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A Framework for Evaluating the Business Analytics Maturity of University Programmes

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Abstract: The impact that business analytics (BA) has on companies' performance will cause, in the near future, a significant increase in the demand for specialists in the field. Universities will play an important role in covering the deficit of professionals already reported by companies, provided that their offer is tailored to real market demands and their students are prepared to acquire the appropriate knowledge and skills. This paper proposes a framework for assessing the maturity level of BA in economic university programmes, based on the knowledge and technical skills needed by BA professionals. This maturity framework is applied to Romanian economic study programs to assess their analytical level and to identify their possible development directions. The educational programmes offer is then confronted with the real demand on the Romanian labour market, highlighting the types of jobs needed in the BA field and the related requirements for each of the analytical levels of the proposed model.

Keywords: business analytics; maturity framework; business analytic skills; job requirements

1. Introduction

Much has been written lately about Big Data, cloud computing, artificial intelligence and how they will change our lives. The power of computing has grown significantly, but will we be able to use all these new capabilities? We produce, transmit and store large volumes of data, this is what Big Data is all about, but to what extent do we manage to understand this data, and more importantly, to use it in a manner that will support the sustainable development of our businesses and our society?

The transition to the fourth industrial era, when knowledge becomes the main competitive advantage [1] requires companies to increasingly question how to benefit from the knowledge hidden/extracted from data. The number of professionals dealing with data analysis is considerably undersized and the training of new specialists can take years. Alwin Magimay, head of digital and analytics at KPMG UK says, "The analytics market is a bit like computer programming in the 1990s—we are in the phase of building up competence and it's the beginning of a long journey" [2].

The impact that the Big Data phenomenon has on demand on the job market has begun to be analysed by specialists in recent years. There is an increasing discrepancy between what organizations require in terms of data analysis capabilities and the availability of specialists at the moment [3,4]. For example, in 2016, according to SAS company [5] less than a quarter of companies' employees used predictive tools, although most employees were interested in training in order to use business analytics (BA) in their daily work.

Increasing the analytical capacity of a company can be done in three ways [6–8]:

- By hiring from the market—all conducted studies show a very large labour market deficit in terms of data analysis jobs [2–4]. International Data Corporation (IDC) estimates that by 2019 the Big Data analytics market alone will exceed $ 187 million [9].
- By training existing personnel—although this option seems to be more effective, the complexity of the field raises questions about the structure and the necessary duration of such training. According to American Management Association [7], strengthening the analytical capabilities of a company would imply that, besides math knowledge, a good understanding of finance, operations and marketing, combined with statistical analysis, presentation skills and a focus on problem solving is required.
- By increasing the supply of IT solutions and tools that are easy to use and have a short learning curve.

Necessary competencies in this field are rarely investigated and, most often, only for the purpose of cataloguing them and reporting the shortage of prepared persons [8,10]. Competences can be defined as "the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations", while knowledge is "the outcome of the assimilation of information through learning" and skills represent "the ability to apply knowledge and use know-how to complete tasks and solve problems", according to the European Key Competence Framework [11] (p. 8). Job titles are diverse, from data scientist to data analyst or business analyst. In recent years, studies have been published that develop an empirical typology of data analysis professions [12], studies that identify these abilities according to the job described and divide them in certain categories [13]. However, all require a wide range of knowledge and skills that rarely are owned by one person.

This shortage of professionals automatically leads to the need to create a larger number of specialized individuals and, due to the complexity of knowledge and abilities that they have to have, it is very difficult to train them within a short space of time within companies. A solution seems to be held by the universities [8,12,14], which, through the programmes they offer, could provide much of this knowledge and these abilities. Moreover, universities, as key actors for sustainable development [15], can prepare these specialists to be empowered to act in complex situations and to solve problems related to the field in a future-oriented way that promotes sustainable development. How quickly do the study programmes adapt to market requirements and to what extent the identified programmes respond to the real market demands are questions that we will try to answer in this paper.

In this paper, we chose to use the term business analytics and not other terms such as business intelligence or data science, without the exact definition being the subject of this article. This option is motivated by the fact that our analysis focused on the main business schools in Romania and we have proposed a tailored approach. Business analytics is composed of "all methods and techniques that are used by an organization to measure performance" [15], including data mining, predictive analytics, applied analytics and statistics [16].

Romania is one of the countries known worldwide for its IT specialists. Approximately 10% of the graduates trained annually by the Romanian informatics school choose to work abroad [17]. Given the fact that data analytics specialists are frequently required to have solid business knowledge [12,18], we intend to analyse how current business education in Romania responds to the dynamics of the business analytics labour market.

Specifically, the main objectives of this paper are to identify technical knowledge and skills for the business analytics field, to build and validate a framework for evaluating the Business analytics maturity of university programmes and to use the framework for analysing economic masters' programmes in Romania.

This study analyses three related questions:

Q1: What knowledge and technical skills are imparted by economic university in business analytics programmes in Romania?

Q2: What are the main requirements of business analytics jobs on the Romanian market?

Q3: How do economic university programmes match the requirements for BA jobs in Romania?

These questions are answered by applying the proposed framework of knowledge and the technical skills for business analytics and a content analysis method. By using the same set of competence dimensions, the answers to the first 2 questions are used to discuss the overall issue of how curricula are aligned with workforce demands for BA-related knowledge and technical skills. The focus is placed on the Romanian market.

According to these ideas, the paper is structured as follows: the second section presents the current state of the research field, addressing separately the main contributions to the assessment of business analytics competences in university programmes and the contributions to the skills required for business analytics professionals. We divided the third section in two sections as well, presenting data related to business analytics courses in economic universities from Romania, to business analytics jobs on the Romanian market and the methods used for analysis. The fourth section presents in detail the steps followed for designing the maturity framework for assessing university programmes, and then the resulting model is applied for the collected data in the fifth section and the results of the analysis are presented in form of tables and dashboards. Discussions and conclusions related to our framework importance, applications and future developments complete the article.

The main contribution of the paper is the framework for evaluating the business analytics maturity we propose, which will allow universities to evaluate their study programmes and to identify for each programme the level of maturity in BA. The framework can also be used to propose new BA study programmes that meet the requirements of BA jobs and provide students with the knowledge and skills needed to become BA specialists.

2. Current State of the Research Field—Related Work

In this chapter, we will present the current state of the research field, considering both the study of programmes related to business analytics offered by universities, as well as the analysis of the labour market, in order to extract the main competencies necessary for the data professionals. Depending on the emphasis placed on the found works, we structured the ideas set out in two sub-sections.

2.1. Assessment of Business Analytics (BA)-Related University Programmes

In general, approaches that analyse the offer of educational programmes for the area of business analytics start from certain competencies sets that should be held by a graduate aspiring to a data professional position, without detailing how these competences are defined or how demands vary depending on industry, market area or other elements. Dubey and Gunasekaran identified the main skills required for a career in Big Data and business analytics, grouping them into two broad categories [4]: (a) hard (technical) skills—statistics, forecasting, optimization quantitative finance, financial accounting, multivariate statistics; (b) soft skills - leadership ability, team skills, listening and so on. The authors propose a theoretical framework for education and training for a career in Big Data and business analytics.

Thus, Turel and Kapoor [18] propose a maturity model of business schools in the US, analysing their offer regarding business analytics, each course being categorized into one of four categories: databases, data analysis, business analytics, or data warehouses. The distinction between ranked and unranked business schools is also taken into account, the conclusion being that, overall, the analysed business schools did not reach an acceptable level of analytical maturity.

A bilateral approach was proposed by Schoenherr and Speier [19] that investigated competencies in the fields of data science, predictive analytics and large data by organizing a large-scale survey on data analysis among Supply Chain Management (SCM) professionals. Subsequent, they analyse the training for data professionals in US universities, at the level of masters programmes, grouping the specific courses into three categories: (a) enterprise business processes and decision making; (b) analytical and modelling tools; and (c) data management. The paper ends with a discussion on how universities should prepare the next generations of data scientists and provides an example of

curriculum development by introducing predictive analytics, for a particular case of a Michigan State University masters.

The theme of aligning the curriculum of master programmes to the labour market demand for data-related skills is found in very recent studies such as Murawski in 2017 [12] for the UK. Starting from job advertisements on online platforms and applying a probabilistic topic model approach, an empirically-derived typology of data professionals is proposed, with five topics being labelled as ideal types of data professionals and their associated skills being grouped into three major categories, by applying the classification proposed by Todd [20]: technical (with the hardware and software sub-categories), business (with domain, management and social sub-categories) and system (with the problem-solving and development subcategories). On the other hand, the offers of UK masters programmes for the domains of data science and Big Data, and business intelligence and analytics were analysed using Todd's schema, and then confronted with the competences identified in the initial typology. Masters programmes cover a small part of the business competencies required on the market, focusing on software competences, problem-solving and development [12], the explanation being that they are specialty masters and business knowledge is expected to be gained in bachelor programmes.

All of the listed works highlight the fact that although universities' curricula have modernized much in recent years, generally speaking, they are far below demand. This represents a problem especially because, as the European Commission highlights [21] (p. 4), the mismatch between demanded and existing skills on the labour market leads to "shortand long-term economic and social losses for people, employers and society". The seriousness of the topic has led the European Commission (EC) to focus economic and sectorial policies in recent years, on the relevance of education to the labour market, the employment rates of young people and the transition from education to work.

2.2. Skills Required of Business Analytics Professionals

There have been a significant number of studies that have been trying over the past years to identify competences regarding Big Data and business analytics, either by consulting business men who represent companies from different industries, via questionnaires [7] or by analysing job advertisements from various specialized sites [8,12,14,22].

