

## **VOLUNTARY DISCLOSURE ON ALGORITHMIC DECISION MAKING SYSTEMS: EUROPEAN EVIDENCE.**

Enrique Bonsón. Professor of Financial Economics and Accounting at the University of Huelva. Plaza de la Merced 11, 21002 Huelva, Spain. (+34) 959217892.

Michaela Bednárová. Assistant Professor of Financial Economics and Accounting at the University of Pablo de Olavide. Ctra. de Utrera, km. 1, 41013 Sevilla, Spain. (+34) 954978179.

David Perea. Researcher in New Technologies and Accounting at the University of Huelva. Plaza de la Merced 11, 21002 Huelva, Spain. (+34) 959217864.

Victor Alejo. Researcher in New Technologies and Accounting at the University of Huelva. Plaza de la Merced 11, 21002 Huelva, Spain. (+34) 959217863.

**Keywords:** ADM; AI disclosure; corporate reporting; European companies; voluntary disclosure.

*Nuevas Tecnologías y Contabilidad.*

*Research Workshop 3: «Inteligencia artificial y crisis económica»*

# **Voluntary disclosure on algorithmic decision making systems: European evidence.**

## **Abstract**

In this paper, we explore the current practices of major European companies regarding algorithmic decision making (ADM) disclosure in their annual/sustainability reports. We develop a methodology based on bigrams of key words and associate words that enables automatic extraction of the information that companies disclose on ADM systems. A sample of 962 annual/sustainability reports, corresponding to the fiscal years 2018 and 2019, of companies listed in 13 European countries' stock markets is examined. Our findings show that ADM disclosure is still at an early stage and that the first adopters are mostly companies operating in the financial sector.

## **1. INTRODUCTION**

Over the last two decades, organizations all around the world have initiated and evolved non-financial disclosure to complete their financial statements with the aim of shedding more light on the general impacts of their activities. Immense stakeholder pressure has pushed companies to be more transparent about their environmental, social and governance performance due to possible negative impacts on the environment and society. This has further led to the development of quite generally accepted non-financial reporting standards, such as the Global Reporting Initiative (GRI), EMAS, ISO 26000, SA 80000 and so on, which provide guidance for companies on how to report their non-financial performance together with their key performance indicators (KPIs). Alongside these standards, legislation has been put in place in some countries as environmental, social and governance issues might imply certain threats to the society as a whole.

Over the last decade, the use of different artificial intelligence (AI) tools has increased. Companies and organizations from different industries have been seeking to develop and apply AI in their processes to improve their efficiency, reduce costs or personalize products and services. Nevertheless, the rapid evolution of new technologies has also raised certain concerns regarding human rights, data security, privacy or ethical issues. In particular, disruptive artificial intelligence tools with a high level of automation, massive data collection and manipulation and possible inherent biases are reasons for the wider society to worry.

Algorithms of all kinds have been and are continuously being created. There is evidence of biased algorithms and their impact on individuals and society. Thus, the rapid proliferation of AI-empowered tools in our daily lives in recent years has caused legitimate worries in the public society, which advocates the ethical and responsible development and implementation of such tools. Thus, there is an urgent call for more transparency in this matter.

Special attention should be paid to highly autonomous AI tools – algorithmic decision systems (ADS), also known as algorithmic decision making (ADM), which are based on the analysis of large amounts of data to infer correlations or to derive information to make decisions. Such applications imply, per se, potential practical and ethical concerns as the decision making is left to machines.

The use of ADM systems is increasing in EU countries (AlgorithmWatch, 2019), which implies that humans will be less and less involved in decision-making processes (Hoofnagle et al., 2019). Companies incorporating ADM into their day-to-day activities and operating in the EU market should comply with the EU regulations related to the use of AI, in particular Article 22(2)(b) of the GDPR, which addresses the case of automated decision making, providing specific exemptions and relevant safeguards (Malgieri, 2019). The GDPR subjects ADM to new transparency, ethics and accuracy requirements; however, it makes a clear policy preference for human-in-the-loop systems (Hoofnagle et al., 2019).

As these technologies continue to evolve rapidly, an increasing number of new as well as established companies are using them to build applications that reliably perform activities that were previously undertaken by humans. Therefore, it is just a natural evolution that stakeholders are now putting pressure on companies to be more transparent about the use of artificial intelligence, in particular different aspects of ADM as a part of non-financial disclosure. Indeed, some companies have already started to respond to this request by voluntarily disclosing such information in their annual or non-financial report. However, the fact that this is quite a novelty implies a lack of standardization in such a disclosure. To standardize the way of reporting on AI applications, first, a consensus has to be achieved on what and how to report and which key elements should be disclosed to satisfy the information needs of different stakeholders.

To shed some light on the emerging trend of AI disclosure, the aim of this paper is to analyse the current practices of major Western European companies regarding the automated decision-making (ADM) disclosure in their annual or sustainability reports. This paper proposes a methodology based on bigrams that enables the automatic extraction of the information on ADM that companies disclose. The sample consisted of the annual/sustainability reports of companies listed on the stock markets of 13 Western European countries from both 2018 and 2019. A total of 962 PDF documents were downloaded from companies' websites. Our findings show that only a small number of companies reported on ADM in their non-financial or annual reports. The early adopters of this new form of non-financial disclosure are mostly companies operating in the financial sector.

## **2. LITERATURE BACKGROUND**

### **2.1. Previous studies**

The first studies focusing on the scope of information technologies' responsibility date to the early 1990s, when ethics in the information age started to be discussed (Mason, 1986; Moor, 1985). Ethics in emerging IT was the main object of a number of studies in the following years as well (Brey, 2012; Bynum, 2001; Chatterjee et al., 2015; Floridi, 2010; Sarathy and Robertson, 2003).

