



INTEGRATING BIG DATA ANALYTICS COMPETENCE INTO THE ACCOUNTING CURRICULUM¹

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Abstract: *In the era of the new information technologies, in order to benefit from their deployment and create more value to the businesses, accountants should develop new skills and competences in Big Data and data analytics. Accounting educators are experiencing high pressure to enhance the technological content of accounting courses. Programmes' curricula and modules' syllabi should be adapted to the current labour market requirements and employers' expectations from graduates. This paper is aiming to present different approaches and few good practices of integrating Big Data Analytics into the accounting curriculum. Moreover, the experience of the Faculty of Economics and Business Administration, Sofia University „St. Kliment Ohridski”, is shared with the purpose to attract academics' and practitioners' attention and to initiate further discussions on this hot topic.*

Key words: *Big Data analytics, new skills and competences, accounting educators, curricula and syllabi changes, good practices*

Background and introduction

Currently there are many definitions of Big Data. According to one of the most simplified it is „just turning mess into meaning” (2016: 28), which properly describes the core intent to provide meaningful information for decision making purposes by making sense of large volumes of data, coming from different sources and generated in different environment [11]. In fact, the volume is so huge and cannot be analysed by using the traditional techniques, data management tools and software programmes. One of the characteristics of Big Data is that it encompasses structured and unstructured data, the latter comprising about 90% of the data sets. Among the examples are email messages, Facebook posts, blogs, phone calls, graphs, videos, incl. customer transactions, stock movements and storage. There is no one broadly accepted understanding of how to determine which data sets are big and there are various assumptions across different domains [6]. Probably a common classification criterion is the ability of data to enhance the capabilities of the information system that uses the data. Despite the challenge to define Big Data, there are four agreed characteristics, known as the 4 Vs, comprising of: huge Volume, high Velocity, huge Variety and uncertain Veracity (figure 1).

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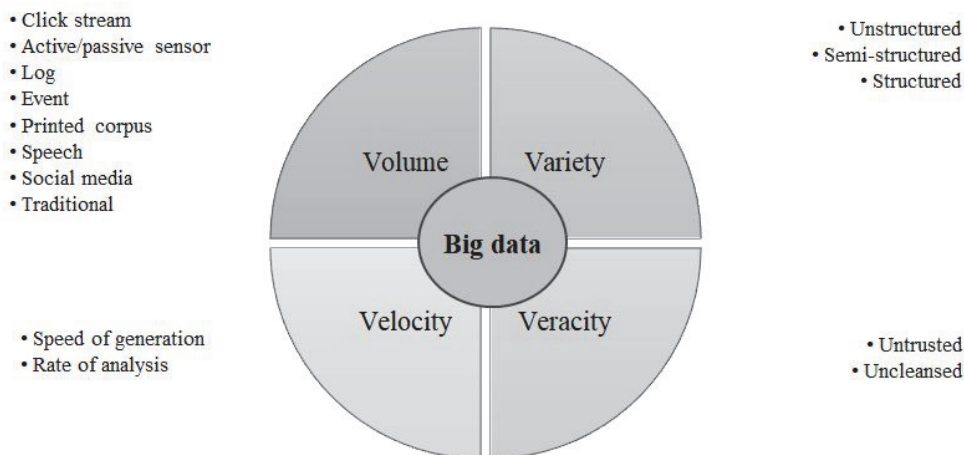


Figure 1. The four V's of Big Data

Source: EY, 2014, p. 2

Big Data is characterised with huge *volume* because of its vast amount compared to traditional data sources. Its enormous *variety* comes from different sources as pointed out earlier and is being created by machines and people [7]. On the other hand, *velocity* refers to the fast speed of data generation as well as the continuous basis of creating and adding new data to the data sets. Finally, *veracity* is related to data quality and the need to test its reliability, authenticity and validity [6], [7], [8].

Besides the opportunities associated with Big Data, there are also many challenges that should be considered. Some of them are listed and briefly described in table 1.

Table 1. Big Data challenges

Data quality issues	Description
Consistency	Interdependence between applications and organisation; minimising data conflicts
Integrity	The ability to identify whether data sets are modified, deleted, hidden or destroyed on purpose or by mistake
Identification	Verification of data by linking at least two separately recorded pieces of information about the same piece of data
Aggregation	Summarising and simplifying Big Data coming from different sources
Confidentiality	Considering data sensitivity and limiting the access to certain data

Source: Zhang et al., 2015; Enget et al., 2017.