To analyse how the labour market looks and the required skills on the Big Data field, Bensberg and Buscher [14] use text mining on job ads collected from specialized sites, combined with a smaller number of announcements from major information technology (IT) companies: Cisco, SAP, Amazon and Microsoft. 70% of the analysed jobs are categorized in five major job families: Big Data developer, data scientist, Big Data architect, data analyst and data engineer. For each of these five job profiles a detailed analysis of the concepts, programming languages, software and soft skills is realized, the author proposing a more serious involvement of educational programmes and changing the curriculum in order to take into account this obvious demand on the labour market.

Miller and Hughes [8] are considering the rapid rise in demand for data science and analytics (DSA), analysing how "data democratization" turns into jobs that remain unoccupied in companies. To identify the roles and skills of the DSA ecosystem, the Burning Glass database was used, which at the time of the analysis (2016) recorded over 130 million unique current and historical job records. Based on the over 300 identified skills, DSA jobs have been grouped into six major categories: data scientist and advanced analytics, data analyst, data systems developers, analytics managers, functional analysts, data-driven decision makers. In order to support those interested in market dynamics in this area, the authors propose 3 matrices in which they analyse skills and jobs according to the hardest to fill and the fastest to grow, matrices that only highlight the gaps in the DSA market that require the most attention. The final recommendations of the study focus on the new DSA focused educational programmes, new data labs, and the continuous development of DSA competences and skills.

A different approach to the study of the demand for analytical skills is found in the paper published in 2013 by the American Management Association (AMA) [7], where the surveys technique was used on two data sources: AMA and its global affiliates and i4cp's global survey panel, including

more than 50 industry sectors from over 40 countries. The results of the analysis of these surveys are presented in the form of 10 key findings, which indicate an increase in the importance of analytics in the future due to increased competition and the need for performance, which highlight the top five analytical skills now and in 3 years, but also identify the main challenges induced by Big Data Analytics. The main recommendation for companies is the rapid training of people within the organization while shifting from the strategic decision-making process to a more analytically based model.

The research performed by Cegielski [23] takes into consideration only graduates of business schools, analysing demanded knowledge, skills and abilities (KSA) for entry level in the Big Data and business analytics field. It is a cross-cutting approach, applying several different research methods: through the Delphi technique, some analytic professionals on KSA are surveyed regarding the KSA that business graduates should acquire to occupy an entry-level position in business analytics; through the content analysis method the active job ads on three entry-level BA sites are examined and the identified KSA are grouped in three categories: business, analytical and technical, an adaptation to the classification scheme proposed by Todd and McKeen [20]. A novelty is that the authors also took into account the level of proficiency for each of the identified KSAs. To close the loop, a survey was conducted including all items from all three categories identified in the two studies. An important conclusion, regarding the main technical skills and abilities, is that Excel, SAS, SQL and R are the top four skills for entry-level positions in BA.

Most of the identified papers take into consideration the US job market. For the Romanian market, we have identified a single paper, published in 2014 [24], which performs an empirical analysis of employers' satisfaction with the skills offered by the graduates of Romania's business schools, starting from the general framework provided by European Qualifications Framework (EQF) and the National Qualifications Framework in Higher Education (CNCIS).

These papers highlight the fact that for the Big Data and analytics domains the necessary skills are complex and very specific, but they also signal the lack of a common framework for jobs and skills in the field and the lack of clear definitions of new job titles and skills, which only make the situation even more difficult.

Most of the analyzed papers take into account only the skills needed for certain job profiles, without correlating them with the necessary knowledge to be assimilated. Also, to structure the types of competencies in Big Data and business analytics, there are few framework proposals, for example the model developed by Turel and Kapoor [18]. Most commonly, Todd's framework is used, but it is general in the IT field, with the appropriate adjustments. Also, there is no clear delimitation between the data field and the analytical field, referring to professional data profiles [12,14] or analyzing data science and analytics [8].

Starting from these, we propose to develop an analytical maturity framework dedicated to the economic field that highlights the path a student should follow in order to become a good BA specialist. We chose to have a similar approach to Murawski [12], that of confronting the competencies offered by the programs of the economic universities with the skills required by the job market, but in terms of an analytical maturity framework specific to the field of business analytics similar to Turel [18]. In the following, we will present in detail the following steps so that, they can be repeated for data related to any other country.

3. Methodology and Data Collection

In order to achieve the proposed objectives, we started by collecting available data provided by the Romanian university programmes in the field of economics as well as data regarding the jobs for the business analytics field that are being sought on the Romanian market. A content analysis [24] was used as the analysis and interpretation method for the first part of the analysis and a frequency analysis [23] was applied to active job postings for the second part, as it will be detailed below.

3.1. Business Analytics Courses Offered by Romanian Economic Universities

The study gathered data from the top four Romanian economic universities [25]: The Bucharest University of Economic Studies (ASE), Faculty of Economic and Business Administration–Vest University (FEAA), Faculty of Economic and Business Administration–Alexandru Ioan Cuza University and Faculty of Economic and Business Administration–Babes-Bolyai University (FSEGA). We undertook a survey of the curricula of master and bachelor study programmes (2017-2018) using the following websites: http://www.ase.ro, https://www.feaa.uvt.ro, http://www.uaic.ro, https://econ.ubbcluj.ro [26]. The four universities include 13 economics faculties offering master study programmes in the following fields: accounting, administrative science, business administration, economics, economic cybernetics, statistics and informatics, finance, management, marketing and international business and economics. For each faculty, the masters and bachelors programmes were identified, then for each masters/bachelors programme the curriculum was studied and the courses that could be included in the BA field were identified; 158 master and 47 bachelors programmes have been identified and used in the analysis phase. The process of identifying the courses was iterative and involved two members of the research team. First, courses selection was based on the title. Then we realized a content analysis of analytical programmes for all study programmes (bachelors and masters), and so the list of BA courses was expanded. Although the analysis has covered both bachelors and masters programmes, the article will focus on masters programmes. After analysis, we observed that most bachelors programmes in the faculties only offer knowledge and technical skills at a base level in the BA field.

In order to structure and analyse the educational offer of these programmes, we started from the idea that students' training for jobs in BA field should focus on 4 domains: Data Analysis, Databases, Data Warehousing and BA [3,27–30]. According to Turel and Kapoor [18], the degree to which economic universities cover these areas defines their BA maturity level and essentially determines whether students are prepared for BA jobs. The Data Analysis domain includes statistics, decision sciences, data mining, machine learning, predictive analytics, marketing analytics; the BA domain includes business intelligence, data visualization, big data; the Databases domain refers to database entry and database management systems, database data models, design, management and implementation of databases, especially relational databases, and the Data Warehousing domain refers to data warehouse concepts, dimensional modelling, dimensional design, data warehouse design, management and deployment [18].

According to the Institute of Operations Research and Management Sciences (INFORMS) organization [31] BA includes descriptive analytics (such as enterprise reporting, dashboards, scorecards, OLAP, data visualization, etc.), predictive analytics (such as simulation, advanced statistics, data mining, machine learning, text analytics, etc.) and prescriptive analytics (such as decision trees, optimization and simulation algorithms, etc.). Starting from this definition, in our analysis we will use two main domains: Business Analytics (or Analysis domain) and Big Data Management and Computing Infrastructure (or Data domain). Big Data Management and Computing Infrastructure refers to the collection of structured and unstructured data from internal / external sources, their integration, their storage in relational databases/No-SQL databases, big data modelling, as well as the infrastructure needed to process such data (e.g. Apache Hadoop ecosystem). Studying curricula and analytical programmes, 126 BA courses were identified at masters level, and 220 BA courses at bachelors level that were used in the analysis phase. The data obtained were stored in an Excel file with the following structure: university, faculty, field of study, programmes, level (master/undergraduate) and analytical courses (Figure 1).

University	Faculty	Fields of Study	Programmes	Level	Analytical Courses
The Bucharest University of Economic Studies	Business Administration in Foreign Languages	BUSINESS ADMINISTRATION	Business Administration	master	
The Bucharest University of Economic Studies	Business Administration in Foreign Languages	BUSINESS ADMINISTRATION	Entrepreneurship and Business Administration	master	Business intelligence
The Bucharest University of Economic Studies	Business Administration in Foreign Languages	BUSINESS ADMINISTRATION	Entrepreneurship and Business Administration in Energy	master	

Figure 1. Initial structure of the data source.

The identified analytical courses were grouped in the two main domains: Big Data Management and Computing Infrastructure and Business Analytics, and 17 categories taking into account their name and analytical curriculum (Table 1). The Big Data Management and Computing Infrastructure domain includes the following categories of analytical courses: data warehouses, Big Data and fundamentals of databases. The Bussiness Analytics domain includes the following categories of analytical courses: analytics and data science, artificial intelligence, business intelligence, data mining, data analysis, decision support systems, geospatial analysis, quantitative analysis, operational research, econometrics, games theory, spreadsheet software for analysis, statistics and time series.

Table 1. Analytical course domains and categories (examples).

