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BIG DATA AND PROFILING VERSUS GDPR[2]

1. INTRODUCTION

Nowadays, large data sets (Big Data) are used in telecommunications, marketing, transport, automotive, banking, tourism and many other areas. Nonetheless, aside of obvious opportunities for development, Big Data triggers numerous questions of a legal nature, including the proper implementation of the principles of data processing in large collections. There is also concern about the threat to the information autonomy of the individual[3] or the need to give consent to profiling[4]. Privacy is eroding mainly due to decisions taken by not always fully conscious and sovereign Internet users[5]. The risks are increasingly recognised, stemming from the huge scale of data collection, tracking and profiling, security, transparency, and their incorrectness, discrimination and much wider supervision by the authorities of various countries[6].

This paper examines the concept of Big Data and related profiling. Moreover, Big Data application and its possible limitations linked to personal data protection will be discussed. Accordingly, Big Data will be presented amidst the changes in personal data protection, once the General Data Protection Regulation (GPRD) has come into force[7].

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[3] B. FISCHER, *Prawo użytkowników wyszukiwarek internetowych do poszanowania ich autonomii informacyjnej* [in:] *Internet Ochrona wolności, własności i bezpieczeństwa*, ed. G. SZPOR, Warszawa 2011, p. 68.

[4] W. WIEWIÓROWSKI, *Profilowanie tylko po powiadomieniu*, Http://www.computerworld.pl/news/377157/GIODO.profilowanie.klientow.tylko.po.powiadomieniu.html.

[5] I. LIPOWICZ, *Nowe wyzwania w zakresie ochrony danych osobowych* [in:] *Internet Ochrona wolności, własności i bezpieczeństwa*, ed. G. SZPOR, Warszawa 2011, p. 14.

[6] P. DROBEK, *Zasada celowości w dobie wielkich zbiorów danych (big data)*, Dodatek do Monitora Prawniczego, Aktualne problemy ochrony danych osobowych 2014, Issue 9/2014, p. 21.

[7] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (OJ L 119, 2016, p. 1).

2. WHAT IS BIG DATA?

To date, no legal act has defined Big Data. Nonetheless, it refers to the process of collection, processing, analysis of data and visualization of results using large data sets. Interestingly, nowhere is the precise size of the data filing system specified which would make it Big Data.

Whether a data filing will be defined as a Big Data depends mainly on the specificity of the specific data processing process. Hence, for processes in which very large amounts of data are collected over a short period of time, a set will have to have its volume specified in Petabytes (PB) to be qualified as Big Data. On the other hand, for processes with a much slower pace of collection, to qualify a filing as Big Data, the volume counted only in Megabytes (MB) may suffice. In this regard, it is noteworthy that the issue whether the filing volume prevents its data from being analysed with traditional analytical tools stand vital in the context of qualifying a filing as Big Data. If so, the Big Data comes into play.

The 5V model is currently used to describe the Big Data sets:

- *volume*,
- *velocity*,
- *variety*,
- *velacity*,
- *value*.

According to the model, Big Data must meet specific conditions such as: large amount of data in the filling, data variability and diversity, and reliability and value of data that make up the set. Filling under analysis and its data which show those characteristics will be considered Big Data.

For Big Data it is essential that the data it contains originate from a variety of sources and to a large extent are not structured. This notion is not only about large amounts of data, but also about new possibilities for their analysis[8]. They are extracted, by way of illustration, from social networking sites, cloud computing, marketing information systems or customer

[8] Ibid., p. 21.

databases. It should be emphasized that data are collected less frequently by administrators in an active way, but tend to be gathered passively, having been left by the users at the same time[9].

It should be noted that the concept of Big Data has developed considerably and today is perceived differently than around the year 2000. It can be pointed out that the first forecasts concerning the "information boom", which was to come, emerged already in the 1940s. It was then that the problems were emphasized of interpreting mass amount of information that the humankind would be rapidly producing. On this note F. Rider, Wesleyan University Librarian, published *The Scholar and the Future of the Research Library* in 1944. Rider estimated that American university libraries would double their collections every sixteen years on average as a result of data explosion[10].