Due to the rapid evolution of IT and the use of artificial intelligence in business and public administration, serious concerns arose regarding AI ethics, which was the main topic investigated by several authors (Angwin et al., 2016; Bonsón et al., 2021a; Cath, 2018; Fjeld et al., 2020; Floridi, 2019; Greene et al., 2019; Hagendorff, 2020; Hao, 2020; Hickok, 2020; Jobin et al., 2019; Robbins, 2020; Vidgen et al., 2020). Alongside the fast development of new IT tools and the penetration of AI, a number of studies focused on privacy concerns and data protection (Ashwort, 2006; Beke, 2018; Bbrandimarte, 2013; Culnan and Bies, 2003; Kehr et al., 2015).

The concept of corporate digital responsibility (CDR) started to appear in the literature very recently, and a few studies related to this topic have been published. However, the scope of those studies is rather narrow. Liyanaarachchi et al. (2020) explored the CDR related to data

management in the banking sector. Isensee et al. (2020) studied the relationship between organizational structure, sustainability and digitalization in SMEs. The first study with a wider CDR scope was the one by Lobschat et al. (2021), who introduced a framework of CDR culture. While several professionals have discussed the concept of CDR and there is an increased awareness of this topic, in the academic literature, there is still a lack of conceptualization and no previous studies on CDR disclosure.

## **2.2. Corporate digital responsibility (CDR)**

Lobschat et al. (2021) made a parallel between human behaviour and its compliance with certain ethical norms and digital technology, arguing that the development of new technology that assists in human decision making or makes decisions autonomously should be governed by the same rules. With this argument, they pointed out that the usage of new technologies is not solely a technological challenge but implies certain responsibilities, which we can refer to as corporate digital responsibility (CDR). The Institute of Consumer Policy defined CDR as: “companies’ responsibility for the consequences of their business processes, products and services for employees, suppliers, customers, society as a whole and the environment encompassing: 1) data and algorithmic decision making, 2) participation and reduction of inequality, 3) digital education, 4) future of work, and 5) digitalization in service of an ecologic transformation” (Conpolicy, 2021).

Lobschat et al. (2021) introduced a comprehensive framework of CDR culture. According to them, in compliance with CDR, organizations should demonstrate how responsibly they operate in the digital age. In their conceptualization of CDR, they focused on ethical aspects that are inherent to the digital context while also drawing links between corporate social responsibility (CSR) and CDR.

### *Conceptualization of CDR: a new layer of CSR?*

Indeed, CDR shares some principles with CSR, which covers economic, legal and ethical concerns related to environmental and social issues (Schwartz and Carroll, 2003). Nevertheless, Lobschat et al. (2021) considered CDR to be slightly separated from CSR due to its particularities related to digital technologies, such as the moral challenges related to the malleability (often unintended) of digital technologies (Soltani, 2019) and the high level of proliferation of digital technologies in our daily lives.

Other studies (Deloitte, 2019; Gärtner et al., 2018; PWC, 2019) have considered CDR to be a new layer of CSR. The empirical evidence obtained in this study confirms this approach as we observed that early adopters of CDR disclosure provide this information in their CSR reports. Thus, organizations perceive CDR as a complementary aspect of CSR. Similarly, Pauer, an expert in CDR and digital ethics at PWC (2020), argued that the CDR approach and sustainability go hand in hand and pointed out the importance of boosting stakeholders’ trust in digitalization. Nicolai Andersen, chief innovation officer at Deloitte (2019), talked about redesigning corporate responsibility by extending its scope to CDR.

Over the last decades, organizations have managed their responsibility to the environment and society at large through CSR. Nevertheless, the digital revolution has brought new responsibilities, which should be treated with the highest strategic priority (Deloitte, 2019). Gärtner et al. (2018) pointed out the immense impact of digitalization due to the exponential advancement of technology. He argued that, as digitalization redefines almost all aspects of our lives, such as

the economy, society and even our values and beliefs, it is of the utmost importance to adjust the way in which organizations approach their responsibility.

### **2.3. Algorithmic (automated) decision making (ADM)**

Algorithmic decision systems (ADSs), also known as algorithmic decision making (ADM), are based on the analysis of large amounts of data to infer correlations or to derive information to make decisions. Humans are error prone and biased, but systems can be biased too, so it is important to know who built them, how they were developed and how they are ultimately used. To avoid bias in the algorithm, it should be fed with a representative data set, the right model should be chosen and the algorithm should be continuously reviewed and monitored. Therefore, transparency regarding these aspects might not only increase the trust in ADM but also serve as proof of a company's commitment to corporate digital responsibility (CDR).

Regarding ADM, we should distinguish between decisions that are rather predictable (with certain input, we obtain an expected and repetitive output, such as ADM in automating quality control) and decisions that are based on machine learning (so the decision is made within a "black box"), particularly when they might have an impact on an individual's life. ADM processes are fed with data that might be biased. If there is a bias in the data that the ADM is trained with, this bias would be reinforced and amplified, which would ultimately lead to unfair or discriminatory decisions.

Thus, the results yielded by ADM can be discriminatory without decision makers being motivated to discriminate. For example, there might be some variables, such as gender or race, that normally cannot be taken into consideration when making a decision but are often statistically associated with seemingly inoffensive characteristics, such as height or postal code. As ADM works with huge sets of correlated data, it can lead to indirect discrimination. Therefore, individuals should have some basic rights, such as transparency, when a decision has been made based on "black box" ADM.

### **2.4. Research questions**

CDR seems to be a new layer of CSR. This implies changes in corporate disclosure in the coming years. Early adopters of CDR reporting, normally large corporations, under pressure from stakeholders, might start to realize the importance of their digital responsibility and try to legitimate their digital practices via voluntary disclosure. Transparency in this matter increases the level of trust of society (Osburg, 2017) and of consumers (Thorun, 2018) in digitalization and offers a platform for companies to inform the wider public about how they leverage digital technology for the greater good in society (Shingles et al., 2016).

In our research, we focused on a particular aspect of CDR (data and algorithmic decision making); within this subcategory, we focused on ADM due to the high risk that the application of this technology implies, which therefore seems to be the most relevant to stakeholders. As there is still a lack of guidelines on how to report on CDR in general, the main aim of our study was to analyse the current ADM reporting practices of large Western European companies. To shed some light on the current practices, the following research questions were formulated:

*RQ1. Are Western European companies disclosing information about the use of ADM in their annual/sustainability reports?*

*RQ2. What is the content of those disclosures?*

RQ3. What are the factors associated with ADM disclosure?