Domains.	Categories	Analytical Courses
Big Data Management &Computing Infrastructure	Big Data	Advanced Database Elements (NoSQL)
		BI and Big Data, Big Data, Big Data and Web Computing, Big Data Management, Polyglot Persistence and Big Data
	Data Warehouses	Data Warehouses
	Fundamentals of Databases. RDBMS	Advanced Databases, Database Management Systems, Databases, Databases and Programs, Databases for Accounting and Finance, Databases in Economy, Financial and Banking Databases Management Systems, Oracle RDBMS, Relational Databases Management
Business Analytics	Analytics and Data Science	Analytics and Data Science, Data Science Methods
		Big Data Analytics
		Business Analytics
		Expert Systems
		Hybrid Intelligent Systems, Intelligent Systems
		Natural Language Processing
		Neuronal Networks
		Software for Quantitative Analysis and Modelling
	Artificial Intelligence	Artificial Intelligence, Artificial Intelligence for Business Knowledge Management
	Business Intelligence	Business Assistance Systems
		Business intelligence, Business Intelligence Systems, Information Systems for Business Intelligence
		Data Visualization
		OLAP Technology
	Data Analysis	Advanced Marketing Data Analysis, Advanced Online Marketing Data Analysis, Data Analysis, Data Analysis and Statistical Analysis Systems, Data Analysis Software, Data Analysis using SPSS, etc.

All members of the research team verified and validated the way in which the analytical courses were grouped in the 17 categories. There were small differences of opinion on the inclusion of some

courses in some categories, as well as the inclusion of some BA course categories in a particular domain, and therefore the list of courses for each category and each domain was iteratively refined.

3.2. Business Analytics Jobs on the Romanian Market

To address the second question, we collected entry-level job solicitations posted on two popular Romanian employment sites, https://ro.indeed.com/ and https://www.ejobs.ro/, during the month of July 2018. We selected these sites because Ejobs is the main Romanian job portal and Indeed.ro is one of the top three job search engines, in terms of traffic. As such they offered the highest chances of finding a relevant number of job listings [32]. The job listings were collected manually as most of Romanian job sites and search engines are protected against the use of web scraper tools.

We collected and analysed empirical data from listing referring to both the Big Data Management and Computing Infrastructure and Business Analytics job markets. An initial search for job postings on the two platforms identified 107 jobs postings in Romania.

Next, we used the filters in the search criteria to limit the job listing to include only those positions that were full-time, required a university degree and less than 3 years of professional experience (entry-level and junior). We also eliminated from the data set the duplicates as well as any listings that had missing or erroneous information. We chose to limit the analysis to only jobs requiring under 3 years of professional experience because further on we are interested in studying how education programmes prepare students for the labour market, as such we are interested in the requirements of jobs dedicated to recent graduates, those who have knowledge and skills accumulated in university studies rather than through practical experience or other types of studies.

After filtering the data, we obtained 82 job announcements matching the criteria. The data was input into an Excel spreadsheet for conducting the analysis. This is not a study of the size of the job market for BA, but rather an investigation of the skills and competencies specified in advertisements aimed at BA.

In the process of preparing and entering the data, the following details were identified: activity field, location, responsibilities, required education, experience required and skills

We used a frequency analytic approach (a widely used qualitative research technique, including in studies regarding job requirements [33] and needed skills [23]) to examine active jobs postings for entry-level and junior jobs. We assumed that the most important skills required for these types of positions would appear with the highest degree of frequency in jobs listing.

Taking into consideration the format and information provided by the majority of job listings we decided to categorize the contents of the jobs listing, using the schema of Cegielski and Jones-Farmer [23] in: technical skills, business skills and analytical skills, as this approach best suits the information provided in the postings.

4. A Framework for Evaluating the Business Analytics Maturity of University Programmes

In order to ensure a uniform analysis of the study programmes taken into account, but also to assess how the market requirements are met, a framework of analytical skills named *A framework for evaluating the Business analytics maturity of university programmes* was proposed (Table 4).

For the development of the framework, the method proposed by Becker [34] to develop maturity models was used. This method is also used by the European Research Center for Information Systems (RCIS) "for the development of a maturity model designed to assess the application of IT performance measurement" [34] (p. 219).

The following steps have been taken:

1. "Problem definition". The study highlighted in previous paragraphs the need to develop *A framework for evaluating the Business analytics maturity of university programmes.*
2. "Comparison with existing maturity models". Initially, the articles focused on BA and BA maturity models, published in renowned international journals/conferences, were identified. It

was found that most BA maturity models were proposed for industry and only two BA maturity models for universities were identified [4,18]. The two BA maturity models for universities were analysed. This framework aims to fill this gap.

3. "Determine development strategy". In developing this framework, we took into account the results presented in [8,14,18,23,31], as well as the experience of the research team members in teaching analytical courses and we used the design science research approach proposed by Becker [34].
4. "Iterative maturity model development". The process of developing the framework was an iterative process. The framework proposes 4 BA maturity levels: basic, moderate, moderate-advanced and advanced and takes into account the two domains presented in 3.1. In establishing the four maturity levels, we started from:

    - the three categories of analysts identified by Davenport in [35]: a. analytical amateurs (those using only spreadsheets); b. analytical semi-professionals (those who know how to use visual tools and create simple models); c. analytical professionals (those who can create algorithms);
    - Certified Analytics Professional (CAP®) Examination Study Guide—INFORMS [31];
    - The evolution of BA in recent years.

The *Knowledge* column refers to the knowledge (only technical) that students have to accumulate for each BA maturity level, and the *Hard (technical) skills* column refers to the technologies / applications / tools that students need to know how to use. Thus, there is a separation of knowledge from technical skills. To create the list of knowledge and technical skills, the O * NET (Occupational Information Network) framework [36] was used also, a framework developed by the US Department of Labor in collaboration with its Bureau of Labor Statistics 'Standard Classification of Occupations' (SOC). We searched for BA-related occupations and only technical skills and technical knowledge were extracted. For example, for business intelligence (BI) analysts the top four identified technical skills are: 1. analytical software, BI and data analysis software; 2. database management system software; 3. database reporting software; 4. database user interface and query software.

For each maturity level, the necessary Knowledge and Technical skills were specified. Taking into account that certain knowledge is found on several maturity levels (e.g., "knowledge of visualization techniques"), the level of knowledge from basic to advanced is explicitly specified. The same is done for technical skills, it is explicitly specified how well students need to work with that technology / application / tool.

In order to achieve a global assessment of an analysed study programme and to fit the programme on one of the frame levels, a score was awarded for each maturity level: Basic level—1 point, Moderate level—2 points, Moderate-Advanced level—3 points and Advanced level—4 points.

Each analytical course was matched to a maturity level taking into account its curriculum and the classification by levels for different BA categories presented in Table 2.

Table 2. Classification by levels (with the corresponding score) for different business analytics (BA) categories.

BA	Basic (1point)	Moderate (2 points)	Moderate-Advanced (3 points)	Advanced (4 points)
Descriptive	simple statistical techniques (standard deviation, mean, median, frequency distribution, sampling methods)			
Predictive		—Operational research —Game Theory	—Simulation —Advanced statistics such as: regression (logistic, linear, step-wise, multiple), statistical inferences (confidence intervals, hypothesis testing, analysis of variance, design of experiments), analysis of variance (ANOVA), Forecasting, time series analysis —Data mining (classification algorithms/ clustering algorithms/ frequent pattern mining, association rules)	—Machine learning —Text analytics —Artificial Intelligence (Artificial neural networks, Expert systems) —Spatial machine learning
Prescriptive			—Decision theory/decision modelling —Decision trees	—Optimization algorithms —Fuzzy rule-based System —Switching neural networks (logic learning machine)

For bachelor programmes, 1 point was awarded for:

- 1 course in the Statistics category (usually Statistics for business),
- 1 course in the Fundamentals of databases. RDBMS category (typically, Databases)
- 1 course in the Spreadsheet software for analysis category
- 1 course in the Econometrics category.

The four disciplines were considered to be the foundation for Business analytics training. Also, from our analysis, we found that these disciplines are mandatory for almost all bachelor programmes. It is an aspect that shows us that there is an interest from the economic universities in the analytical training of the students. The question is, "How big is this interest?"

The other subjects received 2/3/4 points, depending on the maturity level they were allocated to in the framework. Also, the rest of the courses in the Statistics category (from bachelor level) received 2 points, the same for the ones in the Fundamentals of databases. RDBMS/Econometrics/Spreadsheet software for analysis categories. A correlation between the analytical courses in the bachelor programmes and the analytical courses in master programmes has been attempted, for example, the business intelligence course appears both in the bachelor and master's degree on the same maturity level.

Table 3 shows examples of awarding the score for the analytical courses according to the associated maturity level. The framework was evaluated for consistency and adequacy in addressing the problem after each iteration [34]. All team members validated the maturity level associated with each analytical course, taking into account the analytical programmes. Special attention was paid to ensuring a correlation between knowledge and technical skills (for example, advanced knowledge of visualization techniques and dashboard design are correlated with advanced skills with data visualization tools (QlikView, Tableau, SAS, and Analytica)). Using this framework, an analysis of the study programmes offered by the economic universities was made in Section 5.1 to see if these programmes offer students the technical knowledge and skills required by the BA job market. Also, in Section 5.1 there is a ranking of universities for each study field, depending on the number of analytical courses offered/number of points obtained, as well as for each level of analytical maturity: basic, moderate, moderate-advanced and advanced.

