DOI: 10.18254/S278229070019620-8 Original article

Sustainable Growth and the Role of Artificial Intelligence in Improving Circular Economy

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Abstract. Sustainable development has three dimensions, economic, social and environmental. The three-fold dimension of sustainable development implies the consideration of the environmental issue that goes beyond mere protection of the environment since it cannot be considered separately from the economic-productive system and social needs. The circular economy operates along the same three dimensions. A central role in the successful implementation of the circular economy must necessarily be given to the enterprises. Artificial intelligence provides a powerful tool in the transition to a circular economy, acting as an instrument for innovation in the business model, by directing business activity towards sustainable capitalism, overcoming the model of capitalism aimed solely at profit.

Keyword: circular economy; artificial intelligence; sustainable business model.

For citation: Amatuccia, Carlo, and Giovanni Mollo. 2022. Sustainable growth and the role of artificial intelligence in improving circular economy. *Law & Digital Technologies* 2(1): 7–15.

INTRODUCTION

Sustainable development has an economic, social, and environmental dimension. This three-fold dimension implies the consideration of the environmental issue that goes beyond mere protection of the environment since it cannot be considered separately from the economic-productive system and social needs. The circular economy can play a crucial role in the fulfillment of sustainable growth, mainly to help tackle the climate crisis by reducing GHG emissions along supply chains.

Whereas artificial intelligence provides a powerful tool in the transition to a circular economy, acting as an instrument for the innovation of business activities towards sustainable capitalism, overcoming the model of capitalism aimed at profit maximization only. Such a desirable path will require a new enterprise definition based on the concept of the "Sustainable business model".

1. SUSTAINABLE DEVELOPMENT

The principle of sustainable development has its roots in the United Nations Conference on the Human Environment held in Stockholm in 1972. In fact, the first principle proclaimed as a result of the work of the Conference, states that "man has a fundamental right to freedom, equality and satisfactory living conditions in an environment which allows him to live in dignity and well-being, and he bears a high degree of responsibility for the protection and improvement of the environment for future generations", and the second principle stated that "the Earth's natural resources, including air, water, flora, fauna and especially the natural ecological system, must be safeguarded for the benefit of present and future generations through careful planning or appropriate management" (United Nation 1972).

The principle was reformulated in paragraph 27 of the 1987 Report of the World Commission on Environment and Development of the United Nations, entitled Our Common Future, which states that "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (Federal Office for Spatial Development ARE1987).

This principle was reaffirmed by the United Nations Conference on Environment and Development, held in Rio de Janeiro from 3 to 14 June 1992, according to which "human beings are at the center of concerns for sustainable development. They have the right to a healthy and productive life in harmony with nature" (United

[1] Although the article is a joint work, paragraphs 1 and 2 are attributable to Giovanni Mollo and paragraphs 3 and 4 to Carlo Amatucci

[2] The opinions expressed are personal and in no way involve Consob.

Nation 1992, 1). It was also stated that "the right to development must be realized in such a way as to equitably meet the environmental and developmental needs of present and future generations" (United Nation 1992, 2).

At the 2002 UN Summit on Sustainable Development in Johannesburg, the participants solemnly agreed on the following declaration: "we firmly pledge to use our rich diversity, which is our collective strength, in constructive partnerships for change and for the achievement of the common goal of sustainable development" and "we agree on the need for the private sector to operate within transparent and stable rules to strengthen corporate public accountability" (United Nation 2002).

In 2012, the UN organized in Rio de Janeiro the United Nations Conference on Sustainable Development (UNCSD), also called Rio+20, at the end of which, the final document introduced the idea of a green economy in a context of sustainable development and poverty reduction (United Nation 2002).

In 2015, the UN Conference on Climate Change, held in Paris, culminated with the adoption of the 2030 Agenda for Sustainable Development, which consists of 17 objectives (OSS/SDGs, Sustainable Development Goals) and 169 targets (United Nation 2015).