### 3. METHODS

#### 3.1. Sample and methods

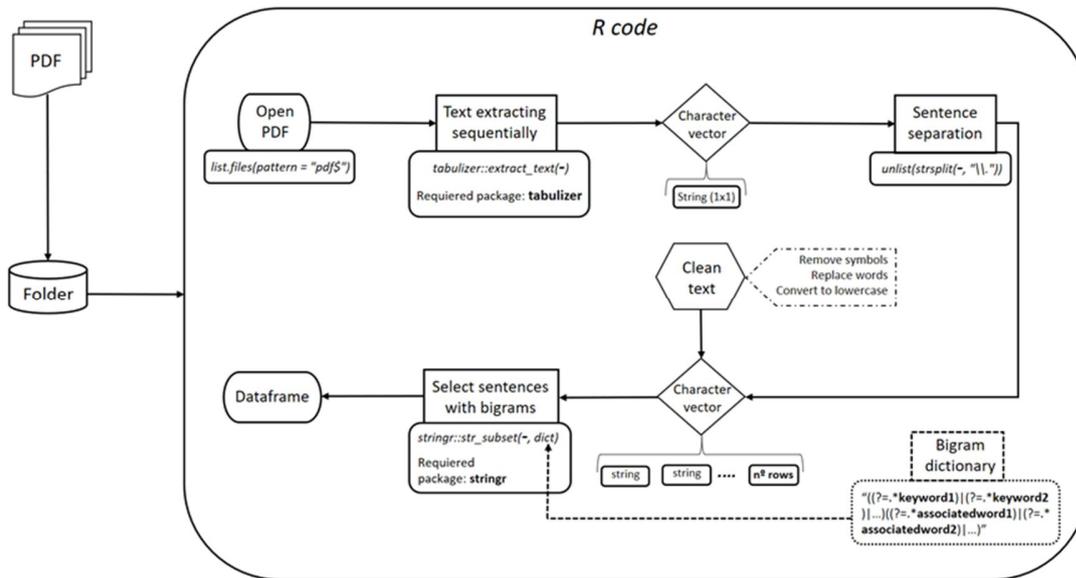
The sample consisted of the annual/sustainability reports of companies listed on 13 Western European countries' stock markets in 2018 and 2019. A total of 962 PDF documents were downloaded from companies' websites (Table 1).

**Table 1.** Number of documents analysed from Western European countries

Country	Index	Dec. 2018	Dec. 2019	Total
Austria	ATX 20	32	33	65
Belgium	BEL 20	22	23	45
Denmark	OMXC 25	45	46	91
Finland	OMXH 25	39	38	77
France	CAC 40	41	41	82
Germany	DAX 30	49	52	101
Greece	FTSE 20	23	22	45
Ireland	ISEQ 20	19	22	41
Italy	invt40	67	68	135
Netherlands	AEX 25	27	31	58
Portugal	PSI 20	23	23	46
Spain	IBEX 35	43	44	87
Sweden	OMXS 30	44	45	89
		474	488	962

The reports were processed as shown in Figure 1, which also displays a flowchart providing an overview of the text-mining operations conducted with the open-source R statistical advanced software (R Core Team, 2018), detailing every step and R package function used. The extraction of the text was performed through the `extract_text()` function of the `tabulizer` R package (Leeper, 2018), which converts the text of an entire PDF file or specified pages into a single character vector (1 × 1). This is necessary due to the small semantic structure of the PDF format. Once the text is extracted, it is separated independently into sentences with the functions already incorporated into R `unlist()` and `strsplit()`. The `strsplit()` function splits the elements of a character vector into a substring list according to a parameter. This list must be converted into a vector through the `unlist()` function, which produces a vector that contains all the atomic components that occur in it. In this way, a vector (number of rows × 1) ready for analysis is extracted. Before the analysis with the dictionary, the symbols should be deleted, some words should be replaced and capital letters must be converted into lower case.

**Figure 1.** Flowchart of PDF text mining



All the reports were later analysed automatically using the “*str\_subset*” function of the “*stringr*” R package (Wickham, 2019), which keep strings matching a pattern. This pattern is a dictionary formed by a combination of two ngrams (bigrams), which are divided into keywords and associated words (Table 2). Based on this function, some of the words from each group must appear in the sentence together regardless of their order.

**Table 2.** Dictionary

Keywords		Associated words	
algorithm	(s) (ic)	decision	(s)
automat	(ed) (able) (ability) (ic)		

The analysed companies in our sample operate in 11 different sectors. Table 3 shows the distribution of companies by sector, and Table 4 provides details of the dependent and independent variables used in this study.

**Table 3.** Distribution of companies by sector

Energy	7.93%
Materials	10.67%
Industrial	18.60%
Consumer discretionary	9.76%
Consumer staples	6.10%
Healthcare	7.93%
Financial	20.73%
Information technology	4.57%
Communication services	5.79%
Utilities	3.05%
Real estate	4.88%

### **3.2. Variables**

To try to answer RQ3, “What are the factors associated with ADM disclosure?”, we used the following independent variables: the geographical area of the country where the company is listed, the sector in which the company operates, the company size and its sustainability leadership position. These variables were selected from the previous literature on companies’ non-financial information disclosures (Baird and Zelin, 2000; Bonsón et al., 2021b, Clatworthy and Jones, 2003; Gao et al., 2016; Kohut and Segars, 1992). Therefore, we addressed classic elements of study in this matter, which allowed us to reach consistent conclusions about ADM disclosure.

#### *Geographical area*

The practice of disclosing different topics in business reports can vary from region to region as the different cultural and social considerations of a country are a driving factor that influences the presentation of reports (Golob and Bartlett, 2007). Both the characteristics and the cultural trends draw the role of companies (Welford, 2005). Organizations’ strategies are strongly influenced by their institutional characteristics and by the legacy reflected by the culture of a specific country or region (Doh and Guay, 2006). In short, several authors have argued that the region or country of a company influences its social behaviour (Hassan et al., 2013; Mikkilä and Toppinen, 2008; Sotorrió and Sánchez, 2008; Thanetsunthorn, 2015). Welford (2005) presented data showing that, in general, there is a higher level of corporate social responsibility reporting in Northern Europe than in Southern Europe, perhaps suggesting a historical trend towards greater transparency in the north and links with the development of the economic system.