Table 3. Score granted for courses according to associated maturity level. (examples)

	BA Maturity Level			
Level	**Basic (1 point)**	**Moderate (2 points)**	**Moderate-Advanced (3 points)**	**Advanced (4 points)**
Bachelor	Basics of Econometrics Basics of Statistics Macroeconomics Database Management Systems Descriptive Statistics Econometrics Economic Informatics Economics Statistics Financial and Banking Databases Management Systems Office Applications Technology in Management etc.	Advanced Databases Data Analysis Decision Support Systems Economic Statistics Games Theory Geospatial Modeling and Visualisation of Statistical Data Information Analysis using SPSS Marketing Data Analysis Multidimensional Statistical Analysis etc.	Business Intelligence Computational Intelligence in Economics Data Analysis Inferential Statistics Introduction in Data Mining Multivariate Statistics Statistical Hypothesis Testing	Advanced Database Elements (NoSQL) Artificial Intelligence Time Series Time Series Analysis Time Series Analysis and Prevision
Master	Fundamentals of Econometrics	Actuarial Statistics Advanced Marketing Data Analysis Data Analysis Data Analysis and Statistical Analysis Systems Data Analysis using SPSS Decision Support Systems Geospatial Analysis applied to marketing etc.	Advanced Econometrics Advanced Statistics Bayesian Statistics Business Intelligence Cluster Analysis Computational Statistics Data Mining Data Mining and Knowledge Discovery Data Mining and Simulation etc.	Analytics and Data Science Artificial Intelligence BI and Big Data Big Data Analytics Data Science Methods Hybrid Intelligent Systems Intelligent Systems Natural Language Processing Neuronal Networks etc.

Although the proposed framework only highlights the technical knowledge and skills required by the BA job market, a very important role is also played by soft skills.

According to Bensberg and Buscher [14], the main soft skills required for BA jobs are: communication skills, team skills, analytical and critical thinking skills, engagement, creativity, organizational skills and willingness to learn. But at present, these soft skills are not specific only to the BA domain, they are highly demanded on the labor market, especially for the business domain. This high demand is related in part to the role they play in ensuring a sustainable development. The previously mentioned skills can be found amongst the elements that form the key competencies for sustainable development identified by Rieckmann [37]. These key competences are complex, comprising of more than just knowledge and skills and are relevant in various business contexts [38]. The connection between the two only serves to emphasise the role the BA domain plays in attaining a sustainable future and the need for well-prepared specialists in the area.

In Romania, a National Qualifications Framework has been implemented containing 8 levels of qualification ranging from basic (Level 1) to advanced (level 8) together with corresponding knowledge, soft skills and competencies [39]. This framework is compatible with European Qualifications Framework. Level 6 and 7 refers to knowledge, soft skills and competencies for bachelors degree and masters degree.

Also, the National Qualifications Framework for Higher Education Matrix includes: "qualification levels, learning outcomes expressed in terms of knowledge, skills and competencies as well as the level descriptors for qualifications in higher education" [40] (p.31). The following soft skills are identified: critical and thinking skills, problem-solving skills, creativity and innovation, communication skills, organizational skills, personal and professional development (willingness to learn new things), team skills and social interaction [39]. It can be seen that these soft skills correspond to those specified by Bensberg and Buscher [14]. According to the National Qualifications Framework for Higher Education Matrix, for each programme/field study are specified the knowledge, skills and competencies that can be reached.

In Section 5.2, the identified jobs were organized according to the proposed business analytics maturity model levels, based on the technical skills required for each job (Table 4).

Table 4. A framework for evaluating the Business analytics maturity of university programmes (knowledge and technical skills).

BA Maturity Level	Domain	Knowledge	Hard (Technical) Skills
Advanced level	Big data management and computing infrastructure	—advanced knowledge of techniques to capture and manage big data (non-relational components and distributed data storage) —advanced knowledge of techniques to integration big data —strong knowledge of big data modelling techniques —strong knowledge of big data cleansing techniques	—high proficiency with a variety of NoSQL database platforms (Cassandra, CouchDB, HBase, MongoDB); —high proficiency with data integration tools (Informatica, Talend, etc.) and preparation tools (Alteryx Analytics, SAS Data Loader for Hadoop, etc.); —experience with Data Quality & Data Profiling metrics and tools —good skills with Apache Hadoop ecosystem and related data technologies (Apache Hadoop, MapReduce, HIVE, HBase); —advanced skills with big data modelling tools (ERWin, Enterprise Architect Visio, etc.); —experience with Agile delivery methodologies (SCRUM)
	Business analytics (data science and advanced business analytics)	—advanced knowledge of visualization techniques and dashboard design; —advanced knowledge of predictive modelling concepts, machine learning approaches, clustering and classification techniques, deep learning algorithms, —advanced knowledge of prescriptive techniques; —advanced knowledge of design and implement domain-specific models and techniques such as marketing analytics, finance analytics, supply chain analytics, digital marketing and Social Media analytics, etc. —advanced knowledge of big data programming	—advanced skills with Data visualization tools (QlikView, Tableau, SAS, Analytica); —advanced skills with SAS/Analytica for simulation —advanced skills with R, Python, Scala, SAS for predictive modelling; —advanced skills with machine learning tools (Apache Mahout, R, Spark, Scala); —advanced skills with MATLAB for data mining, optimization, simulation; —advanced skills with SPSS Modeler, SAS Enterprise Miner; —advanced skills in NPL (Watson Natural Language Understanding, Standford NPL);
Moderate-advanced level	Big data management and computing infrastructure	—strong knowledge of RDBMS, database tuning and performance —good knowledge of NoSQL databases —good knowledge of ETL techniques —good knowledge of data warehousing concepts, data warehouse structures, data mart, design, implementation, management, data architecture of OLTP and data warehouse —depth knowledge of dimensional data modelling (star/snowflake schema) and methodologies	—good skills with a variety of NoSQL database platforms (Cassandra, CouchDB, HBase, MongoDB) —good skills with a variety of ETL tools (Microsoft SSIS-SQL Integration Services, ODI, etc.) —proficiency with a variety of data warehousing platforms (Oracle, IBM, Microsoft) —good skills with data modelling tools and methodologies (ERWin, Enterprise Architect Visio, UML, etc.)
	Business analytics	—good knowledge of BI (business reporting, OLAP), good knowledge of the methods, procedures and techniques of report writing —good knowledge of GIS; —good knowledge of visualization techniques and dashboard design; —good knowledge of in-database analytics; —good knowledge of predictive analytics (such as: regression, statistical inferences, simulation, forecasting models, data mining); —good knowledge of operational research and econometrics; —good knowledge of decision theory; —good knowledge of Big data programming;	— proficiency with BI platforms (Oracle OBIEE, Business Objects, Cognos, MicroStrategy, Microsoft Analysis/ Integration/ Reporting Services, Microsoft DAX Language, Crystal Reports) —experience in building data visualization dashboards using Tableau/QlikView/Power BI —proficiency with SQL analytics (experience creating advanced SQL queries) —good skills with data mining tools (IBM Watson, SAS Enterprise Miner, KNIME, Rapid Miner) —experience using Python/R/MATLAB for analysis —proficiency with Google analytics (for marketers)

Table 4. *Cont.*

BA Maturity Level	Domain	Knowledge	Hard (Technical) Skills
Moderate level	Big data management and computing infrastructure	—good knowledge of databases and query languages; —knowledge of ERD, database design (other BD courses) and cleaning data; —basic knowledge of Big data programming;	—experience with SQL database systems (Oracle, SQL Server, Postgres, MySQL), reading and writing SQL code —core skills with NoSQL databases (MongoDB) —core skills with data modelling tools and methodologies (UML, etc.) —basic skills with R/Python
	Business analytics	—basic knowledge of visualization techniques; —basic knowledge of BI concepts, report techniques; —basic knowledge of GIS concepts; —good knowledge of statistics (other statistics courses, Survey Statistics, Quantitative analysis); —good knowledge of econometrics (other econometrics courses); —knowledge of Decision Support Systems; —knowledge of operational research;	—some experience with Data visualization tools (Qlik sense cloud, Power BI) —some experience with BI platforms (Power BI) —some experience with GIS platforms (ArcGIS online) —experience using statistical packages for analysing datasets (SAS/SPSS)
Basic level (foundation)	Big data management and computing infrastructure	—core knowledge of databases (concepts, data models, database design, development, relational database concepts)	—basic skills with Oracle database/MySQL database /Microsoft SQL database/Access database —basic understanding of SQL, reading and writing basic SQL code
	Business analytics	—basic knowledge of statistics (descriptive techniques); —basic knowledge of econometrics;	—essential skills in SPSS, SAS —advanced proficiency with Excel

5. Analysis and Results

In this section, we will present the results of the analyses in detail. To view these results we used Tableau software as a data visualization tool, both for the analysed university programmes and for the area of job advertisements. According to Gartner's Magic Quadrant for Business Intelligence and Analytics Platforms—2018 [41], Tableau is a BI market leader followed by Qlik and Microsoft.

5.1. Analysis of BA Courses Offered by Romanian Economics Universities

In order to analyse the BA courses'offers of the Romanian economic universities, we sought answers to the following questions:

1. How prepared are Romanian business students in BA? Do economic universities offer BA competencies corresponding to the requirements of jobs in the BA field?
2. Which faculties offer business analytics programmes or BA courses?
3. What are these programmes (or courses) called?
4. What are the masters programmes that offer the most analytical courses and at what level of analytical maturity?
5. What are the fields of study that offer the most analytical courses and the level of analytical maturity?

We identified the following common categories for BA-related courses names: statistics, data analysis, business intelligence, analytics and data science, data mining, decision support systems, and Big Data (Figure 2). Figure 2 shows the percent of total number of courses for each course name category and the total number of BA-related courses that fall within each category (only masters level), as well as a distribution of the categories of courses per universities. We observed that data analysis courses represent the second most common category of BA-related courses (behind statistics) with 21 courses (16.67%of BA-related courses) and 24.6% of BA-related courses fall into the statistics category.