The goals and targets, as stated in the preamble of the 2030 Agenda, "are interconnected and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental dimensions" (United Nation 2015). This statement is the key to the proper implementation of the goals and targets set by Agenda 2030.

The principle of sustainable development became part of the Italian legal system with art. 3-quater of Legislative Decree 152/2006 and subsequent amendments, the so-called Environmental Code, which states that all human activity legally relevant under this code must comply with the principle of sustainable development, in order to ensure that the satisfaction of the needs of current generations cannot compromise the quality of life and opportunities of future generations. The principle of sustainable development becomes central in the action of the public administration pursuant paragraph 2 of the aforementioned provision, according to which in the comparative choice of public and private interests characterized by discretion, the interests of environmental protection and cultural heritage must be given priority consideration.

2. SUSTAINABLE DEVELOPMENT AND THE SOCIO-ECONOMIC SYSTEM

According to international sources, sustainable development has three dimensions: economic, social and environmental (Fraccia 2010a, 2010b, 2012; Greco and Salimbeni 2003; Lomonaco 2004; Lanza 2002; Pepe 2002a, 2002b). The goals and targets are the result of the balancing of these three dimensions, therefore they are interconnected and indivisible.

The existence of a three-dimensional space in which sustainable development takes place implies a consideration of the environmental issue that goes beyond the mere protection of the existing environment, since environmental protection cannot be considered separately from the economic-productive system and from social needs.

In an earlier interpretation it was pointed out that the protection of the existing environment, that did not consider the needs of development, would have undermined "the ultimate purpose of protection of the human species that inspires the environmental discipline, because, frustrating, beyond a certain limit, the development needs of the current ones, would lose sight of the interests of future generations" (Fraccia 2010a, 20). Following the same thought, by definition, the problem of environmental protection arises only in the presence of development. Pursuing only environmental protection would result in in the situation of conflict with sustainable development "which should be resolved in favour of the second since the (true) environmental protection is justified only because of (or if compatible with) sustainable development" (Fraccia 2010a, 20).

The principle of sustainable development, however, overcomes the forementioned opposition as environmental protection represents one of the three dimensions of sustainable development.

The environmental challenge, in fact, "inevitably raises questions that also (and above all) concern the way the economic and productive system functions and is structured" (Moliterni 2020, 32). The environmental issue has imposed the search for new development models able to combine "the increasingly challenging objectives of environmental protection with the characteristics of market economies" (Moliterni 2020, 33).

In this context, the idea of a Green economy was introduced, with an uncertain progress (UNDESA 2012). The concept of the Green economy was established within the United Nations, as a system capable of ensuring economic development, generating long-term benefits without, however, exposing future generations to significant environmental risks (Moliterni 2020, 33).

The UNEP (UN Environment Program), in its report on the global green economy, defined the Green economy as "an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and the destruction of non-renewable resources. It is a low-carbon, resource-efficient and socially inclusive economy" (Fortunato 2019, 420). This definition led to the assumption that there was a direct connection between the Green economy and sustainable development. "The green economy would be the means to enable the simultaneous advancement of environmental and economic goals according to the logic of the same concept of sustainable development" (Moliterni 2020, 34).