Based on economic forecasts for 2030, the impact of AI on the GDP varies between regions; in Europe, the impact will be greater in the south than in the north, 11.5% and 9.9%, respectively (PWC, 2017). Accordingly, for this study, we addressed the dissemination of ADM in two different geographical areas: the first includes countries in northwestern Europe, such as Belgium, Finland, Germany, Ireland, the Netherlands and Sweden, while the second contains several countries in southwestern Europe, like France, Greece, Italy, Portugal and Spain.

#### *Sector*

Another of the classic elements that are addressed in this kind of reporting is the company’s sector. The literature has shown some consistent evidence of a significant relationship between industry and disclosure (Bonsón and Bednárová, 2013; Bonsón et al., 2021ab; Brammer and Pavelin, 2006; Hahn and Kühnen, 2013; Hassan et al., 2013). A recent report (Eager et al., 2020) by the European Parliament revealed that some of the leading economic sectors in terms of AI adoption are financial services, automotive and assembly, and high-tech and telecommunications, but the industries that are leading the development of AI capabilities tend to focus more on developing capabilities in house, as is the case of high-tech or financial services.

In our study, we considered the eleven sectors defined by the Global Industry Classification Standard (GICS), which we segmented into two groups. The first group contains companies that operate in the financial and insurance service sectors. The second group consists of all the others.

#### *Company size*

Company size is commonly used as an important and fundamental company characteristic in empirical studies. Dang et al. (2018) showed that different proxies are used to measure company

size, such as the number of employees or net assets, but the most popular measures in corporate finance are the total assets, total sales and market value of equity. Based on their research, of these three measures, we used the total assets as a measurement for two reasons: (1) it is the most used firm size proxy in papers, 56.23% compared with the 22.99% and 18.39% of total sales and market capitalization, respectively; and (2) it seems to be a more relevant measure of investment policy (Comment and Schwert, 1995; Graham et al., 2012; Harford et al., 2008).

The interest in studying company size is that this element has a positive effect on the adoption, scope and quality of reports and is linked to corporate visibility (Bonsón et al., 2021a). Numerous studies (Bonsón and Bednárová, 2013; Bonsón and Flores, 2011; Brammer and Pavelin, 2006; Clarkson et al., 2011) have supported the idea that, in general, large companies are more likely to disclose more non-financial information and have a greater social impact since, for small companies, not being exposed to a huge number of stakeholders, the need to explain their business conduct and convey credible information is substantial.

In this context, ADM information disclosure can be considered to be more likely to occur in companies with more resources, considering that large companies must guarantee their legitimacy by pointing out their ADM efforts in their corporate reports. However, the original value of the total assets is not used – only 3% of studies use it – since most studies in empirical corporate finance use the natural logarithm form of firm size measures to mitigate the substantial skewness of these data (Dang et al., 2018).

#### *Sustainability leadership*

Finally, another determinant that is considered to be important is sustainability performance. Numerous studies have found that companies with better results in sustainability tend to disclose more non-financial information (Dhaliwal et al., 2012; Hummel and Schlick, 2016; Ng and Rezaee, 2015; Rezaee and Tuo, 2017). In our study, we use the MSCI's environmental, social and corporate governance (ESG) ranking. In this way, we classify companies as leaders (rating = AAA–AA) or not (all other ratings and unrated companies).

Table 4 below summarizes the variables used in this study and their measurements.

**Table 4.** Variables' definition and measurement

Variable	Full Name	Shortened Name	Description	Source
Dependent	ADM report	ADM	Dummy variable (if the company has reported at least one relevant mention of ADM = 1; other = 0)	PDF mining as shown in Figure 1
Independent	Geographical area	GeoArea	Dummy variable (northern country = 1; southern country = 0)	Country location
	Sector	Sect	Dummy variable (financial sector = 1; other = 0)	Global Industry Classification Standard (GICS)
	Company size	Size	Natural logarithm of the total assets of the company in 2019	Investing.com
	Sustainability leadership	SustaiLead	Dummy variable (leader in ESG ranking = 1; other = 0)	MSCI

To check the relationships between the variables, the generalized linear model (logit regression) was applied.

$$\{logit(ADM) = \beta_0 + \beta_1 GeoArea + \beta_2 Sect + \beta_3 Size + \beta_4 SustainLead\}$$

#### 4. FINDINGS

*RQ1. Are Western Europe companies disclosing information about the use of ADMs in their annual/sustainability reports?*

After the content analysis of 962 documents, 28 mentions of ADM in companies' reports were identified. These mentions were associated with 20 companies, of which 17 operate in the financial sector. Thus, the answer to our RQ1 is that only a small number of Western European companies disclose information about the use of ADM in their annual/sustainability reports.

*RQ2. What is the content of those disclosures?*

To shed some light on the content of the disclosures, Tables 5 and 6 provide extracts from annual/sustainability reports related to ADM. Our findings show that the majority of ADM disclosures were related to credit risk assessment (CRA) or ADM responsibility. Regarding the ADM responsibility, we found that there was no mention of any standards followed. In total, there were five mentions of ADM responsibility disclosure, all of which were rather general. Just one company reported that it had formally defined guidelines for responsible AI (Table 6). In addition, there was one mention categorized as "medical algorithms and diagnostic" from a company operating in the healthcare–pharmaceutical industry and two mentions labelled as "others", which were reported by companies from the consumer staples sector, explaining how AI is used in electronic devices such as smartphones, home robots and so on.