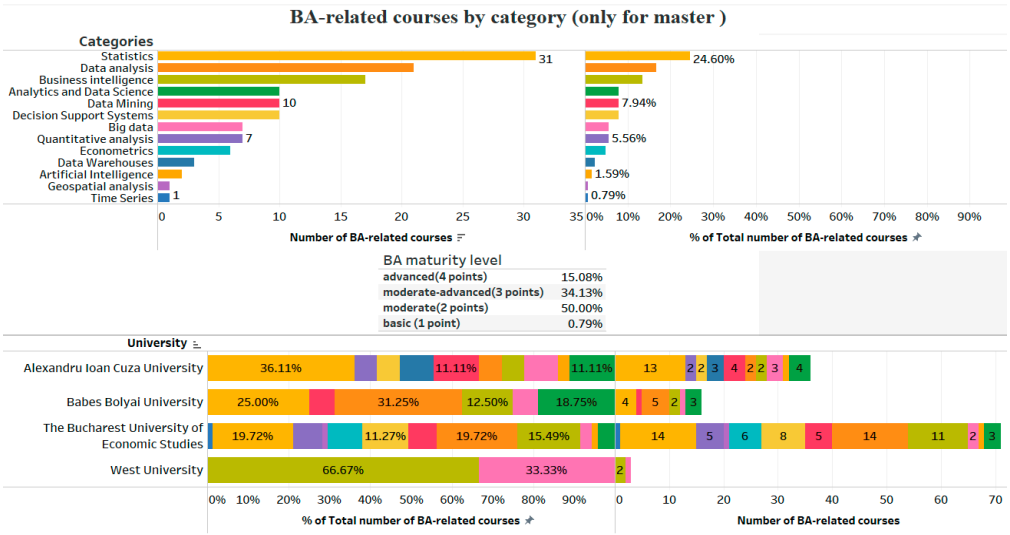

Figure 2. Common categories for BA-related course names (master level) and a distribution of courses categories per universities.

Also, we observed that only 7.9% of BA-related courses (7 courses in the Big Data category and 3 courses in Data Warehousing) fall into the *Big Data Management and Computing Infrastructure* domain, and we can conclude that business students are not prepared for this area. Although most of the analytical courses are included in the BA domain, it is noted that the share of advanced analytical courses is rather small, namely 15.08%. However, there are preoccupations from masters programmes

to adapt to the rapid evolution in BA and provide advanced analytical skills such as analytics and data science courses (4 courses at Ioan Cuza University, 3 courses at FSEGA and 3 courses to ASE).

According to the analysis, it was found that the bachelors level provides only the foundation for the training in the *Business Analytics* domain, 86.36% of the analytical courses being statistics, econometrics, spreadsheet software for analysis and fundamentals of database. For masters study programmes (158 different master's study programmes), statistics courses represent between 19.72% (ASE) to 36.11% (Ioan Cuza University) of the total number of BA-related courses offered by universities. We noticed that only two business intelligence courses and one Big Data course are available at West University, with statistics courses being only available at bachelors level.

There are three master's study programmes in statistics: statistics programme (ASE), econometrics and applied statistics programme (FSEGA) and statistics and actuarial sciences in insurance and health care programme (Ioan Cuza University).

Presently, there is only one BA programme, namely the *Data Mining* programme at Ioan Cuza University. This programme ranks first in the hierarchy by the number of analytical courses offered (11 courses), but offers only 2 advanced analytical courses (Figure 3). Figure 3 also shows a hierarchy of study programmes (TOP 2) on each BA maturity level proposed in the framework, also specifying the number of analytical courses offered by the programme at that level of maturity. It should be noted that the Finance and Banking programme (ASE) is the only programme that offers a basic level course (see Figure 7).

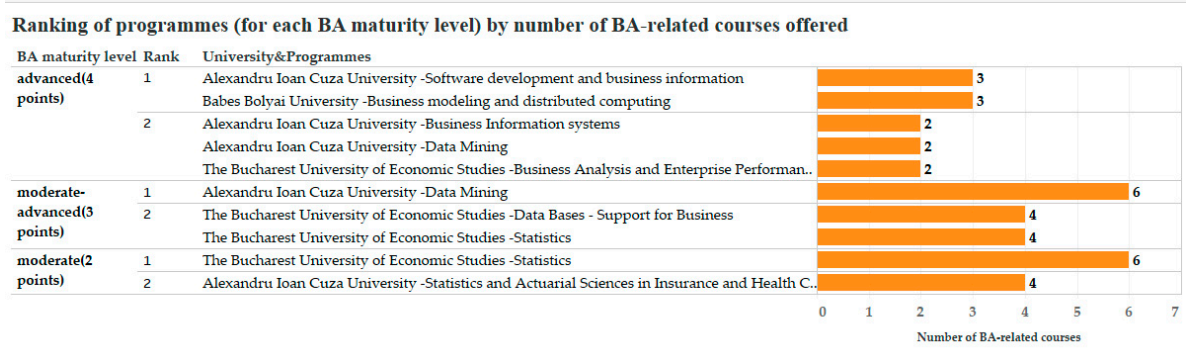

Figure 3. Ranking of master programmes for each BA maturity level.

Compared with the world's top universities, we see that Romanian universities do not yet offer their students sufficient BA topics. For example, the University of Washington offers 46 analytics programmes, Carnegie Mellon University offers 25 analytics programmes, and George Mason University offers 31 analytics programmes [42]. According to the portal Studyportal masters [43], in the UK there are 52 analytics programmes, in Germany there are 9 BI and analytics programmes, and in France there are 16 programmes at masters level.

Figure 4 shows the distribution of programmes by the number of analytics courses offered (only master level) by each university. At the graduate level, 95 out of 158 programmes (60.13% of all programmes) do not offer any analytics courses. Only, 31.01% of all programmes offer one or two analytics courses and only 8.86% of all programmes offer 3 or more courses.

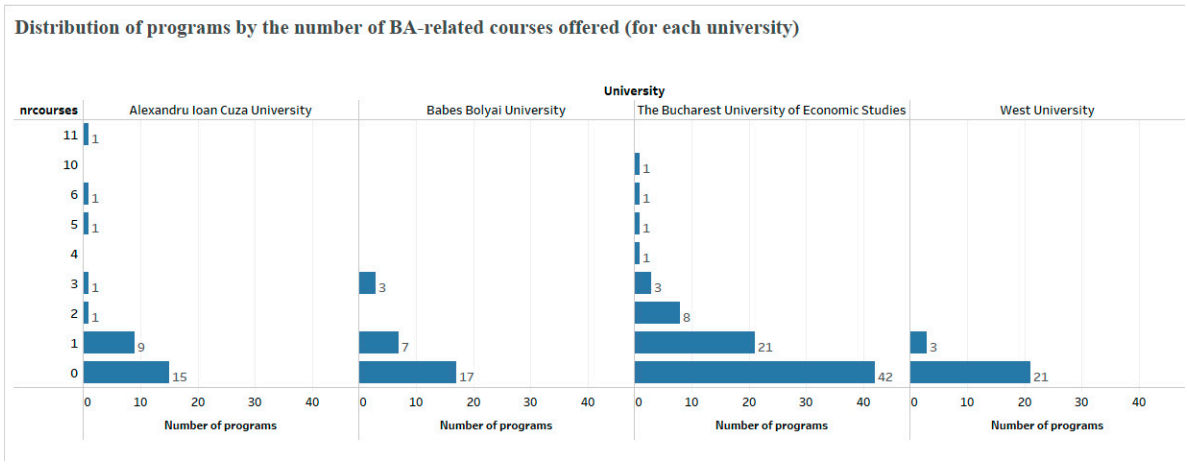

Figure 4. Distribution of programmes by number of BA-related courses offered (for each university).

The distribution of BA courses by field of study and the analytical maturity levels proposed in the framework is illustrated in Figure 5. Each circle refers a program. It is noticed that the *Economic Cybernetics, Statistics and Informatics* domain offers the most BA courses, but predominantly for the moderate and moderate-advanced levels. Students in this area are the only ones who are prepared enough to successfully apply for a BA job.

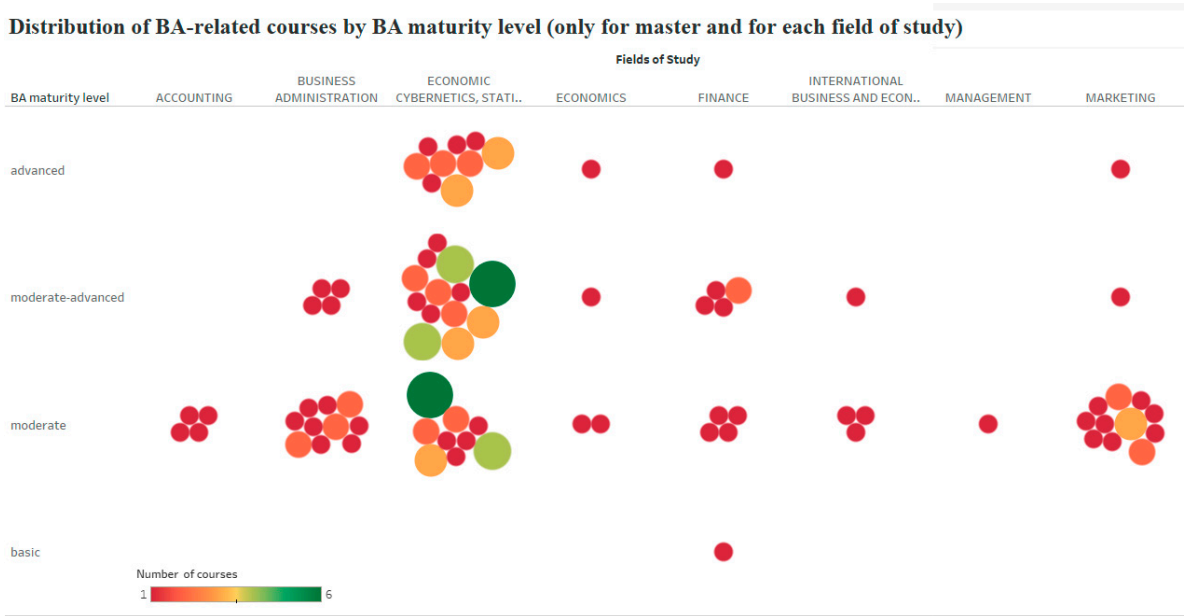

Figure 5. Distribution of BA-related courses by BA maturity level (for each field).