As stated above, from company's point of view, Big Data is a combination of different types of data, collected and processed from many new data sources. There are several factors pushing upward the Big Data trend – the exponential growth in computing power,



the new sources of data and the improvement of the digital infrastructure. Computing power is considered as the main enabler as it makes possible the processing and storage of data sets, characterised with huge amount and complexity. New types of software have been developed and enhance those capabilities. Improvements of the visualisation tools are of management's great benefit, supporting the decision making process through bettering data analytics and presentation. Advances in cloud computing are also important for spreading the usage of Big Data across the organisations. By sharing the computer resources, the businesses reduce their costs and receive access to more data sets and computer power for processing and storage. Machine learning also benefits from the huge data sets as they are used for testing the models, built on sophisticated algorithms, and improving the accuracy of the results. Recent developments in computing is giving the companies an easy and quick access to new data sources as the internet, social media, mobile devices, primary public sector data, chips and sensors, embedded in physical assets. The businesses' internal data sources are also increasing due to the augmented application of digital technologies in sales, marketing, supply management, etc. Now the management could test on a systematic basis clients' behaviour, intentions and preferences thus building competitive advantages and creating more value to the company. The digital infrastructure is also propelling the upward trend of Big Data. Crowdsourcing and open source software are good examples of new types of collaboration and creation and sharing of knowledge [9].

Data analytics is a very specific process associated with the purposeful exploration of the data sets and has many applications – for improving the business decision making, scientific research, etc. Most commonly, it is associated with a complete cycle, encompassing data understanding, sorting and organising the data files, data visualising, interpreting and communicating [6].

Structuring the research problem

Accountants could seize the opportunities and benefit from Big Data and data analytics in many ways. There are several areas with such opportunities for creating value to the company as valuation of its data assets [14], improvement of the decision making process and management of risks. In order to benefit from the new information technologies and their deployment and create more value to the businesses, accountants should develop some new skills and competences [15]. Among them are the Big Data analytical skills because of the increasing focus on Big Data for the accounting profession [16]. Those new trends are shaping its future and influencing the accounting higher education by imposing new demands of graduate core competences.

Accounting educators are experiencing high pressure from the international professional accounting and accrediting bodies to enhance the technological content of accounting courses. Universities are challenged by the Big Data and data analytics augmented application because they have to play an important role in this process as initiators for curricula review and relevant implication tests. Programmes' curricula and modules' syllabi should be adapted to the current labour market requirements and employers' expectations from graduates. Big Data is tied to many disciplines and that turns out to be a practical problem [8].

Aim of the paper and research methodology

This paper is aiming to present few good practices of integrating Big Data and data analytics into the accounting curricula and syllabi. The research uses an interpretive and critical methods approach. The author outlines some of the problems and discusses few of

the challenges facing the accounting educators due to the recent information technology advances and their augmented business application. The relevant literature is reviewed and different ways for meeting those new requirements are presented and analysed based on the current practices of universities. Moreover, the experience of the Faculty of Economics and Business Administration, Sofia University „St. Kliment Ohridski”, is shared with the purpose to attract academics’ and practitioners’ attention and to initiate further discussions on this hot topic.

Approaches for integrating Big Data analytics competence into the accounting curriculum

In 1989, the managing partners of the largest international accounting and auditing firms in the world (then the „Big Eight”) issued their „White Paper” – a joint document, calling for fundamental changes in the accounting curriculum. A central point in the White Paper was the creative use of information technology, which was considered essential for the future of the accounting profession and accounting higher education [4], [13].