**Table 5.** Disclosure category: ADM for credit risk assessment (CRA)

Sector	Disclosure extract
Banking and Financial Services	For certain selected retail portfolios, scorecards and automated strategies (together referred to as 'score enabled decisions') are deployed to automate and to support credit decisions and credit management.
	For procedures in favour of private customers, small businesses and small economic operators, decision-making engines (scopri, transact) are used to support the financing of the proposed transaction, which define a summary valuation with increasing riskiness.
	Various lending requirements are stipulated, including (but not limited to) client rating, maximum loan amounts and maximum tenors, and are adapted to regional conditions and/or circumstances of the borrower (i.e., for customer loans a maximum loan amount taking into account customer net income). Given the largely homogeneous nature of this portfolio, counterparty creditworthiness and ratings are predominately derived by utilizing an automated decision engine.
	For individual customers and SMEs with low turnover large volumes of credit transactions can be managed more easily with the use of automatic decision models for classifying the customer / transaction binomial.
	Similarly, for our personal customers, we continued to expand the use of automated credit decision tools so that customers seeking home finance or a consumer loan are now able to get loan approval on the spot.
	However, no credit application may be processed in the Bank without the recommendation of the branch manager who is responsible for the credit, with the exception of credit decisions made via automatic modelling. Automatic models used in such decisions require the approval of the Group Chief Executive.
	The Bank has established two new exclusive partnerships for 2018 (FORD & PLAISIO), with a few more expected to commence in 2019. Online automated decision engines have substantially improved service levels and new microloans are delivered swiftly to the customer.
	With regard to the bank's credit policy rules, group organization contributed to the design of a mechanism for the automatic system of checks and balances regarding the customer's transactional behaviour, that promotes sound decisions regarding credit card renewals.

**Table 6.** Disclosure category: ADM responsibility

Sector	Disclosure extract
Banking and Financial Services	<b>prevention of unacceptable effects</b> we monitor <b>the impact of the decisions made by artificial intelligence algorithms</b> to prevent undesirable effects being created or aggravated. By way of example: AI algorithms could be used in healthcare, which might have repercussions for treatment and insurance cover. In our view, it is un-acceptable if a higher risk for a serious illness results for the person concerned <b>due to decisions made by an AI algorithm.</b>
	Financial service providers belong to a small group of companies who have the obligation to say “no” if we are convinced that it is the right thing to do for our customers: “please do not buy this; may I explain to you why I think you should not take this loan, but I believe in you”. By “refusing to lend”, we may avoid future risk costs, but we will certainly not earn any profits. but regardless of whether a loan is granted or not – how do our customers benefit if we believe in them, but if, in the future, such <b>decisions will be taken only on the basis of some algorithms</b> without recognising the individual? and as regards loans that even in the future may not be granted by artificial intelligence – what are our beliefs good for if regulatory standards do not allow us to grant loans without collateral and / or guarantees? we will have to find really good answers to all these questions in the course of the next few years.
	<b>to inform persons</b> concerned about the fact that their personal data is being processed and (a)...., .... (l) if applicable the existence of <b>automated decision-making, including profiling</b>
Consumer Internet	payu has formally defined a responsible lending <b>guideline</b> to govern its approach in this vital area, including elements of <b>responsible artificial intelligence</b> and the <b>avoidance of bias and discrimination</b> within automated and data-driven credit decision models.
Telecommunications	in addition, we have volunteered to participate in <b>the digital rights</b> ranking pilot to test its revised methodology integrating indicators on targeted advertising and algorithmic decision-making systems in view of the next ranking in 2021.

**RQ3. What are the factors associated with ADM disclosure?**

Regarding our RQ3, our findings show that there is a relationship between the ADM reporting and the sector in which a company operates (Table 7). Thus, companies operating in the financial sector are more likely to disclose information about ADM in their annual/sustainability reports. There was no significant relationship between the ADM disclosure and any other factor, such as geographical area, sustainability leadership or size of the company.

**Table 7.** Generalized linear model (logit regression)

Independent variable	Dependent variable				
	ADM report				
	Estimate	Std error	t value	Sig.	
(Intercept)	-5.55643	1.52355	-3.647	0.000265	***
Geographical area	0.01185	0.51697	0.023	0.981720	
Sector	3.01541	0.71034	4.245	2.19e-05	***
Company size	0.13948	0.14372	0.970	0.331799	
Sustainability leadership	-0.66922	0.63074	-1.061	0.288683	

\*\*\* Significant at p < 0.001 (2-tailed).

**5. DISCUSSION AND CONCLUSIONS**

As CDR seems to be a new layer of CSR, we might anticipate certain changes in corporate disclosure in the coming years. Following the pattern of CSR disclosure evolution, first we might expect early adopters, normally large corporations, to disclose CDR aspects voluntarily to legitimate their digital practices. This is likely to continue with the seeking of a global consensus

on what to disclose and how, which would be followed by legislation. Nevertheless, while the legislation on CSR disclosure took more than two decades to be implemented, with CDR, we face greater urgency to address the associated risks due to the exponential advancements of technology due to which the damage might take decades to repair, particularly in relation to ADM.

Our findings show that ADM disclosure is rather scarce and still at the preliminary stage. Only 20 Western European companies disclosed information related to ADM in their annual/sustainability reports in the years investigated. In total, there were 28 mentions.

The main categories of ADM disclosure that were identified in our study were ADM for credit risk assessment (CRA), ADM responsibility, medical algorithms and diagnostics, and other. The latter was related to the electronic sector disclosing the AI technology used in devices such as smartphones, smartwatches or home robots. The most frequent disclosure was related to CRA by companies operating in banking and financial services and ADM responsibility. Nevertheless, despite the fact that ADM for CRA was the most frequent reporting category, the disclosure itself was rather general and lacked details on which processes are fully automated and which are just assisted by the AI.

The second most frequently reported category was ADM responsibility. However, the way in which this category was reported showed weaknesses as well. We observed different approaches to this type of disclosure. Some companies were simply expressing general concerns regarding unacceptable effects of the decisions made by AI or regarding a future scenario in which decisions will be taken only on the basis of an algorithm. Other companies were more specific regarding ADM's responsibility towards issues such as avoidance of bias and discrimination, digital rights or transparency when ADM is being used for personal data processing and client profiling.

Analysing the factors, we found that companies operating in the banking and financial sector are more likely to disclose information about ADM. Thus, the size of the company, the country and sustainability leadership were not associated with ADM disclosure.

