DIGITAL WASTE MANAGEMENT AS A TOOL OF ESG MODEL

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Abstract: *The digitalization of society and economy has by presently ended up a urgent advancement of the 21st century, influencing each zone of standard of, living economy, legislative issues, etc. Squander administration - counting squander anticipation - and the more enveloping concept of a circular economy are no special case to this. Computerized innovations come with the guarantee of a more compelling squander administration, i.e. more secure, more straightforward, more prudent and more resource-efficient processes, way better sourcing of profitable fabric within the squander streams and a viable interface to other divisions in a future circular economy. This report analyzes the status quo, openings and dangers coming about from the computerized change of the squander administration segment. It appears that the squander administration division is in an early stage in this advancement. The chances as well as the effect of its computerized change are still developing and can still be formed. The report needs to contribute to an moved forward understanding and administration of this process. To this conclusion, it considers the important computerized innovations within the segment, counting display and future applications and the coming about potential benefits. It gives an understanding of the more extensive scene that the digitization handle is set into, and in that highlights the drivers and inhibitors that direct this improvement. Consideration is additionally given to the outside impacts made by the computerized change of the squander administration segment within the financial, natural and social domains. Besides, barely any division is as closely connected to the rise of a circular economy as waste management. Subsequently, the report too discusses how advanced advances are fundamental and in fact vital to the creation of the circular economy because it is imagined for illustration within the European Green Deal and the Circular Economy Activity Plan.*

Keywords: *e-waste, digital waste, digital trash. Sustainability*

INTRODUCTION

There is no aspect of 21st century living, work, or policy that has not been touched by the digital revolution of society and business. This is also true for the broader notion of a circular economy, which includes waste management and waste avoidance. Better waste management is possible with the help of digital technologies, which allow for safer, more transparent, more economically and resource-efficient processes, better sourcing of valuable material in the waste streams, and an efficient link to other sectors in a future circular economy. The current state, opportunities, and threats brought on by the waste management industry's digital revolution are all examined in this paper. This demonstrates that the waste management industry is at the forefront of this movement. Its digital revolution has yet to fully materialize, and hence, its prospects and effects are still malleable. The purpose of this paper is to aid in bettering our knowledge of and control over this process.

This is accomplished by research on the useful digital technologies in the field, including their current and prospective uses and the advantages that may accrue as a result. It explains the context in which digitalization is taking place and draws attention to the factors that are driving and restraining it. The external impacts of the digital revolution of the waste management sector on the economy, environment, and society are also discussed. Furthermore, waste management is arguably the industry most intrinsically tied to the development of a circular economy. Therefore, the paper also explains why digital technologies are crucial to the development of the circular economy, as envisioned by initiatives such as the European Green Deal and the Circular Economy Action Plan.

ESG management involves implementing strategies and practices that promote sustainability, responsible business conduct, and long-term value creation. It goes beyond traditional financial metrics and takes into account the broader impact and sustainability of a company's operations. ESG considerations are increasingly important for investors, as they seek to align their investments with their values and address the risks and opportunities associated with environmental and social issues. Companies that effectively manage their ESG factors can benefit from improved risk management, cost savings, enhanced reputation and brand value, access to capital, and better long-term performance. ESG management is often integrated into a company's overall business strategy and decision-making processes, and it requires ongoing monitoring, reporting, and engagement with stakeholders.

Waste matter is undesired or useless. It is everyone's duty to make sure that hazardous waste is disposed of safely, sustainably, and in accordance with all waste disposal laws. E-waste is rapidly growing, with a 20–25% yearly growth rate. E-waste is the fastest-growing waste stream due to market spread, replacement markets, and high obsolescence rates combined. Pollution prevention techniques include those that reduce the use of energy, equipment, and other resources—both hazardous and non-hazardous—as well as other materials [1,2]. The hazards of criminal and civil responsibility, operating expenses, and the need for transport and disposal may all be reduced by effective waste management. It is a multidimensional waste stream made up of both economically valuable and scarce components [3].

Brief overview of the topics of digitalization, waste management, and waste prevention.

The term "digitalization" refers to the process of accelerating many different types of contact by expanding the number of linked devices and data flows. This process has been a driving force behind the dramatic digital transformation that European societies and economies have been through. (Negreiro, Tambiama - European Parliamentary Research Service, 2019) [5] The European Commission (EC) defines digital transformation as "a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services" (European Commission, 2017). This definition can be found in the European Commission's report titled "Digital Transformation." It is essential to differentiate the concept of 'Digitisation' from 'Digitalisation' in this context. According to the OECD's Going Digital (GD) Horizontal Project (2017) [11][12], 'Digitisation' refers specifically to the conversion of information or data from analogue to digital format, whereas 'Digitalisation' refers to the adoption or increase in use of digital or computer technology (by an organization, an industry, or a country), and therefore describes more generally the way digital technologies are affecting economy and society.