The term Big Data is considered to have been coined 19 years ago. In August 1999 Bryson, D. Kenwright, M. Cox, D. Ellsworth, and R. Haimes, together published an article *Visually exploring gigabyte data sets in real time*[11] and with the term Big Data mentioned in a subtitle. It was pointed out that by Big Data one should understand large collections of data, not-positioned or highly difficult to process or analyse with traditional analytical tools.

In 2001, however, an analytical and consulting company specializing in the issues of strategic use of technology and technology management - Gartner, published a report[12], attempting to describe Big Data through a 3V model:

- *volume*,
- *velocity*,
- *variety*.

Furthermore, quoting after Gartner's dictionary *Big Data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation*[13].

[9] Ibid., p. 21.
[10] *Historia w pigułce: big data*, http://www.brief.pl/artykul,2824,historia_w_pigulce_big_data.html.
[11] S. BRYSON, D. KENWRIGHT, M. COX, D. ELLSWORTH, R. HAIMES, *Visually exploring gigabyte data sets in real time*, Communications of the ACM, nr 42/8, p. 82-90.
[12] D. LANCY, *3D Data Management Controlling Data Volume Velocity and Variety*, Stamford 2001, https://blogs.gartner.com/doug-laney/files/2012/01/ad949-3D-Data-Management-Controlling-Data-Volume-Velocity-and-Variety.pdf.
[13] *Big data*, https://www.gartner.com/it-glossary/big-data.

It should be noted here that the concept of Big Data, and the ways of data processing, has showed a material development, primarily due to material increase in the amount of data collected, and their high variability over short time. Respectively, a large part of collected data became outdated soon and biased the results of analyses.

In this context, given the outdated nature of the processed data Big Data were labelled as Bug Data, that standing for waste data. At the same time, the phenomenon of processing outdated data began to be called ROT, that is *Redundant, Obsolete and Trivial*, which in translation means redundant, obsolete and invalid data. For this reason, the 3V model has been extended by two additional components - *velacity* and *value* of collected data, thus creating the currently used 5V mode[14].

This variation has made Big Data much more usable. Moreover, the nature and evolution of the components of Big Data models clearly implies the large data sets gaining in importance over the examined 10-year period. Furthermore, recently, in particularly highly variable areas, with fast data obsolescence, only data obtained during the last year or even half of the year have been used to limit the number of analyses based on outdated Big Data. Meanwhile, such Big Data sets began to be referred to as Fast Data sets.

3. BIG DATA AS A PROCESS

In order to understand the way data are processed, certain concepts must be clarified that are used and intrinsic in data processing in the Big Data files. *Data Science* is the first concept closely related to the Big Data filing system. The term can be viewed as data science, which deals with the process of acquisition, processing, visualization and inference based on structured and unstructured data, with the use of statistical methods, data mining, machine learning and predictive analysis. Closely related concept of a *Data Scientist* denotes a person dealing with the analysis of disordered data, which is a part of large data sets of the Big Data type.

Another very important concept related to Big Data is *Data mining*. This term is often referred to as data exploration or *Data mining*. Data mining has been known for many years as an area of interest of computer science. The technique in question assumes acquiring new

[14] A. MEDNIS, *Big data a regulacje prawne*, Warszawa 2014, p. 5.

information or knowledge from previously possessed data files. Accordingly, it can be pointed out that *Data mining* is primarily a collection of modern analytical techniques for automated discovery of statistical dependencies and schemes in large data files. Exploration of new relationships and diagrams, subsequently presented in the form of logical rules, decision trees or neural networks can have a high economic value and support corporate financial and marketing decisions. Data mining based environments often rely on advanced machine learning algorithms and large data files. And even though data mining grew out of artificial intelligence and the above machine learning, given the scale of the problems it faces, new, sophisticated algorithms, methods and architectures must be developed from scratch. It can also be pointed out that the purpose of the *Data Mining* techniques is to better utilize the data that an entity already has and to obtain information from them, which may curb operating costs or boost gains from products or services delivered on the market.

The above *Machine learning* inseparably links to *Data mining*, because virtually every model used in *Data mining* is based on *Machine learning*, that is learning to detect certain relationships between the collected data by software or an algorithm. *Machine learning* can be based on two different models. In the former - s*upervised machine learning* – the software is fed with a specific material to learn at the onset. The latter - *unsupervised machine learning* assumes that the software will be input with no learning material at first.