#### *Addressing standardization needs*

However, this topic being quite a novelty, there is a lack of standardization in such disclosures. Indeed, no company reported its compliance with certain standards regarding ADM usage. To standardize the method of reporting on ADM, first, a consensus has to be achieved on what to report and how, what the key elements should be and what information should be disclosed to satisfy the information needs of different stakeholders. As our findings suggest, at the moment, we are at the preliminary stage of ADM disclosure; therefore, such tools are still lacking. Thus, one of the implications of our research is to point out the lack of standardization in ADM disclosure and the urgency to act in this matter.

The main aim of the new standards for AI disclosure should not be to impose a greater burden on companies in preparing their non-financial reports or to demonize the usage of AI, which can indeed be highly beneficial, but there are certain fundamental rights of individuals that should be guaranteed. Hence, it is important to act quickly as the negative impacts of irresponsible AI usage might take decades to correct. Given that AI technology in a modern and interconnected world is a global problem, a global consensus based on a multistakeholder approach should be pursued. Only in this way can we, as a society, guarantee the respect of fundamental rights such as freedoms, privacy, data protection and non-discrimination while using AI technology and benefiting from it.

To contribute to the evolution of a standardized framework for AI reporting to which ADM disclosure belongs, we elaborated a list of basic elements that might be relevant to such disclosure. Those could be classified into three categories: governance model and system control; ethics and integrity; and strategy.

Regarding the governance model and system control, organizations should be transparent about how AI is governed. Hence, the following information should be provided: the governance structure; who is being held responsible; consultations with critical stakeholders about AI usage; an overview of the key AI topics; and the main areas of concern.

Some companies might rely on international principles regarding the ethical use of AI, such as the IEEE, UE, OECD and so on, while others might design their own principles or code of ethics related to AI usage. On this point, organizations should provide some information about the mechanism for advice and concerns about ethics regarding the responsible use of AI.

Concerning the strategy, perhaps the most relevant part of this section is how AI-related risks are identified and managed. Companies can also report on ongoing training activities related to the responsible usage of AI and any projects focused on Sustainable Development Goals (SDG), in which AI plays a crucial role.

#### *Contributions and limitations of the study*

First, we analysed the current practices of AI reporting among large Western European companies focusing on ADM disclosure. Second, we pointed out the importance of standardization in this area. Third, we proposed a set of general elements that should be disclosed to structure the information about corporate digital responsibility (CDR), improve the transparency, mitigate the risks and prove real responsibility in the usage of AI and ADM.

Before closing, a number of limitations should be acknowledged and future research outlined. In our study, we considered only large Western European companies; thus, the sample might be extended or compared with a sample from another region. Similarly, more factors influencing the propensity to disclose ADM could be tested. Regarding the content analysis, in future research, a wider scope of CDR disclosure could be analysed.

## **REFERENCES**

AlgorithmWatch. (2019). *Automating Society Taking Stock of Automated Decision-Making in the EU*.

Ashworth, L., & Free, C. (2006). Marketing dataveillance and digital privacy: Using theories of justice to understand consumers' online privacy concerns. *Journal of Business Ethics*, 67(2), 107–123.

Angwin, J., Larson, J., Mattu, S., Kirchner, L. (2016). Machine bias. There software used across the country to predict future criminals. and its biased against blacks. ProPublica. Available at: <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

- Baird, J. E., & Zelin, R. C. (2000). The effects of information ordering on investor perceptions: an experiment utilizing presidents' letters. In *Journal of Financial and Strategic Decisions* (Vol. 13).
- Beke, F. T., Eggers, F., & Verhoef, P. C. (2018). Consumer informational privacy: Current knowledge and research directions. *Foundations and Trends in Marketing*, 11(1), 1–71.
- Bonsón, E., & Bednárová, M. (2013). Corporate LinkedIn practices of Eurozone companies. *Online Information Review*, 37(6), 969–984. <https://doi.org/10.1108/OIR-09-2012-0159>
- Bonsón, E., & Flores, F. (2011). Social media and corporate dialogue: The response of global financial institutions. *Online Information Review*, 35(1), 34–49. <https://doi.org/10.1108/14684521111113579>
- Bonsón, E., Lavorato, D., Lamboglia, R., Mancini, D. (2021a). Artificial Intelligence activities and ethical approaches in leading listed companies in the Eurozone. Working paper
- Bonsón, E., Perea, D., & Azevedo G., (2021b). Tone and content analysis in the president's letters to shareholders. Spanish evidence. *Upravlenets (The Manager)*, 12(1), 89-91.
- Bonsón, E., Perea, D., & Bednárová, M. (2020). Environmental Disclosure as a Tool for Public Sector Legitimacy: A Twitter Intelligence Approach. *International Journal of Public Administration in the Digital Age*, 7(3), 1–31. <https://doi.org/10.4018/IJPADA.2020070101>
- Brammer, S., & Pavelin, S. (2006). Voluntary environmental disclosures by large UK companies. *Journal of Business Finance and Accounting*, 33(7–8), 1168–1188. <https://doi.org/10.1111/j.1468-5957.2006.00598.x>
- Brandimarte, L., Acquisti, A., & Loewenstein, G. (2013). Misplaced confidences: Privacy and the control paradox. *Social Psychological and Personality Science*, 4(3), 340–347.
- Brey, P. A. E. (2012). Anticipating ethical issue in emerging IT. *Ethics and Information Technology*, 14(4), 305–317.
- Bynum, T. W. (2001). Computer ethics: Its birth and its future. *Ethics and Information Technology*, 3(2), 109–112.
- Cath, S., (2018). Governing artificial intelligence: ethical, legal and technical opportunities and challenges. *Philosophical transactions of the royal society a-mathematical physical and engineering sciences*. <https://doi.org/10.1098/rsta.2018.0080>
- Chatterjee, S., Moody, G., Lowry, P. B., Chakraborty, S., & Hardin, A. (2015). Strategic relevance of organizational virtues enabled by information technology in organizational innovation. *Journal of Management Information Systems*, 32(3), 158–196.