According to the Organization for Economic Co-operation and Development (OECD), and today widely accepted, this digital transformation can "spur innovation and productivity growth across many activities, transform public services, and improve wellbeing as information, knowledge, and data become more widely available" (Going Digital (GD) Horizontal Project, 2017). This notion is widely accepted today. The World Economic Forum estimates that the combined global value of digital transformation to society and industry will exceed US$100 trillion by the year 2025. The European Parliamentary Research Service found that an efficiently functioning digital single market could contribute €415 billion per year to the economy of the European Union (EU) for the period of 2014-2019 and create hundreds of thousands of new jobs. Fostering digital transformation is higher than it has ever been on the political agenda of the European Union (EU) due to the immense development potential that it presents for EU businesses and society (Digital Europe Programme, 2019). According to the European Commission (EC), "EU businesses are not taking full advantage of these advanced technologies or the innovative business models offered by the collaborative economy," and "the state of the digitization of industry varies across sectors, particularly between high-tech and more traditional areas, as well as between EU countries and regions" (European Commission, 2017). These are both statements that are considered to be true by the EC. Figure 2.1 depicts the heterogeneity that exists between nations in the waste, water, and sewage sector. It illustrates the degree to which a selection of EU nations have reached a certain level of "digital maturity" in relation to a variety of specified parameters, which are depicted along the horizontal axis.

Waste management is described as the "discipline concerned with controlling the generation, storage, collection, transport or transfer, processing, and disposal of waste materials in a manner that best addresses the range of public health, conservation, economic, aesthetic, and other environmental concerns. Planning, administrative, financial, engineering, and legal duties are all included in its purview [9][10]. The fundamental ideas and terminology pertaining to waste management, such as those for waste, recycling, and recovery, are laid down in Directive 2008/98/EC. The regulation specifies how to identify between waste and byproducts as well as when waste ceases to be rubbish and becomes a secondary raw material (so-called end-of-waste criterion).

According to the Directive, E. C. [8], waste prevention refers to "measures taken before a substance, material or product has become waste, and that reduce: a) the quantity of waste, including through the reuse of products or the extension of products' lives; b) the adverse impacts of the generated waste on the environment and human health; or c) the content of harmful substances in materials and products."

Since the Waste Framework Directive was introduced in 2006, the waste hierarchy has governed waste policy in Europe. After the waste hierarchy was established, waste management switched from processing enormous amounts of garbage to creating value. Because of this, attention has shifted from high volume, low value commodities to low volume, high value materials like copper and gold. They can be found in used vehicles or electronic garbage, which necessitates extensive processing in order to remove the metals. Waste treatment processes got increasingly sophisticated and expensive. As a result, there was a demand for efficiency, which prompted ongoing research into new technologies. This led to conflict between market forces for material recovery and recycling and regulations governing garbage. The processing of waste no longer took place near to the point of generation, but rather to locations with better market prices, cheaper costs, or laxer environmental regulations.

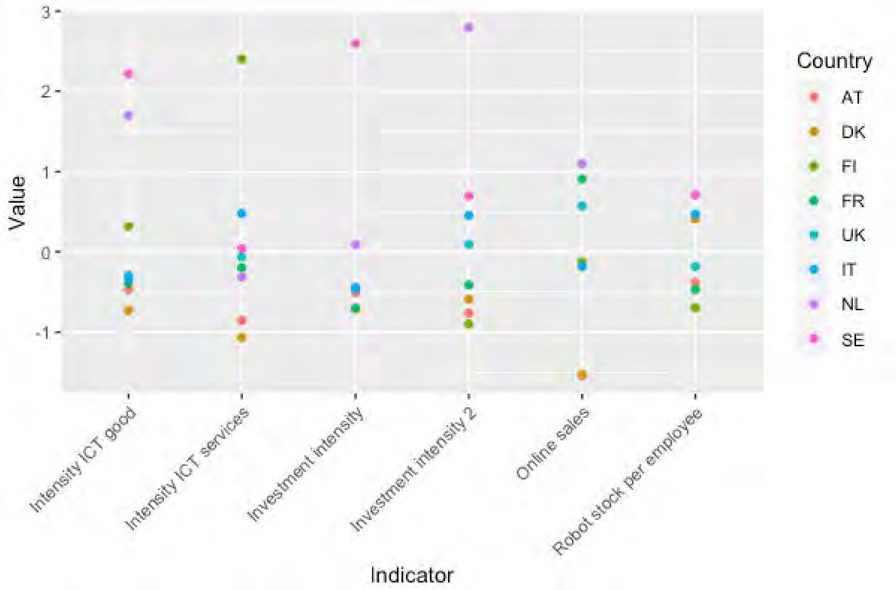

Figure 1: Spread of digital maturity for EU countries and different indicators for the waste, water and sewage sector. The y-axis shows data normalised for each indicator. Scattered points show heterogeneity while lumped points would stand for a similar status for all countries. Data adapted from OECD scoreboard.