In 2012, the US Pathways Commission on Accounting Higher Education, created two years ago by the American Accounting Association and the American Institute of Certified Public Accountants, published the report „Charting a National Strategy for the Next Generation of Accountants” with seven recommendations for the future of accounting higher education [1]. According to recommendation number four, one of the objective should be to define a body of knowledge which will serve as a foundation for accounting’s curricula of the future and will be connected to „a map of competences and related performance levels for alternative accounting career paths” (2012: 37), [1]. Technology advances and global business trends should be reflected in the accounting curricula. In 2015 the Pathways Commission stated in one of its surveys that business intelligence/analytics are among the most important skills for students. Moreover, the Association to Advanced Collegiate Schools of Business (AACSB) states the following in its Accounting Accreditation Standard 7: „The dynamic nature of IT developments related to data creation, data management and processing, data sharing, data analytics, data mining, data reporting, data security, and storage within and across organizations is critical for the development of emerging professional accountants. The underlying learning experiences for accounting graduates demand an interdisciplinary approach that draws input from professionals and academic scholars with expertise in information systems, statistics, computer science and engineering, ethical issues related to IT and „big data,” etc. The focus should not be on „accounting information systems” only, but on information storage, management, and analysis for accounting graduates.” (2014: 5), [2]. The AACSB supports the interdisciplinary integrated accounting curriculum and strongly „believes that accounting is where Big Data belongs” (2017: 4), [10].

Professional accounting bodies as the Association of Chartered Certified Accountants (ACCA), the Institute of Chartered Accountants in England and Wales and the Chartered Global Management Accountants (CGMA), are also changing their qualification modules content by introducing information technologies into the syllabi. For instance, in April 2019, ACCA introduced a new data analytics unit as part of the Ethics and Professional skills module thus giving a direct response to „digitisation and the latest technological developments affecting global business” [3]. In fact, some of the ACCA exams as Business Reporting and Strategic Business Leader have already introduced Big Data, disruptive technology and cyber attacks through various business scenarios. CGMA has also added some material on Big Data analytics in their 2015 syllabus [8].



Obviously, accounting educators are experiencing high pressure to adapt their curricula and syllabi to the requirements of the accounting profession due to recent changes in the business environment and management expectations from graduates. Currently, there are several examples of how universities react to those inquiries for change. Accounting higher education patterns are changing. As Big Data and data analytics are tied to many other disciplines, special attention should be paid for finding the most efficient ways for integrating the required technical content. The current practice shows that there are several ways for developing the needed competences in graduates. Basically, there are three approaches to incorporating data analytics into the accounting curriculum – a focused approach, integrated approach, or hybrid approach [5]. We will briefly introduce and discuss them in the following paragraphs.

The *focused approach* refers to the introduction of a stand-alone course in data analytics into the accounting curriculum. Dzuraniin et al. (2018: 26) suggest that such separate course could follow the fundamental accounting courses giving the students opportunity for developing in advance the fundamental accounting skills and knowledge [5]. One of the pioneers among universities, the School of Accountancy at the Rawls College of Business, Texas Tech University, has already included several core and elective modules on data analytics in the accounting curriculum: Data Analytics for Accountant, Data and Analytics for Tax Accountants, Introduction to Data Analytics, Advanced Data and Analytics for Accountants³. St. Mary's University's Greehey School of Business opened a new Bachelor of Business Administration degree program in Accounting and Data analytics. Its aim is to prepare more students for careers as data analysts. According to the information, published on the university website, the “students complete the basic 120-hour accounting major, plus an additional 30 hours in data analytics and information systems courses and electives”⁴.

Gamage is a proponent of the *integrated approach*⁵ [8]. The author believes that it should be applied for embedding data analytics topics into the current courses in the Accounting degree programs and also argues that in order to enhance the technical content of the current curriculum, some existing topics have to be sacrificed. He suggests few Big Data topics that could be included within several existing courses. They are presented in table 2. In fact, Gamage supports PwC view for integrating data analytics into accounting coursework [12]. Dzuraniin et al. discuss some of the benefits and limitation of this approach. For instance, they consider as a significant benefit that there is no need to add a course to an already full curriculum. Moreover, students will be exposed to data analytic elements throughout the accounting curriculum, thus understanding more fully the significance of data analytics for their professional development [5].

³ <http://www.depts.ttu.edu/rawlsbusiness/about/accounting/courses.php>
https://catalog.ttu.edu/preview_program.php?catoid=11&poid=9178

⁴ <https://www.stmarytx.edu/academics/programs/accounting-data-analytics/>

⁵ Dzuraniin et al. introduce this approach as an integrative approach.