Clarkson, P. M., Overell, M. B., & Chapple, L. (2011). Environmental Reporting and its Relation to Corporate Environmental Performance. *Abacus*, 47(1), 27–60. <https://doi.org/10.1111/j.1467-6281.2011.00330.x>

Clatworthy, M. A., & Jones, M. J. (2003). Financial reporting of good news and bad news: Evidence from accounting narratives. *Accounting and Business Research*, 33(3), 171–185. <https://doi.org/10.1080/00014788.2003.9729645>

Comment, R., & Schwert, G. W. (1995). Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures. *Journal of Financial Economics*, 39(1), 3–43. [https://doi.org/10.1016/0304-405X\(94\)00823-J](https://doi.org/10.1016/0304-405X(94)00823-J)

Conpolicy (2021). The Institute of Consumer Policy: Corporate Digital Responsibility. <https://www.conpolicy.de/en/topics/corporate-digital-responsibility/>

Culnan, M. J., & Bies, R. J. (2003). Consumer privacy: Balancing economic and justice considerations. *Journal of Social Issues*, 59(2), 323–342.

Dang, C., (Frank) Li, Z., & Yang, C. (2018). Measuring firm size in empirical corporate finance. *Journal of Banking and Finance*, 86, 159–176. <https://doi.org/10.1016/j.jbankfin.2017.09.006>

Deloitte (2019). Redesigning Corporate Responsibility. How Digitalization changes the role companies need to play for positive impacts on society. <https://www2.deloitte.com/de/de/pages/innovation/contents/redesigning-corporate-responsibility.html>

Dhaliwal, D. S., Radhakrishnan, S., Tsang, A., & Yang, Y. G. (2012). Nonfinancial disclosure and analyst forecast accuracy: International evidence on corporate social responsibility disclosure. *Accounting Review*, 87(3), 723–759. <https://doi.org/10.2308/accr-10218>

Doh, J. P., & Guay, T. R. (2006). Corporate social responsibility, public policy, and NGO activism in Europe and the United States: An institutional-stakeholder perspective. *Journal of Management Studies*, 43(1), 47–73. <https://doi.org/10.1111/j.1467-6486.2006.00582.x>

Eager, J., Whittle, M., Smit, J., Cacciaguerra, G., & Lale-demoz, E. (2020). Opportunities of Artificial Intelligence.

Fjeld, J., Achten, N., Hilligoss, H., Nagy, A., Srikumar, M. (2020). Principled artificial intelligence: mapping consensus in ethical and rights-based approaches to principles for AI. Berkman Klein Center Research Publication. <https://doi.org/10.2139/ssrn.3518482>

Floridi, L. (2010). Ethics after the information revolution. In L. Floridi (Ed.). *Cambridge Handbook of Information and Computer Ethics* (pp. 3–19). Cambridge: Cambridge University Press.

Floridi, L. (2019). Translating principles into practices of digital ethics: five risks of being unethical. *Philosophy and Technology*, 32, 185–193. <https://doi.org/10.1007/s13347-019-00354-x>

- Gao, F., Dong, Y., Ni, C., & Fu, R. (2016). Determinants and Economic Consequences of Non-financial Disclosure Quality. *European Accounting Review*, 25(2), 287–317. <https://doi.org/10.1080/09638180.2015.1013049>
- Gärtner, C., Heinrich C.: Vorwort. (2018) In: Fallstudien zur Digitalen Transformation. SpringerGabler
- Golob, U., & Bartlett, J. L. (2007). Communicating about corporate social responsibility: A comparative study of CSR reporting in Australia and Slovenia. *Public Relations Review*, 33(1), 1–9. <https://doi.org/10.1016/j.pubrev.2006.11.001>
- Graham, J. R., Li, S., & Qiu, J. (2012). Managerial attributes and executive compensation. *Review of Financial Studies*, 25(1), 144–186. <https://doi.org/10.1093/rfs/hhr076>
- Greene, D., Hoffmann, A., Stark, L. (2019). A Critical Assessment of the Movement for Ethical Artificial Intelligence and Machine Learning. *Proceedings of the 52nd Hawaii International Conference on System Sciences*. <https://hdl.handle.net/10125/59651> ISBN: 978-0-9981331-2-6(CC BY-NC-ND 4.0)Page 2122
- Hagendorff, T. (2020). The ethics of AI ethics: an evaluation of guidelines. *Minds and Machines*. 30, 99-120. <https://doi.org/10.1007/s11023-020-09517-8>
- Hahn, R., & Kühnen, M. (2013). Determinants of sustainability reporting: A review of results, trends, theory, and opportunities in an expanding field of research. *Journal of Cleaner Production*, 59, 5–21. <https://doi.org/10.1016/j.jclepro.2013.07.005>
- Hao, K. (2020). let's stop AI ethics-washing and actually do something. *MIT Technology Review*. Available at: <https://www.technologyreview.com/2019/12/27/57/ai-ethics-washing-time-to-act/>
- Harford, J., Mansi, S. A., & Maxwell, W. F. (2008). Corporate governance and firm cash holdings in the US \$. *Journal of Financial Economics*, 87, 535–555. <https://doi.org/10.1016/j.jfineco.2007.04.002>
- Hassan, A., Hunter, C., & Asekomeh, A. (2013). GRI application levels and disclosure on specific environmental activities: An empirical investigation of industry membership and geographical region of top european companies. *Social and Environmental Accountability Journal*, 33(3), 156–176. <https://doi.org/10.1080/0969160X.2013.840539>
- Hickok, M. (2020). Lessons learned from AI ethics principles for future actions. *AI and Ethics*, Springer Nature Switzerland AG 2020. <https://doi.org/10.1007/s43681-020-00008-1>
- Hoofnagle, C. J., van der Sloot, B., & Borgesius, F. Z. (2019). The European Union general data protection regulation: what it is and what it means. *Information & Communications Technology Law*, 28(1), 65–98. <https://doi.org/10.1080/13600834.2019.1573501>
- Hummel, K., & Schlick, C. (2016). The relationship between sustainability performance and sustainability disclosure – Reconciling voluntary disclosure theory and legitimacy theory.