Source: OECD – Organisation for Economic Cooperation and Development, 2017a

The waste management industry is now moving quickly toward a circular economy. The limitations on resources are increasingly acting as the engine rather than the benefit of, say, recycling as an end in itself. Numerous resources are in short supply, including chromium, cobalt, fluoride, and rare earth elements. It is strategically significant to be able to reclaim these resources from the goods in which they have been utilized, especially if their reserves are found in nations outside the European sphere of influence or will be exhausted in the future. These and other essential resources are needed by our economy but will become more difficult to get or more expensive to obtain in the future. This motivates a new policy concept that examines the usage phase of materials and products in addition to the objective of increasing the use of recycled materials. Eionet Report - ETC/WMGE 2020/4 6. It poses the subject of how we might lengthen the useful lives of products and maintain materials' high value throughout the course of their lifetimes.

The line between raw resources, finished goods, and trash blurs in a circular economy. The value chain for a product includes material management, and manufacturers are still in charge of the goods and materials they put on the market. In leasing arrangements, manufacturers even retain product ownership while simply offering a service to the client. Existing stakeholders in this intricate system of material management need to reevaluate their roles since this might have profound repercussions on the waste industry. This encourages the incorporation of cuttingedge technology that can be provided via digitalization. The subsequent chapters will analyze this process in great detail.

What is E-waste?

The proliferation of electronic device use may be attributed, in part, to the quickening pace of technological advancement as well as the expanding purchasing power of consumers. The rise in consumption has environmental repercussions, whether such repercussions are caused by the exploitation of raw materials or by the garbage created after products have been used. Electronic waste, also known as "e-waste" or "Waste of Electronic and Electrical Equipment (WEEE)", is defined as "all components, sub-assemblies, and consumables, which are part of the product at the time of discarding" (EU WEEE Directive 2012/19/EU Article 3e, 2012). Another name for this type of garbage is "Waste of Electronic and Electrical Equipment (WEEE)." Several definitions are offered by various references [3], but the one that stands out the most is that e-waste refers to electrically powered appliances of any size or purpose that the buyer is no longer interested in purchasing. E-waste can be formed not only because the product has lost its service function or achieved its lifespan, but also because of the behavior of the customer or outmoded technology, both of which diminish the lifespan of EEEs. By using the word "no longer desired," we indicate that e-waste can be generated for any of these reasons.

According to the definition, electronic waste can include a wide variety of items that range in both size and the components that make them up. Since 2002, when the Basel Convention and the "European Union Waste of Electronic and Electrical Equipment Directive" were passed, an increased awareness of electronic waste has grown. The problem with electronic waste is that its amount is always increasing, which is a direct result of rising consumption as well as shorter product lifespans.

According to Sahajwalla and Gaikward [7], only 15% of electronic garbage gets recycled, despite the fact that e-waste is regarded to be the type of waste that has increased at the fastest rate over the previous decade (3-4% per year). The quantity of electronic trash produced is directly correlated to the rising level of concern around such waste.

What is digital trash?

The proliferation of cloud computing and storage has made it both cheaper and simpler than ever before to store massive volumes of data, particularly for major companies who have the financial means to acquire significant quantities of storage at once. Although it may appear that storing data shouldn't need a significant amount of energy, there is a carbon cost associated with doing so.

There are a variety of different estimates on the amount of energy that is required for data storage, but most industry professionals agree that it requires a substantial quantity of energy. One response to this question came from Justin Adamson, who was studying engineering at Stanford at the time. He stated that for every 100 gigabytes of data that you save and keep on the cloud, you produce around 0.2 tons of carbon dioxide per year. This is not a significant amount of CO2 when compared to other activities that generate carbon, such as driving a car or heating a home with gas. On the other hand, the cost of carbon may quickly build up, which is especially problematic for huge companies that rely on the acquisition and analysis of vast "big data" sets.

According to study carried out by HubSpot in 2016, the typical organization saved and stored 347.56 terabytes of information. Keeping so much data saved would result in the emission of around 700 metric tons of carbon dioxide every single year. A new word that reflects the negative effects on the environment that improper data stewardship may have is "digital waste." The long-term repercussions of holding enormous volumes of information in a digital format, whether that information is raw data, processed data, idle or in use, are referred to as data waste. Digital waste is synonymous with data waste.