Under its life cycle, information is processed in the Big Data scale in various types of successive processes. Depending on the methodology adopted, the types and number of stages that make up the whole process may vary[15]. Regardless of the adopted model, all of those stages are designed towards better performance on different levels. Big Data analysis can enhance efficiency, minimize errors, reduce costs or optimize processes.

In this paper, the Big Data life cycle has been adopted, covering four consecutive phases, that is data generation, acquisition, storage and analysis.

3.1. DATA GENERATION

Data generation refers to the production of data processed on a large scale, which contain diverse and complex sets of information from various heterogeneous or diffuse sources. Data

[15] Conf. *Big data lifecycle*, https://cloud.google.com/solutions/data-lifecycle-cloud-platform.

sources include public registers, social networking sites, GPS transmitters, video-monitoring, mobile phones, smartwatches, etc. These data are typically sourced from business, Internet and research[16].

Regardless of the source, the data can be divided into three types depending on the degree of ordering[17]:

- structured data,
- unstructured data,
- semi-structured data.

It often proves difficult to determine to what extent data are structured. Data in public registers is usually considered as structured, such as the National Court Register (KRS) or Central Registration and Information on Business (CEIDG), but the data in the e-mail box will be only partially structured (besides, the degree to which they are structured within the e-mail boxes provided by several mail providers may vary). Usually a subjective criterion related to the degree of problems to track down information will be helpful here. The more difficult it is to trace a record, or to compare different records within a database on considering different criteria, the more likely it is that the controller is processing data in an unstructured database.

3.2. DATA ACQUISITION

Acquisition, that is collection of data from various sources, involves processing them for further analysis (including establishing relationships between them or obtaining completely new information). Sometimes the acquisition may also coincide with data filtering whereby data important for further analysis may be determined, and irrelevant, outdated or incomplete data will be excluded[18].

[16] K. VENKATARAMANAN, M. SREEDEVI, *A Review on Big Data Concepts*, International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 3 (2016), p. 278.
[17] E. THOMAS, *Big Data Fundamentals Concepts, Drivers & Techniques*, Crawfordsville 2015.
[18] A. LABRINIDIS, H. JAGADISH, *Challenges and opportunities with Big Data*, Proceedings of the VLDB Endowment, 5/2012, p. 2032.

3.3. DATA STORAGE

Within the data processing cycle on the Big Data scale, the storage phase consists of the permanent maintenance and management of data (for instance on servers, in warehouses). Accordingly, both the hardware infrastructure and data management matter in the data storage system. The former consists of common ICT resources arranged to promote multitasking.

The storage stage is sometimes referenced as the "preparation" stage because it primarily seeks to standardise data files, agree date formats and geographical coordinate systems, remove duplicates, divide columns, delivery headers and generally make the data set useful for analytical software[19].

3.4. DATA ANALYSIS

A fundamental step in data processing within Big Data is its analysis. The analysis can be divided into 6 key technical areas: structural data analysis, text analysis, multimedia analysis, web analysis, network analysis and mobile analysis. This classification aims to highlight the key characteristics of the data analysed within each area[20].

Data analytics is dedicated to controlling the full life cycle of data, which includes data collection, cleaning, organisation, storage, analysis and management. Moreover, this concept encompasses development of analysis methods, research techniques and automated tools. In large dataset environments, the challenge is to develop and use highly scalable distributed technologies and structures that can analyse large amounts of data from different sources. The analysis of large data files differs from traditional data analysis mainly because of the volume, velocity and variety of the data processed. Data analysis encompasses many stages of processing. First, the business context of the analysis is established. The next step is to identify data that will prove useful from the perspective of a specific business case. Next, data is obtained and filtered in terms of usefulness, timeliness or correctness[21].

[19] L. POUCHARD, *Revisiting the Data Lifecycle with Big Data Curation*, International Journal of Digital Curation 2015, Vol. 10 Issue 2 (2015), p. 186.
[20] K. VENKATARAMANAN, M. SREEDEVI, op. Cit., p. 278.
[21] Ibidem, p. 279.