The other study fields offer a small number of BA courses and especially at the moderate level, the students of these fields being insufficiently trained for a BA career, taking into account the labour market requirements resulting from the analysis presented in Section 5.2.

A hierarchy of universities was realized in Figure 6, taking into account the number of analytical courses offered per study field. The labels indicate the number of courses offered at each university. The highest number of courses are offered by the economic cybernetics, statistics and informatics field being the leader with 68 courses, at master level. Business administration, marketing and finance offer a small number of analytics courses as compared to economic cybernetics, statistics and informatics. Administrative science does not provide any analytics course, at master level.

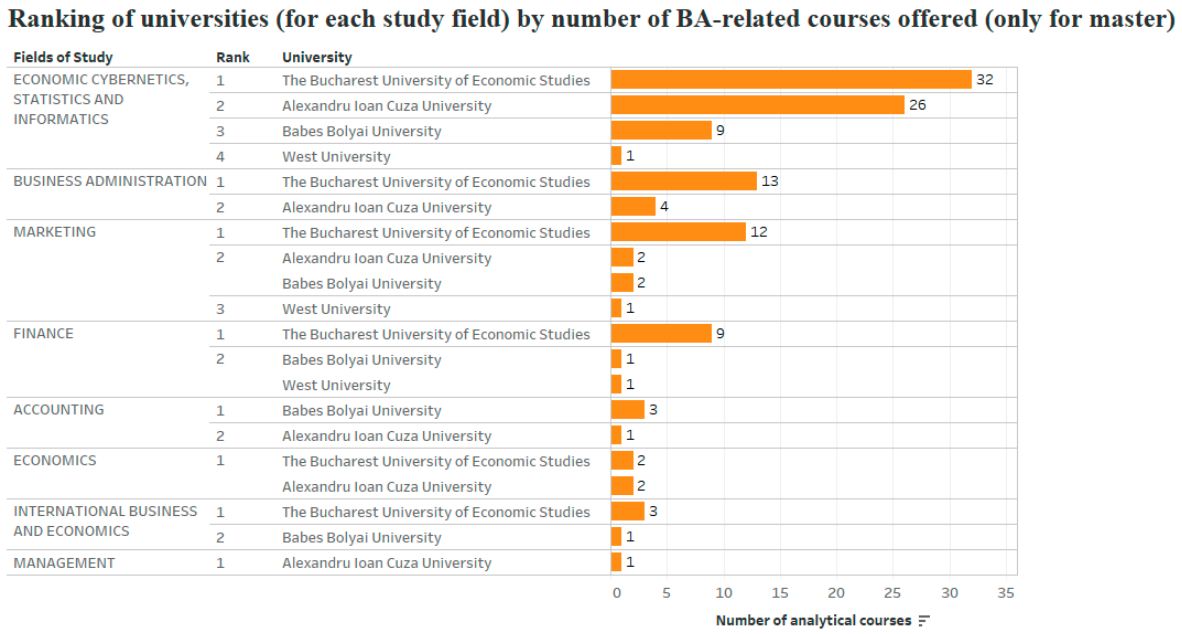

Figure 6. Ranking of universities (for each study field) by number of BA-related courses offered (master).

It is also noted that ASE offers the most BA courses in most study fields, except management and accounting, although in these areas, business analytics are very important.

A comparative analysis between the total number of programmes and the number of programmes with BA-related courses, for each study field (displayed as a percentage as well) reveals a considerable discrepancy between the study fields, the percentage of programmes with BA courses ranging from 88.89% in economic cybernetics, statistics and informatics to 0% in administrative sciences (Figure 7). For example, in the *Management* field, from 27 different study programmes, 26 programmes do not offer any analytics courses (except human resource management programme from the Ioan Cuza University, which offers the statistics for business course).

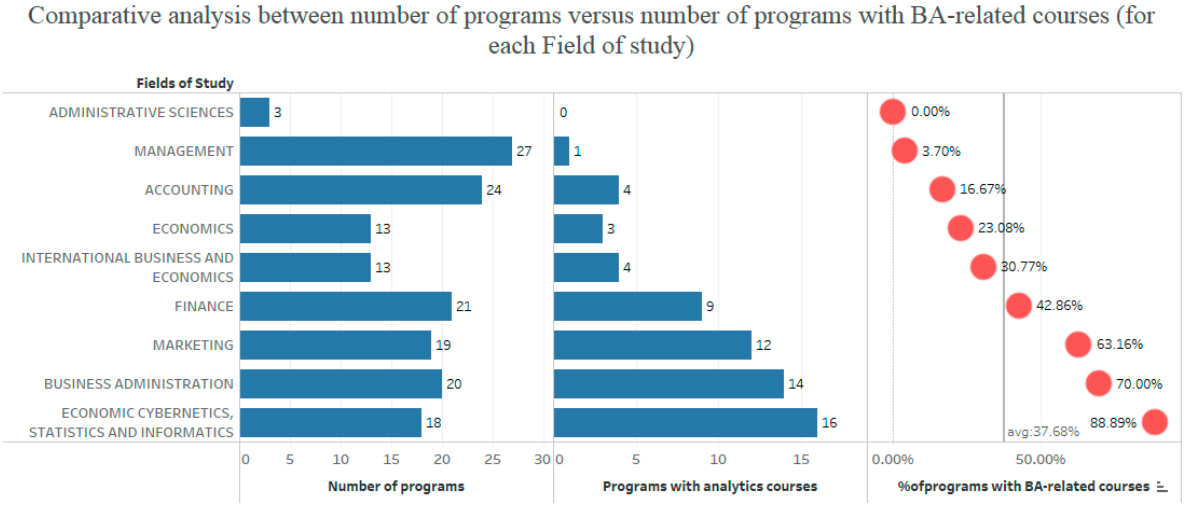

Figure 7. Comparative analysis between number of programmes versus number of programmes with BA-related courses (for each field of study).

It is noticed that a very large number of programmes from areas such as management, accounting, economics, administrative science, and finance do not offer students the accumulation of analytical skills, not even at a moderate level.

The question arises as to why there are very large discrepancies between study fields, but also between universities. An explanation would be that economic universities do not currently have a common strategy on adapting the curriculum to the rapid evolution of BA.

Most masters programmes do not consider the development of moderate-advanced and advanced analytical skills to be a priority, and that BA jobs would be a great opportunity for students of these programmes. Also, many masters programmes and, implicitly, university staff involved in the relevant teaching process consider that only students in the economic cybernetics, statistics and informatics study field have to specialize in BA, which is a big mistake. At present, if graduates of economic universities want to engage in BA-centric organizations, they need to be familiar with BA tools.

Also, developing BA solutions for marketing, financial, sales or HR departments require development teams that must have training in the field as well as good BA knowledge.

There is also a mistaken perception from the students, who believe that working in BA involves only graduating from a faculty with a computer/statistical/cybernetic profile.

Most BA courses offered by Romanian economic universities are at the moderate maturity level, and in Figure 8, it is noted that most BA courses are offered by ASE (the largest economic university in Romania), but at a moderate and moderate-advanced level. Each circle refers a program.

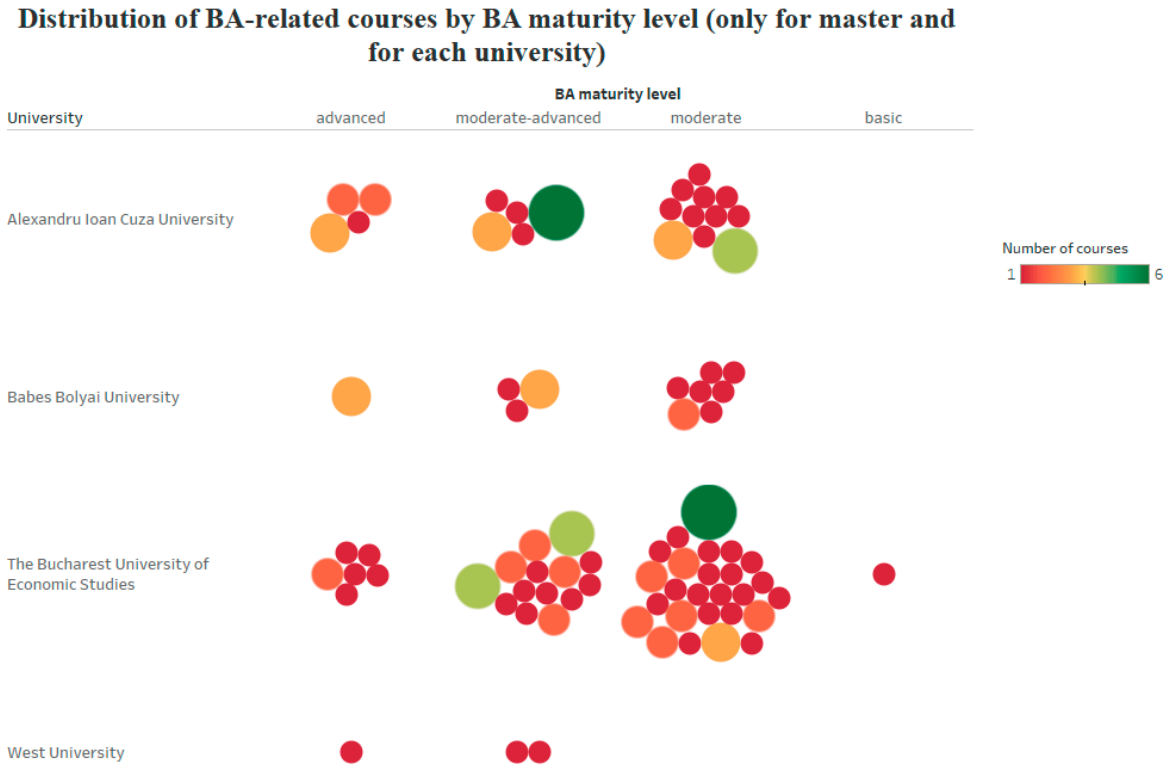

Figure 8. Distribution of BA-related courses by BA maturity level (for each university).