Experts frequently use the phrase "digital waste" to refer to the carbon emissions and energy consumption that are created by data-driven infrastructures. These infrastructures include the enormous database complexes that power cloud services supplied by companies such as Microsoft, Google, and Amazon. In their paper[1] on digital trash, culture, and technology law for the Harvard International Law Journal, Harvard legal experts Elettra Bietti and Roxana Vatanparast utilize this concept. They show how much energy data collecting has started to use, as well as specific use-cases of data that are particularly energy-intensive. The article also discusses why this shift toward more energy-intensive data collection practices has occurred.

Estimates suggest that digital technology is responsible for somewhere in the neighborhood of 4% of all carbon emissions. This number is anticipated to become twice as large by the year 2025.

What causes data to consume such a large amount of energy?

There are some applications of information that need far more energy than others. It's possible that training a single AI system will consume the same amount of carbon dioxide emissions as five automobiles will emit over the course of their careers combined. Mining for bitcoin already consumes about the same amount of power as some nations, and this number is expected to keep rising in tandem with the market as it develops. IoT devices, which are becoming increasingly popular as a method for gathering data on a variety of topics ranging from the operation of machines to that of HVAC systems, are on course to generate 79 zettabytes of information every single day by the year 2025. The enormous volume of data that these devices create may provide a challenge for businesses, even if companies are increasingly embracing these devices to collect data that might assist them in streamlining operations and predicting future occurrences.

In a similar vein, it's possible that the availability and usefulness of data from sources such as car telematics systems, internet advertising services, and ecommerce platforms are what's fueling the expansion of commercial data-collection systems. The data obtained from these sources may offer organizations valuable information about the operation of their machinery as well as the habits and concerns of their consumers. The potential cost that comes with keeping data is another concern for certain industry professionals. The quantity of physical storage gear required increases proportionally with the amount of data being stored. To maintain this gear operational requires a significant amount of both energy and physical space. This is because it needs power not just for the hardware itself but also for support hardware like fans and fire suppression systems. The increasing quantity of data that companies collect also necessitates an increase in the amount of storage space available, which in turn necessitates an increase in the creation of drives that are capable of storing the data. These several processes each result in the release of carbon emissions.

This waste of data arises not just from individual sources of data but also from commercial sources of data. Due to the fact that data has just become incredibly valuable, businesses are producing more data. Information from customers, devices connected to the internet of things (IoT), and even a company's internal systems all have the potential to provide valuable insights or other forms of value. For example, consumer data is frequently an essential component of the sophisticated algorithms used in modern advertising and sales forecasting. When a company has more information on its customers, it can make more accurate predictions about things like consumer behavior, content targeting, and demand.

The value of IoT data for firms who seek to optimize their internal systems is comparable to that value. What Individuals and Businesses may Do Alone to Reduce Their Own Digital Waste There are several things that businesses and individuals may do on their own to reduce their own digital waste. The vast majority of companies are currently engaging in discussions on the usage of data and the governance of it. Businesses have been forced to review the ways in which they collect, store, and handle data as a result of the rising significance of data privacy as well as new rules such as the General Data Protection Regulation (EU GDPR) and the California Consumer Privacy Act (CCPA), both of which were passed in the state of California.

Business executives who are discussing the potential role that new regulations may play in protecting data privacy may also consider taking action to cut down on digital waste. Any company that maintains a significant quantity of data should conduct a data audit, since this is a required step in the process of enhancing data governance and is also likely a good place to begin. Reviewing the company's existing data repositories as well as the sources of data can provide companies the opportunity to get insight into the provenance of their data and the quantity of data they are currently retaining. During this audit, they will be able to categorize datasets according to the possible value and use-cases associated with each dataset, which will enable them to identify stored data that may no longer be required.

These data sets may be eliminated or shrunk in size, which assists a company in minimizing its requirements for data storage and the associated costs of carbon emissions. A company may better manage their expanding storage demands and get a better grasp on how their organization is making use of data by performing these audits many times. Each person is responsible for managing their own data waste in the same manner. Reviewing files stored in the cloud or on personal drives on a regular basis may help anybody identify material that they no longer use, which will enable them to free up space and minimize the amount of money spent on storage.

CONCLUSION

This work serves as a call to evaluate not just the environmental problems that come from data-driven infrastructures, but also wider concerns about the types of social life we would like to encourage. While there are still many topics that need to be investigated in future research on data waste, this contribution serves as a call to consider these issues. The powers associated with data-driven infrastructures not only include economic and technological capabilities, but also political capabilities. Because of the nature of the problems they present, technical remedies will not be sufficient to address them. We need to ask ourselves whether we want technology companies, data-driven infrastructures, and the people who are behind them to have the power to shape the social and ecological conditions of our futures, and if not, who should be exercising such power, and what role law and public political engagement can play in shaping alternatives. If we do not want them to have this power, then we need to ask who should be exercising it, and what role law and public political engagement can play in shaping alternatives.

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