The interpretation according to which the Green economy is linked to sustainable development by a relationship of instrumentality leads to extend the problems and doubts of interpretation inherent to sustainable development to Green economy. In particular, the interpretation according to which sustainable development represents a formula for a simple composition of the interests involved, led to give prevalence to the economic aspect and to the consideration of the environmental aspect" as one of the elements to be included in the economic choices (and not as the prerequisite to rethink the overall structure of the system)" (Moliterni 2020, 34). This approach reduced the Green economy to the marginal role of "container within which a plurality of 'measures' and intervention tools can be brought together", united only by being instrumental to the reduction of polluting emissions and exploitation of natural resources (Moliterni 2020, 35). In this way, the economic system would continue to be structurally independent from the environmental variable, being the latter relegated to operate within the limits of its "green part" identified in the Green economy (Moliterni 2020, 35). The Green economy would therefore be at least insensitive to the social dimension of development and, in particular, to the question of access to public goods and collective resources (Moliterni 2020, 37; Goodman and Salleh 2013; Mattei 2011). Hence, the hypothesis of a passage from the Green economy to the Ecological economy (Munda 1997), characterized by a close connection between the functioning of the ecological system and the economic system, and, more recently, the overcoming of the Green economy in favor of the Blue economy (Pauli 2015), abandoning the linear economy (red economy) (De Leonardis 2017) in favor of the circular economy (blue economy) (Moliterni 2020, Ferrara 2018). The latter represents "a real paradigm shift that imposes significant changes in the use of natural resources, waste management, design and life cycle of goods" (Cocconi 2020).

In such an economy, natural systems are regenerated, energy is from renewable sources, materials are safe and increasingly from renewable sources, and waste is avoided through the superior design of materials, products, and business models. A circular economy offers a positive way forward by redefining value creation to focus on society-wide benefits. It addresses the shortcomings of the current system, while creating new opportunities for businesses and society. Circular economy principles present unique opportunities to help tackle the climate crisis by reducing GHG emissions along supply chains; preserving the embodied energy of products and materials

3. SUSTAINABLE DEVELOPMENT AND CIRCULAR ECONOMY

Circular economy (Cocconi 2020; De Leonardis 2017, 2019, 2020; Bovino 2014; Scotti 2019) is an alternative to our current *linear economy* based on the assumption that our planet has endless *resources.* It's an economy designed to be *regenerative* and *restorative*, keeping "*products, components and materials at their highest utility and value, at all times*" (Webster 2017), where products, components and materials are designed and made for reuse, refurbishment, recycling and returning materials to the planet. The Ellen Mc Arthur Foundation, one of the world most active partner in the promotion of the circular economy, declared that "our way of doing things is reaching its limits. The current system is no longer working for businesses, people or the environment. We take resources from the ground to make products, which we use, and, when we no longer want them, throw them away. Take-make-waste. We call this a linear economy The linear economy has to change. We must transform all the elements of the take-make-waste system". In the circular economy "natural systems are regenerated, energy is from renewable sources, materials are safe and increasingly from renewable sources, and waste is avoided through the superior design of materials, products, and business models. A circular economy offers a positive way forward by redefining value creation to focus on society-wide benefits. It addresses the shortcomings of the current system, while creating new opportunities for businesses and society. Circular economy principles present unique opportunities to help tackle the climate crisis by reducing GHG emissions along supply chains" (Ellen MacArthur Foundation 2019).

The basic idea under the circular economy model is that economic models should be inspired by the way natural ecosystems work "where everything is reused and nothing is lost" (De Leonardis 2017, 168; Cocconi 2020, 17). The economic system should mimic the natural one, thus recognizing "the existence of insurmountable limits that impose the continuous reuse of goods" (De Leonardis 2017, 168) (so-called biomimesis).

Circular economy is, in fact, based on Ecological Economics, which considers economic activity as an extension of biological activity (De Leonardis 2017, 180).

Circular economy represents, therefore, a synthesis between economics and ecology (bioeconomy), which tends to optimize the value of goods and, therefore, operates on their life cycle, taking care not only for "the end of life of the products, but also their beginning of life" (De Leonardis 2017, 182; Cocconi 2020, 30). Following such model, the production process should not simply resolve the problem of how to use what remains at the end of the life of the product, but it should requirea design of what nature offers "to use it and return it to nature" (De Leonardis 2017, 183).

The issue is no longer the proper management of waste or the use of waste as raw materials (De Leonardis 2017, 179). According to circular economy, the production process starts from agriculture, that is, from the use of locally available resources and it returns to agriculture. Waste is only a transitory phase on the way back to nature (De Leonardis 2017, 183).