Table 2. Big Data topics that can be included within existing courses

Course	Topics
Business Statistics	Data gathering techniques, Data exploration, Data summarization, Data analytics, Data visualization, Communication of analytical findings
Business Information Systems	Advanced databases, Information retrieval, Advanced data mining applications, Predictive analytics for decision making, Big Data information management
Management Accounting	Application of Big Data to competitor analysis, Big Data as a strategic resource
Accounting Information Systems	Business intelligence, Enterprise analytics information search and retrieval, Data mining, familiarity with languages such as XBRL, specialized software/reporting systems with decision support, ERP systems, Cybercrime, Data management issues
Business Finance	Financial analytics, modeling and computation of financial risks, Information risk management
Audit and Assurance	Data analytics in auditing, Mine new sources of data, Data integrity, privacy, Safeguards, Cybersecurity, Design and evaluate IS controls, Manage IS risks and compliance, Overseeing fraud risk assessment
Forensic Accounting	Big Data, Benford's law, Financial analytics, Data analytics for fraud, Anomaly detection in forensics and securities
Taxation	Indirect tax and Big Data, tax value and non-tax value form data that is collected in the tax function, Visualization of accounting data

Source: Gamage, 2016, p. 601.

The hybrid approach encompasses features of the focused and integrated approaches. It allows an introduction of stand-alone courses as well as an inclusion of data analytics content in the existing courses.

The experience of Sofia University “St. Kliment Ohridski”

In 2018, in order to respond to the new requirements, imposed on the accounting educators, the Faculty of Economics and Business Administration (FEBA), Sofia University “St. Kliment Ohridski” opened a new, one-year long master programme in Accounting and Big Data Analytics. By applying the focused approach, the curriculum content was significantly enhanced by introducing several core and elective courses thus complementing graduates’ core accounting knowledge and skills with Big Data analytics competence:

- Core – Analytical Research – Theory and Applications, Business Intelligence, Analytical Tools for Big Data
- Elective – Preliminary Processing of Big Data for Analytical Study, NoSQL for Big Data and Data Streams in Business, Business Challenges of New Technologies, Applied Models for Forecasting Economic and Financial Data

At this point of time it would be difficult to assess how successful the master programme is as the first graduates will defend their master theses in November 2019.



Based on the feedback, received from students through several unofficial interviews and discussions, we can say with confidence that the programme meets all major aspects of students' expectations at application. Still, there are some limitations and weaknesses from the faculty perspective, summarised in table 3.

Table 3. Limitations and weaknesses from the faculty perspective – FEBA experience

Limitations and weaknesses	Comments
Difficulties in finding the balance between fundamental and specialised (Big Data analytics) courses while working out the curriculum.	<i>Possible reasons:</i> The lack of similar programmes on the Bulgarian market for educational services. Good practices are shared through publications in some academic research papers only. <i>Possible actions:</i> Initiating and attending national and international forums for discussing accounting educators' experience. „Good” vs. „bad” practices.
The academic and administrative staff faced difficulties in promoting the programme and attracting talented applicants.	<i>Possible reasons:</i> The lack of proper understanding among young people about the significance of Big Data knowledge and competence for a successful career in accounting and audit. <i>Possible actions:</i> Infusing data analytics for building basic skills in all bachelor degree programmes in the field of economics thus making Big Data and data analytics popular among the students.
Building an efficient communication between academics from different departments.	<i>Possible reasons:</i> There were no similar interdisciplinary master programmes at FEBA at that time. The prevailing individualism in the scientific community becomes unfavourable environment for building up an efficient cooperation and performing the targeted joint work. <i>Possible actions:</i> Initiating regular workshops with the academics, involved in the master programme, for discussing current issues, problems and possible solutions. Organising team-building events for stimulating and strengthening the informal communication.

Conclusion

The recent technological breakthroughs are rapidly reshaping the business environment and changing the future prospects of the accounting profession and the required new skill set and competences. Knowledge and skills in data science are now considered a must not a desirable competitive advantage. Accounting educators have already started the process of changing programmes' curricula and enhancing the learning technological content. The insights from faculty shows that the integration of Big Data analytics into the accounting curriculum could follow different approaches and each one is characterised with both benefits and limitations. One of the current problems is the lack of proper understanding among young people about the significance of Big Data knowledge and competence for a successful career in accounting and audit.

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