There is, however, a great demand from employers for graduates with moderate-advanced and advanced analytical skills. Jobs with such skills are the best paid but also very difficult to occupy. Companies have difficulties finding graduates with such skills and so they often develop their own training programmes to prepare BA specialists. This aspect is also highlighted in the study realized by the World Economic Forum [1], in which it is anticipated that between 2018 and 2022 about half of all reclassifications will be offered through the companies' internal departments, about a quarter through private training providers and about one fifth through universities. The study also states that by 2022, 85% of surveyed firms will use BA and there will be an increasing demand from companies for BA jobs such as data analysts, data scientists, AI and machine learning specialists and Big Data specialists.

5.2. Analysis of the Main Requirements of Business Analytics Jobs on the Romanian Market

Each maturity level involves a certain set of knowledge and technical skills and we have used these elements to set each job found on the correspondent level. It should be mentioned that although in the framework, knowledge is presented in an independent category, separate from the technical skills, when setting the level of rank for each found job, we used only the technical skills area. This is due to the fact that job advertisements offer very little information about the knowledge a candidate needs to have, focusing on the technical area, the tools he/she needs to work with. Moreover, many announcements are ambiguously formulated, there is confusion between skills and knowledge and there is no clear distinction between the different types of desired skills (technical, analytical, and business). We have tried to make this differentiation using the Cegielski model [23] and classifying the information offered in the ads according to it.

From this perspective, the Romanian jobs' market in the business analytics domain is still an immature market compared to the markets in Western Europe or the United States.

We organized the jobs according to the proposed BA maturity model levels, based on the technical skills required for each job, resulting the following grouping:

- 15 jobs at the basic level
- 16 jobs at the moderate level
- 21 jobs at the moderate-advanced level
- 30 jobs at the advanced level

We note that the number of available positions for high-level specialists is double that available for lower-skilled staff, although we are talking about entry-level jobs. This confirms that the market is looking for highly trained people who have advanced knowledge in the latest technologies: Big Data environment, machine learning etc.

Table 5 presents the key skills (technical skills& knowledge, business skills and analytical skills according to [23]) desired by employers when they hire business school graduates for entry-level and junior positions.

Table 5. The key skills desired by employers as derived from jobs listing.

Model Level	Top Business Skills	Top Analytical skills	Top Technical Skills and Knowledge
Basic	Good English skills Effective communication skills Communication skills Ability to effectively work in a team environment Organizational skills	Good analytical skills Attention to details Quality-oriented Interpretive skills	Advanced Excel MS Office SQL
Moderate	Strong English skills Good communication and presentation skills Ability to effectively work in a team environment Organizational skills Proactive behaviour	Analytical thinking Attention to details Algorithmic and structured thinking Capacity to analyse and synthesize information	Relational databases SQL Server SQL language MySQL Proficient Excel SPSS NoSQL databases Office Java, JavaScript, Visual Basic

Table 5. *Cont.*

Model Level	Top Business Skills	Top Analytical skills	Top Technical Skills and Knowledge
Moderate-advanced	Advanced English skills Excellent communication skills Ability to effectively work in a team environment Proactive, independent behaviour Highly motivated and ambitious	Strong analytical skills Attention to details Problem-solving skills Ability to work through large amounts of data Ability to extract actionable insight from raw data	Data visualization skills (Tableau, Qlik sense, PowerBI) SQL and relational databases experience Advanced Excel skills Data modelling skills MS Office Data mining and predictive statistics tools NoSQL databases ETL tools Experience working with reporting tools
Advanced	Proficient written and spoken English Excellent professional communication skills High ability to effectively work in a team environment Excellent organization skills Excellent interpersonal skills	Excellent analytical and quantitative skills Great attention to detail Excellent problem-solving skills	NoSQL databases and technologies (Cassandra, MongoDB, Hadoop, Hive) Programming languages – Python Experience in relational databases and query languages (SQL) R language Object oriented programming languages (Java, C++, C#, Java Script) Mastery of agile methodologies

As can be seen by studying each skill category identified in the previous table, the list of analytical and business skills is relatively similar for each of the four maturity levels, which shows that the technical skills are the ones that make the difference and determine framing the job on a certain level in the model. However, although for business and analytical skills it is possible to identify an evolution of the required level for each of them, from basic to advanced (e.g. Good English to Proficient English), the same cannot be said about the technical skills. Descriptions of available positions very rarely specify the level of knowledge of a tool or technology required to occupy that position. In general, the tool/technology is mentioned without specifying how well a candidate needs to know how to work with that tool/technology

Figure 9 shows the results of the frequency analysis for the key skills for entry-level and junior jobs for each of the four levels of our proposed maturity level.

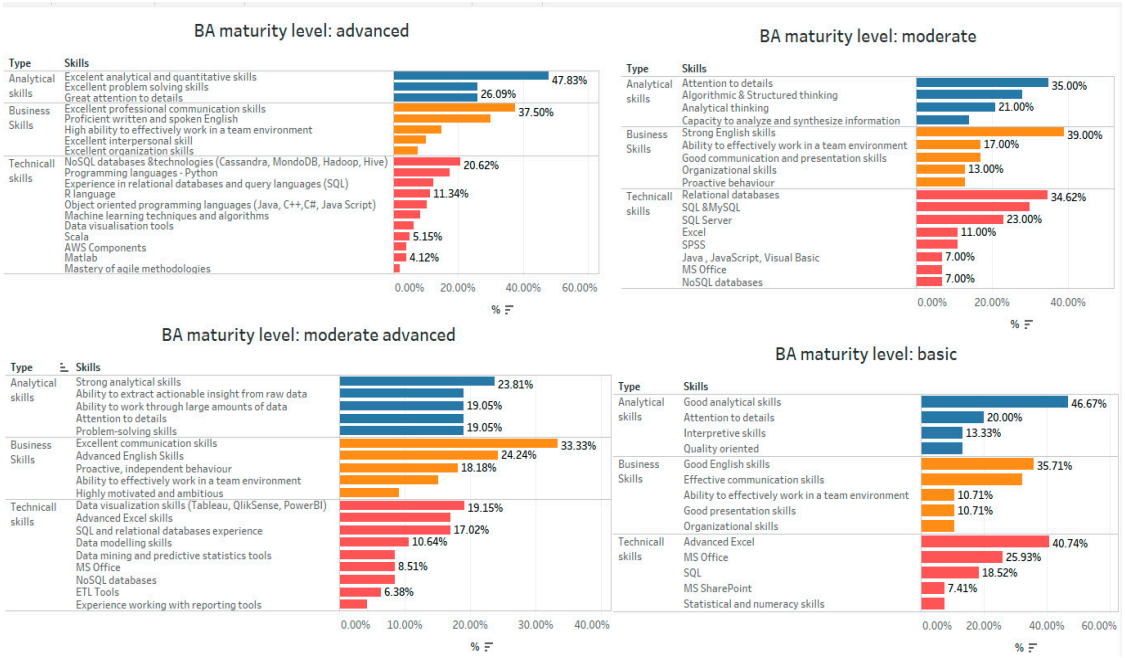

Figure 9. Frequency analysis for the key skills for entry-level and junior jobs.

The most prominent business skills that result from the Figure 9, for the four levels of the model, refer to communication and English skills with a frequency of over 25% for each maturity level while in the analytical category analytical skills (with a frequency between 20–40%) and attention to details (20–35%) occupy the top spots.

The connection between the required soft skills for the BA domain and the key competencies for sustainable development is obvious when comparing the main analytical and business skills found in our analysis with the competencies specified by Rieckmann [37]. The following correlations are easily observed:

- The analyical thinking skill is part of the critical thinking competency;
- The ability to work through large amounts of data and the capacity to analyse and synthesize information are part of the Systemic thinking and handling of complexity competency;
- The ability to effectively work in a team environment is part of the competency for cooperation.

In the technical skills section things are somewhat different, as the required set of tools and technical skills varies significantly from one maturity level to the other. For the basic level the most sought-after skill is advanced knowledge of Excel (40.74%) while for the moderate-advanced level data visualization skills have the highest frequency (19.15%). As we move on to the higher levels the focus shifts to databases, most specifically relational databases for the moderate level (34.62%) and NoSQL databases (20.64%) for the advanced level.

In Table 6 we present the jobs we have identified listed on the two platforms, according to the grouping realized for each maturity level.

Table 6. Jobs by level, according to analysed postings.