The fourth stage consists in the extraction of data. Some data identified as input data for analysis may take a format inconsistent with the solution used in the Big Data analysis process. Incorrect data may distort and, thus bias the analysis results. Unlike traditional data collected by companies (be it this from a customer filling in an order form), with the default structure and pre-approval, data entered into Big Data analyses may be unstructured not checked for correctness. Therefore, this stage is designed to establish complex rules for checking the correctness and removal of any identified irregularities. Additionally, data extraction serves not only to identify the data, but also to transform it into a format compatible with the analytical software. The scope of required extraction and transformation is each time different and depends on the type of analysis and the possibilities of Big Data solution.

In the subsequent stage, the data is aggregated and representative records are identified. Whereas data can be located in multiple databases, data files must be linked via common fields, such as dates or identifiers. It is necessary to reconcile the data or to define data file representing the correct value. The stage of data aggregation and representation integrates multiple datasets and consolidates the results of this integration. The implementation of this stage may become more complicated due to differences in the data:

- data structure - although the data format may be the same, the data model may be different.
- semantics - a value marked differently in two different data files may denote the same thing, by way of illustration 'place of residence' and 'address of residence'.

The scale on which the data are processed may require a lot of time and effort for aggregating the data. Reconciliation of these differences may require a complex methodology, which will proceed automatically, with no human intervention. It is at this stage that the assumptions for data analysis requirements should be made to help increase data re-use[22].

The aggregation is followed by a proper analysis. This stage may be iterative, especially if the data analysis is exploratory, in which case the analysis is reiterated until the appropriate pattern or correlation is detected. Depending on the required analytical result, this step may be as simple as sending a query to a data file to determine an aggregation for comparison. On the other hand, it can prove a very complex operation, as a combination of data mining and complex

[22] Ibidem, p. 280.

statistical analysis techniques to detect patterns and anomalies or to generate a statistical or mathematical model to represent the relationships between variables.

The penultimate stage of the Big Data analysis process is to visualize the results. Analysis of big volume of data and finding useful statistics is of little value if solely analysts can interpret the results. This stage is dedicated to using data visualization techniques and tools for graphical transmission of analysis results, which facilitate effective interpretation by the business sector. Based on the results of the data visualization phase, users can perform a visual analysis and discover answers to questions which they have not yet formulated. It should be noted that the results can be presented in many different ways, which can influence the manner they are interpreted. Nonetheless, it would make no sense to present the results for the sake of the presentation itself. The whole stage of Big Data analysis paves the way to practical application of the results. Based on the data analysis results, the users of the guarantee and claim settlement system have developed a knowledge of the nature of false claims. However, for a measurable benefit from this data analysis, a model based on machine learning is generated which is next incorporated into the existing claims processing system to determine false claims[23].

4. BIG DATA AND PROFILING

The concept of Big Data inextricably links to profiling, a relatively new phenomenon, with relatively few relevant comprehensive studies in doctrine and case-law. So far, it has raised many concerns and reservations, which can be seen even at EU level - the Committee of Ministers of the Member States expressed its doubts and recommendations related to profiling in 2010 in the recommendation[24].

At a very general level, profiling can be compared to categorising people according to different characteristics. Both those "fixed" (be it gender, ethnic origin, age, eye colour) and "variable" (behaviour, habits, preferences)[25]. Profiles tend to be created under a technique known as 'behavioural analysis'. Whereby, a particular behaviour (such us consumer choices)

[23] Ibidem, p. 284.
[24] *Recommendation CM/Rec. (2010)13 on the protection of individuals with regard to automatic processing of personal data in the context of profiling*, Strasburg 2010.
[25]*Towards More Effective Policing, Understanding and Preventing Discriminatory Ethnic Profiling: A Guide*, Luxembourg 2010, p. 8.

is matched and correlated with characteristics (for instance age). Whilst the previous Act on personal data protection of 1997 failed to define this concept, it covered profiling. Article 26a of the Act formulated a general prohibition on issuing final decisions in an individual case if its content derived exclusively from operations on personal data carried out in an IT system. Profiling has been defined in the currently effective GDPR. Under Article 4 (4) of the Act, *'profiling' means any form of automated processing of personal data consisting of the use of personal data to evaluate certain personal aspects relating to a natural person, in particular to analyse or predict aspects concerning that natural person's performance at work, economic situation, health, personal preferences, interests, reliability, behaviour, location or movements*.