Journal of Accounting and Public Policy, 35(5), 455–476.  
<https://doi.org/10.1016/j.jaccpubpol.2016.06.001>

Isensee, C., Teuteberg, F., Griese, K.M, Topi, C. (2020). The relationship between organizational culture, sustainability, and digitalization in SMEs: A systematic review. *Journal of Cleaner Production*. Volume: 275. Article Number: 122944. DOI: 10.1016/j.jclepro.2020.122944

Jobin, A., Ienca, M., Vayena, E. (2019). The global landscape of AI ethical guidelines. *Nat. Mach. Intell.* 1, 389-399

Kehr, F., Kowatsch, T., Wentzel, D., & Fleisch, E. (2015). Blissfully ignorant: The effects of general privacy concerns, general institutional trust, and affect in the privacy calculus. *Information Systems Journal*, 25(6), 607–635.

Kohut, G. F., & Segars, A. H. (1992). The President's Letter to Stockholders: An Examination of Corporate Communication Strategy. *Journal of Business Communication*, 29(1), 7–21.  
<https://doi.org/10.1177/002194369202900101>

Leeper, T. J. (2018). tabulizer: Bindings for Tabula PDF Table Extractor Library. In R package version 0.2.2. <https://cran.rstudio.com/web/packages/tabulizer/>

Liyanaarachchi, G., Deshpande, S., Weaven, S. (2020). Market-oriented corporate digital responsibility to manage data vulnerability in online banking. *INTERNATIONAL JOURNAL OF BANK MARKETING*. DOI: 10.1108/IJBM-06-2020-0313

Lobschat, L., Mueller, B., Eggers, F., Brandimarte, L., Diefenbach, S., Kroschke, M. Wirtz, J. (2021). Corporate Digital Responsibility. *Journal of Business Research* 122 (2021). pp. 875-888.

Malgieri, G. (2019). Automated decision-making in the EU Member States: The right to explanation and other “suitable safeguards” in the national legislations. *Computer Law and Security Review*, 35(5), 105327. <https://doi.org/10.1016/j.clsr.2019.05.002>

Mason, R. O. (1986). Four ethical issues of the information age. *MIS Quarterly*, 10(1), 5–12.

Mikkilä, M., & Toppinen, A. (2008). Corporate responsibility reporting by large pulp and paper companies. *Forest Policy and Economics*, 10(7–8), 500–506.  
<https://doi.org/10.1016/j.forpol.2008.05.002>

Moor, J. H. (1985). What IS computer ethics? *Metaphilosophy*, 16(4), 266–275.

Ng, A. C., & Rezaee, Z. (2015). Business sustainability performance and cost of equity capital. *Journal of Corporate Finance*, 34, 128–149. <https://doi.org/10.1016/j.jcorpfin.2015.08.003>

Osburg, T. (2017). Sustainability in a Digital World Needs Trust. In: *Sustainability in a Digital World*. Pages 3-19. Springer International Publishing

PWC. (2017). Sizing the prize What's the real value of AI for your business and how can you capitalise?

PWC, 2020. Corporate Digital Responsibility and Digital Ethics. <https://www.pwc.de/en/sustainability/corporate-digital-responsibility-and-digital-ethics.html> R Core Team. (2018).

R: A Language and Environment for Statistical Computing. <https://www.r-project.org/>

Rezaee, Z., & Tuo, L. (2017). Voluntary disclosure of non-financial information and its association with sustainability performance. *Advances in Accounting*, 39, 47–59. <https://doi.org/10.1016/j.adiac.2017.08.001>

Robbins, S. (2020). AI and the path to envelopment: knowledge as a first step towards the responsible regulation and use of AI-powered machines. *AI & Society*. 35:391–400

Sarathy, R., & Robertson, C. J. (2003). Strategic and ethical considerations in managing digital privacy. *Journal of Business Ethics*, 46(2), 111–126.

Shingles, M., Briggs, B., O'Dwyer, J. (2016). Social Impact of Exponential Technologies. In: *Tech Trends 2016 – Innovation in the Digital Era*. Pages 112-125. Deloitte University Press

Soltani, A. (2019). Abusability testing: Considering the ways your technology might be used for harm. Enigma 2019. Burlingame, CA, USA.

Sotorrío, L. L., & Sánchez, J. L. F. (2008). Corporate social responsibility of the most highly reputed European and North American firms. *Journal of Business Ethics*, 82(2), 379–390. <https://doi.org/10.1007/s10551-008-9901-2>

Schwartz, M., & Carroll, A. B. (2003). Corporate social responsibility: A three domain approach. *Business Ethics Quarterly*, 13(4), 503–530.

Thanetsunthorn, N. (2015). The impact of national culture on corporate social responsibility: evidence from cross-regional comparison. *Asian Journal of Business Ethics*, 4(1), 35–56. <https://doi.org/10.1007/s13520-015-0042-2>

Thorun, C. (2018). Corporate Digital Responsibility - Unternehmerische Verantwortung in der digitalen Welt. In: *Fallstudien zur Digitalen Transformation*. Pages 174-191. SpringerGabler

Toniolo, K., Masiero, E., Massaro, M., & Bagnoli, C. (2020). Sustainable Business Models and Artificial Intelligence: Opportunities and Challenges. In *Contributions to Management Science* (pp. 103–117). Springer. [https://doi.org/10.1007/978-3-030-40390-4\\_8](https://doi.org/10.1007/978-3-030-40390-4_8)

Vidgen, R.; Hindle, G.; Randolph, I. (2020). Exploring the ethical implications of business analytics with a business ethics canvas. *European Journal of Operational Research*. 281 (3), 491-501

Welford, R. (2005). Corporate Social Responsibility in Europe, North America and Asia 2004 Survey Results. *Journal of Corporate Citizenship*, 17, 33–52.  
<https://doi.org/10.9774/gleaf.4700.2005.sp.00007>

Wickham, H. (2019). stringr: Simple, Consistent Wrappers for Common String Operations.  
<https://cran.r-project.org/package=stringr>