of a typical Business Analytics core is in Decision Sciences group and 15.93% of a typical Business Analytics degree including both core and electives is in Decision Sciences group. Only the Business Analytics and Information Technology and Security groups have more coverage than Decision Sciences group. Furthermore, Decision Sciences group is significant in the core programs and electives. This would imply a strong presence of Decision Science group in newly designed Business Analytics programs and this is very promising.

Based on our research of the current program designs, we can conclude that, if the program design includes only few classes (less than four), two of these classes are from Business Analytics related courses, and the remaining two from Decision Sciences and Information Technology and Security. On the contrary, for programs that are longer than four classes, programs include more opportunities in other areas including Marketing, Accounting, Finance, Economics, Management, Healthcare and etc.

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