It is implied (though not explicitly) that the processing must identify the personality of an entity based on a standard profile and thus make available an automated solution[26]. In order to illustrate this decision in law studies, situations are invoked in which certain categories of information are recorded in a database containing personal data. Subsequently, specialised software, which includes a certain processing algorithm, performs operations on personal data, in each case triggering a decision, relating to the data subjects. This would in particular be the case in the analysis of individuals' creditworthiness based on the information provided[27].

Under the personal data protection legislation in force before 25 May 2018, issue of decisions assessing a person and thus affecting its personal rights should not be delegated to computers; such decisions should always be the responsibility of a human. The solutions adopted in the directive and in the Polish act on personal data protection corresponded to the concept of the right to *self-determination in information technology* and is opposed to ignoring the individuality of the human being objectivised in computer operations[28].

Profiling as one of the forms of data processing has been detailed out in the GDPR, which on 25 May 2018 replaced Directive 95/46/EC[29]. Whereunder, 'profiling' means *any form of automated processing of personal data consisting of the use of personal data to evaluate certain personal aspects relating to a natural person, in particular to analyse or predict aspects concerning that natural person's performance at work, economic situation, health, personal preferences, interests, reliability, behaviour, location or movements*. In pursuance with the

[26] J. BARTA, P. FAJGIELSKI, R. MARKIEWICZ, *Ochrona danych osobowych Komentarz*, Warszawa 2015, p. 483.
[27] D. BAINBRIDGE, *EC Data Protection Directive*, London – Dublin – Edinburgh 1996, p. 67-68.
[28] J. BARTA, P. FAJGIELSKI, R. MARKIEWICZ, op. Cit., p. 480-481.
[29] Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data (OJ L 281, 1995, p. 31).

Explanatory Statement to the GDPR, *the data subject should be informed of the existence of profiling and the consequences of such profiling. Where the personal data are collected from the data subject, the data subject should also be informed whether he or she is obliged to provide the personal data and of the consequences, where he or she does not provide such data*. Further, the Explanatory Statement points out that *decision-making based on such processing, including profiling, should be allowed where expressly authorised by Union or Member State law to which the controller is subject*. The reiterated references to profiling in the content of the GDPR give reason to believe that this issue requires increasing attention and must be provided for in law, as being of vital significance and the use of profiling in business (in both the public and private sectors) is posting a year-to-year increase.

5. SUMMARY

The Big Data collection brings obvious benefits for many sectors of the economy. They can be used in public transport, medicine, genetics, ecology, public transport, science, development of the *Internet of Things* (IoT), sales optimisation, personnel management, etc. First, they are used by companies in their advertising as they enable them to run more targeted and effective marketing. On an interesting note, Big Data has been used in the brewing industry. The Israeli startup WeissBeerger has been the first ever to develop and implement a live monitoring system in bars, pubs and restaurants for the amount, type and brand of beer consumed, measured in specific time frames. It also counts the revenues and beer barrels (kegs) remaining in the backroom. Thanks to this, pub owners are aware of which brands and at what times "drink the best". The system also provides the owners with SMS hints which beer, in what quantities and on what days they should order[30]. Another example of Big Data's application was the action taken by Google, which not only uses large data files in its search engine, but also sponsors research to solve the global malaria problem in Africa[31].

It should be pointed out that although the phenomenon of large databases triggers many concerns, data processing, even on such a large scale, is not prohibited under current legislation. Still, the obligations arising from the GDPR must be met, especially the obligation to provide

[30] *8 zastosowań Big Data, o których nie miałeś pojęcia*, https://www.focus.pl/artykul/8-zastosowan-big-data-o-ktorych-nie-miales-pojecia.
[31] *11 najfajniejszych zastosowań Big Data*, https://plblog.kaspersky.com/10-najfajniejszych-zastosowan-big-data/2812/.

information, and that the principles of data processing must not be infringed. In particular, the difficulties of meeting the requirement of the collected and processed data pertaining to a purpose[32] and being adequate.

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[32] P. DROBEK, op. Cit., p. 21.

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Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (OJ L 119, 2016, p. 1).