The bio-economy, which seems to have only two of the three dimensions of sustainable development, i.e. economic and environmental, actually contains the third, i.e. social. The unsustainability of the system, as it has been pointed out, does not consist in the depletion of non-renewable resources (Cocconi 2020, 18). On the contrary, the critical factor is the geographical location of non-renewable raw materials, which are concentrated only in certain areas of the planet and constitute reserves that are not easily accessible, thus generating "problems in terms of geopolitical security" (Cocconi 2020, 18). Circular economy, in its most evolved version, operates along the three cited dimensions of sustainable development, and involves all its players like public authorities, citizens, businesses, collective subjects (European Commission 2014). All the actors involved are equally important, but a particularly delicate role is played by Company Law, not only as the engine of business and production but also because of its links with both consumers and financiers.

Circular economy is high on Europe's political agenda. On March 11, 2020 the Commission issued a Communication titled "A new circular economy Action Plan for a cleaner and more competitive Europe". The Plan presents "a set of interrelated initiatives to establish a strong and coherent product policy framework that will make sustainable products, services and business models the norm" (European Commission 2020a).

4. ARTIFICIAL INTELLIGENCE AND CIRCULAR ECONOMY

A central role in the implementation of the circular economy must necessarily be attributed to the business enterprise (European Commission 2014). At the helm of the transition to a circular economy is the business community. Without considering the current regulatory principles and constraints that govern the various business models enterprises should consider – the economic, social and environmental dimensions in which they operate to fulfill two principles well defined by the visionary outlooks of Evan and Freeman (1988) more than thirty years ago. The first (principle of corporate rights) which states that the corporation and its managers should not violate the legitimate rights of others to determine their own future. The second (principle of corporate effects) according to which the corporation and its managers are responsible for the effects of their actions on others.

The social dimension requires the corporation to consider not only the demands coming from its shareholders and of the various components that, even indirectly, are involved in the operations, but also the demands coming from society in general.

The environmental dimension requires managers to organize their production cycle in accordance with the principles, mentioned above, that characterize the circular economy in its most advanced form.

As already pointed out by the European Commission, socially responsible conduct implies for companies – going beyond the full compliance of their legal obligations – an additional investment in human capital, in the environment and in the relationships with other interested parties (European Commission 2014). Even if the main purpose of companies is to make a profit – a premise which, now more than ever, is questioned by prominent scholars worldwide and by some jurisdiction as we will see (Sjåfjell and Bruner 2020; Strine 2019; Freeman, Harrison and Zyglidopoulos 2018; Millon 2013; Stout 2012; Keay 2011) – they can also contribute to social and environmental objectives by integrating social responsibility as a strategic investment into their business strategy, management tools and operations. In order to act in a socially responsible manner, companies should integrate social, environmental, ethical, human rights and consumer concerns into the definition of their business strategies in order to: "create shared value among their owners/shareholders and other stakeholders and society at large; identify, prevent and mitigate their possible adverse effects" (European Commission 2011).

The challenge to which companies are called can be facilitated, even if not in all the objectives that are defined in the 2030 Agenda (Vinuesa et al. 2020), by the use of new technologies and, in particular, by the use of Artificial Intelligence (Joshi 2019). The European Commission itself has, in fact, highlighted that "the use of AI systems can play a significant role in achieving the goals of sustainable development and in supporting the democratic process and social rights" (European Commission 2020b, 2).

The European Commission considers the application of the data economy, and in particular AI, as an opportunity of growth for Europe itself, believing that it has the tools "to become a world leader in innovation in the data economy

and its applications" (European Commission 2020b, 2). The Commission believes that Europe is capable to develop an AI ecosystem that will enable its society and economy to enjoy the benefits of technology. Its concrete implementation is a development of a pan-European network of supercomputers, capable of competing at continental level, consisting of eight units (one of which has been recently installed in Bologna) (Cineca.n.d.). In particular, companies would take advantage of new generations of products and services in which Europe is particularly strong as the green and circular economy (Cineca.n.d.).