Basic Level Jobs	Moderate Level Jobs	Moderate-Advanced Level Jobs	Advanced Level Jobs
Business Analyst Customer Data Quality Analyst, Data Governance Analyst, Data Analyst Data Analyst Engineer (junior), Data Technical Analyst, FP&A Analyst, Junior Marketing Analyst, Supply chain analyst	Database Administrator, Customer Master Data Analyst, Data Analyst, Data Architect, Data Research Analyst, Database Developer Senior Market Research Data Analyst, Statistician	Associate Data Engineer, BI and Analytics Analyst, Business Analyst, Data Analyst, Data Analyst with Python/R Programming Language, Data Engineer, Data Scientist, Database Administrator, Digital Data Analyst, Digital Marketing Data Scientist, ETL BI Engineer, Java/Database Developer	BI Analyst Developer, Big Data Architect, Big Data Consultant, Big Data Engineer, Business Analyst, Business Intelligence Engineer, Data Analyst Data Analytics Specialist Data Architect Data Engineer for Big Data Data Engineer Data Scientist Data scientist—Data analyst Data Scientist—Data Engineer Data Scientist Manager Data Warehouse Architect Machine Learning Engineer SAP Big Data and Cloud Analytics Senior Data Scientist for IoT

According to our analysis, we have identified a set of jobs for each model level, with the mention that it is noticeable that some jobs have be assigned to several levels, because although the title used is the same, the sought-after skills differ from employer to employer.

It is most likely that each of these should only be assigned to one level, and the assignation should be done according to the number of available posted positions. The ones that deviate do so from a misguided use of the name of the available position in report with the responsibilities and skills demanded for it.

In addition, it is apparent that there is a demand for a higher number of different positions as we move through the model levels from basic towards advanced, which is in accordance with the number of available positions for each level, which we presented at the beginning of the analysis. Thus, it is clear that the market is more dynamic and has higher demands as the level of our model increase and the complexity of the available position grows.

A study conducted by Miller and Hughes [8] identifies the 10 fastest growing skills in the analytical field. Out of these, seven are amongst the most required elements of jobs belonging to the moderate-advanced and advanced levels of our proposed model: machine learning, data visualization, big data, Tableau, R, Hadoop, and Hive. These results show that the jobs market has high needs that keep touch with the latest trends meaning employees seeking to advance in the field must be prepared accordingly.

By doing a comparative analysis, in Romania out of 2346 IT jobs posted in July 2018 on the two platforms, ejobs and indeed, which meet the filtering parameters used for the analysis (full time, entry-level, university studies), only 107 belong to the BA domain, so a percentage of 4.5%. Most job postings regarding the business analytics domain in the US contain detailed information, clearly specifying the level of training required for each technical skill, while Romanian ads are more ambiguous and more general. In the US out of 145421 IT jobs posted on https://ro.indeed.com/, to which we applied the same filter criteria, there are 15641positions available for business analyst only, so 10.75% for a single job in the BA domain.

Moreover, in the US there are sought positions that do not exist on the Romanian market so far, such as data visualization specialist, analyst, analytics and reporting manager, data quality manager.

6. Discussion and Conclusions

The main contribution of this article is a BA maturity model for university programmes according to the technical knowledge and skills offered. In the context of the expected explosive growth on the

labour market in BA, the evaluation of the BA study programmes, the assessment of their maturity level and some directions for meeting the real needs of the companies are very important. These can play a major role in preparing the educational offer of the universities and in making the decision to modify existing programmes or even introduce new ones. A study conducted in 2017 on the evolution of the BA job market [44] in the US estimates that in 2020 2.7 million jobs will be posted for data science and analytics and most jobs will be for the positions: business analyst, database manager, data mining analyst, financial manager, marketing manager, systems analyst, IT project manager, human resources (HR) manager, computer system engineer, product manager. Europe also estimates a need of 346,000 more data scientists by 2020 [45] and the European Union has defined a strategy to reduce labour shortages and increase the supply of data-scientists and a data-savvy workforce, including efforts made to multiply ICT and data science courses in European universities [46]. Many companies in the financial, marketing and HR domain prefer to develop their own training programmes to train their employees. However, the creation of in-house analytical courses may not be the most effective strategy to keep up with the rapid development of BA. But the lack of a common framework for data science and analytics jobs and skills, and the lack of clear definitions of new job titles and skills, only makes the situation even worse [8]. Additionally, there is a misconception that a degree in Statistics offers enough skills for a career in business analytics [45]. Today, a career in business analytics requires knowledge not only in statistics, but also in databases, data mining, Big Data, etc.

In this context, the proposed framework can be used by universities to establish a common strategy to reduce the gap between their supply and market demand in the BA field. In Romania's particular case, this has been a specific recommendation made by the European Comisson in 2013, to improve the match between educational curricula and labour market demands as part of the national higher education system reform [47]. Such a correlation would help students' career perspectives and their productivity which in turn would mean an increased competitiveness and output for the economy.

In a first step, universities can use the proposed model to assess their level of analytical maturity and check whether they have reached their proposed level, taking into account the type of target specialist or the main market areas to which their graduates are going. Later, the model can be used to improve the level of analytical skills in economic schools, taking into account the technical knowledge and skills required for the types of specialists they are preparing and their level.

As we have already mentioned, the maturity framework proposed in this paper is based on the careful study of the literature and the authors' experience, in a first phase. Later, the model was refined by confronting it with the labour market, studying the variety of offers available on the Romanian market. Moreover, the results of recent similar studies from the US and UK markets have been taken into account to provide a fuller picture of the knowledge and skills required in the BA domain.

The model uses only two areas of expertise, BA and Big Data management and computing infrastructures unlike Turel and Kapoor [18]. A more precise delimitation of the data field from the analytical field was attempted and the categories of analytical courses were grouped in these two areas. The four levels of analytical maturity identified are mapped to the two levels of student training: bachelor and master, thus highlighting the path a business student should undergo in order to become a good BA specialist. Technical skills were correlated with technical knowledge for each level of analytic maturity, making a more complete model than the matrices for technical skills proposed by Miller and Hughes [8], without providing the associated necessary knowledge. The presented model addresses a broader range of BA jobs, unlike Kim and Lee in [28] where knowledge and technical skills are identified only for the data scientists. Several models of analytical maturity have been developed in the industry in recent years, but they are inappropriate for university courses, as they include many aspects related to company specific processes or organization structures. For example, Gartner proposed in 2015 a BI and analytics maturity model [48] on 5 levels to evaluate programmes within organizations, taking into account people, skills, processes, metrics and other components as well as technologies, model it recommends as being a "roadmap for improvements". The proposed levels are: unaware, opportunistic, standard, enterprise and transformative. The Data Warehouse Institute

(TDWI), which proposed in the mid-2000s the first BI maturity model, has developed an analytics maturity model to help users determine the maturity of their organization's analytics initiatives when compared with other companies [49]. The TDWI model consists of five stages: nascent, pre-adoption, early adoption, corporate adoption, and mature/visionary. Some other companies that activate in the field have developed or adapted their own analytical maturity models such as Logi Analytics [50], Arbala technologies [51]. Of course, they are a starting point for a maturity model of university education programmes, but it is almost impossible to apply them.

Closer to the education context is the analytical training and certification programme developed by Informs [31] for analytic semi-professionals and professionals that tracks topics from seven domains or areas of analytics practice: business problem framing, analytics problem framing, data, methodology (approach) selection, model building, deployment, and model life cycle management.

For the case of university programmes, the only works we have identified are those of Turel and Kapoor [18] and Dubey [4]. If the second proposes a theoretical model that remains to be applied and validated by those interested, Turel and Kapoor has a more practical approach, developing two BA maturity frameworks based on course categories and level of training. The proposed models do not provide details about knowledge and skills required for each level and they do not make any connection with the real job requirements on the market.

From the point of view of the universities, the reduction of the BA specialists' deficit can be achieved mainly through involving the business environment and economic universities in creating new BA programmes based on a universally accepted framework of BA competencies. The framework we developed could be adapted and brought to a unanimously accepted form. Also, as economic universities decide they need to adapt their curricula to keep in touch with the business environment to provide students with the necessary BA skills, they may adapt the proposed framework of competencies. Our analysis contains little information that is specific to the case of Romania: names of universities, specialties or courses. For most of the studied courses, the names are found in the field literature [8,19,29,33,39]. The names of universities or specialties can be easily replaced with those specific to other analyzed situation. Courses are grouped into general categories that are met in the literature for the case of other countries or universities [8,19,29,39]. The courses are also grouped in areas with a higher degree of generality. On the other hand, the Romanian job market does not offer in the BA field other descriptions, job types or other skill requirements than those identified in the literature for other markets. Only the level of demand and level of skills required differ, as mentioned in Section 5.2. As a result, the proposed maturity model is generalizable and can be used with small adjustments for any other economics university.

As a future direction for our research, we have considered extending our analysis by collecting data about university programmes and BA jobs for a longer time interval in order to see the evolution in time. A limitation of our model is that it highlights technical knowledge and skills, while business skills and analytic skills are not included in assessing the maturity level. Future research may consider adding these important aspects to the developed maturity model. It would also be interesting to extend the analysis to other categories of universities, not just economic ones.

Although the technical needs are high, the Romanian labour market in the field of business analytics is generally a young market with a rapid evolution, at the beginning of the road, a fact which results from the relatively small number of jobs available in this field compared to other established fields, from their limited variety and from the way of presenting the information regarding the available jobs.

We can conclude that presently there is a significant gap between the offer of economics universities in the BA field and market demand. The vast majority of students in economics universities are not prepared for jobs in the BA field, although there is a huge potential of human resources in universities that could cover the shortage of BA specialists. The need for such specialists is especially high as in the near future BA capabilities are set to become essential in attaining a sustainable development throughout the various economic fields, as demonstrated in the United Nations' 2030

Sustainable Development Agenda, whose entire list of goals requires a comprehensive understanding of large data volumes as well as ways of processing, manipulating, and interpreting them [52].

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