Artificial intelligence is an essential tool when, as in the transition to a circular economy, it is necessary to retrieve and process large amounts of data (Enriques and Zetzsche 2020; Montagnani 2020). In this case, AI acts as an instrument for innovating the business model (Di Vaioa 2020), directing company activity towards a sustainable capitalism, overcoming the capitalism model aimed at gaining just profit (Montagnani 2020, 100; Accenture 2017).

AI is "one of the most important applications of the data economy" (European Commission 2020b) and, simplifying, it can be defined as "a set of technologies that combines data, algorithms and computing power" (European Commission 2020b). Several definitions have been given of AI but all of them expressed the idea of creating "computer programs or machines capable of behaviors that we would consider intelligent if enacted by humans. In 1955, John McCarthy, one of the founding fathers of the discipline, described the process as "consisting of getting a machine to behave in ways that would be called intelligent if it were a human being behaving that way" (Kaplan 2018). In essence, these are systems, governed by an algorithm of machine learning, which are fed by the so-called big data, that is, from the set of information collected through digital devices, and process and correlate the information thus collected according to the rules imposed by the programmer with the algorithm (Stanford Encyclopedia of Philosophy 2018, Finn 2017; Montagnani 2020; Abriani and Schneider 2020). The elaborations and the correlations of the collected information, according to the rules imposed to the system with the algorithm, constitutes the result of a process that is self-feeding and able to create new models starting from initial data (Abriani and Schneider 2020, Council of Europe n.d.). In other words, these systems are structurally capable of adapting to the data they receive, creating new models that allow the system to perform its task more efficiently (Comandé 2019). This means that the machine is able to learn, to adapt to new conditions that arise and which are different from the initial ones (Montagnani 2020, 1010). Of particular interest here are the predictive algorithms, "which detect prospective correlations useful to orient strategic choices on the basis of what has been learned from the data" (Abriani and Schneider 2020, 1329).

In this sense, AI can therefore become a fundamental tool for creation value, "thanks to its unquestionable ability to refine the predictive models needs to offer more accurate and in-depth information to directors and top managers" (Montagnani 2020, 1006).

The IA, therefore, normally constitutes a tool offered to company directors for the fulfillment of their mandate and this fact, as said, requires a reorganization of the business model (Mosco 2019).

Combining the power of AI with a vision for a circular economy means a significant opportunity to reshape world economy. From electronics to food production there are several potential applications of artificial intelligence that will help to speed up the transition to the circular economy. Products at the end of their life are hard to automatically disassemble, sort, and separate. Robotic sensors recognize and sort different waste products for recycling.

In the food industry AI enhances opportunities in farming, processing, logistics and waste management. It is already being used to scan fruit, from the images produced it can determine the optimum time to pick them. Italy, for instance, is among the top countries for biological farming (15.2% of the total) meanwhile being very ahead in implementing AI for the optimisation of irrigation and application of pesticides and herbicides.

In the design industry AI can take advantage of its capacity to rapidly analyse enormous quantities of data in order to improve the ability to identify the best way to design products based on criteria of circularity, considering both the use of raw materials in production and the object's entire life cycle.

5. THE "SUSTAINABLE BUSINESS MODEL" FOR A NEW NOTION OF ENTERPRISE

The exercise of the business activity in the three-dimensional space defined by the circular economy gives a new meaning to the creation of value that determines, consequently, the evolution of the Business Model (BM) in Sustainable Business Model (SBM) (CSR Manager Network 2020; Bifulco and D'Aloia 2008).

BM can be described as the organizational, management and operational system by which activities that transform resources into results are carried out. It defines, therefore, the way in which the company transforms acquired values by creating new value. Clearly, the concept of value is central to the design of the business model, both in terms of counting what is introduced into the production system, i.e. the values acquired, and what is produced by the system,

i.e. the values released. A recent study aimed at defining a method for measuring circularity starts from the consideration that for an effective measurement it is necessary to consider three aspects, namely the quantity and characteristics of the resources withdrawn (material, energy, water), used and reintroduced into the system; the environmental impact of the resources used and reintroduced into the system; the economic value of the resources used and the value when they are reintroduced into the system (Georgescu-Roegen 1998, 2003; Boulding 1981; Costanza 1991).

Bioeconomy, as mentioned above, highlights "the failure to take into account the role played in the process of economic growth by natural resources and energy, and the effects that this growth has on the consumption (destruction) of natural resources and on entropy" (CSR Manager Network 2020, 6; Stile 2015; Cavanna 2014; Scotti 2019). According to the logic of the circular economy, when evaluating the process of economic growth and assessing value creation, it is necessary to "take into account" not only the economic variable but also the environmental and social variable. From this perspective, the view of neo-classical economics that a company creates value when the revenues from its activities exceed the costs of carrying out those activities is obsolete. From the perspective of the bioeconomy, the value creation process must be based on the fact that there are "impassable limits that require the continuous reuse of goods". The definition of value creation must also take account of the fact that there is not only a financial component, but also an economic component in the general sense, as identified above, as well as a social and environmental component. This conception of value should be matched by business models "aimed at the pursuit of long-term corporate value creation processes [...] calibrated so as to maximise the various types of capital" (CSR Manager Network 2020, 7). In other words, a system that allows members and stakeholders to verify the increase in value, according to different perspectives.

We are still at the early stage of evaluating the negative externalities generated by business activity, i.e. to verify the wealth actually produced net of negative externalities, of the social costs produced, then to internalise negative externalities, either voluntarily, as the Corporate Social Responsibility (CSR) claims, or compulsorily, through regulation: "Where the law fails to require corporations to take their externalities into account, corporations rarely take account of their social costs voluntarily" (Johnston 2011, 223). The removal of externalities is, however, extremely far away in all economic systems, despite the increased sensitivity of consumers and businesses and the recognition in some legal systems – such as the English (Companies Act of 2006) and French (Pacte Law of 2019) – of precise obligations for directors to consider the interests of stakeholders in their management choices. Indeed, Article 1833(2) of the French Civil Code provides that "The company shall be managed in its social interest, taking into account the social and environmental challenges of its activity". Section 172 of the UK Companies Act, entitled "Duty to promote the success of the company", provides that:

(1) A director of a company must act in the way he considers, in good faith, would be most likely to promote the success of the company for the benefit of its members as a whole, and in doing so have regard (amongst other matters) to–

(a) the likely consequences of any decision in **the long term**,

(b) the interests of **the company's employees,**

(c) the need to foster the company's business relationships with **suppliers, customers and others**,

(d) the impact of the company's operations on the **community and the environment,**

(e) the desirability of the company maintaining a reputation for high standards of business conduct, and

(f) the need to act fairly as between members of the company.

In an even more avant-garde perspective, the logic whereby ESG (Environment, Social, Governance) factors are considered only as risk factors with respect to business activity and not as interests on the basis of which to direct business activity must be overcome. The management of ESG risks (Pellegrini et al. 2020) and the relative transparency aim (Fortunato 2019), instead, to trigger a virtuous circuit, i.e. to push companies to consider such factors "to the extent that this will be appreciated or, conversely, not rewarded by the market, i.e. by current and potential investors" (Bruno 2018, 980). Therefore, the criterion for making information public "is its relevance to understanding the impact on the business activity (Bruno 2018, 984), i.e. how non-financial issues affect the main risks and how these are managed (Bruno 2018, 985).

In a broader perspective, "circular growth" business models have been proposed (Lacy et al. 2016, 63; Dallocchio et al.n.d.), but each one only pursues individual aspects of the circular economy.

The first of these models is identified as the 'circular supply chain' and requires that the energy and raw materials needed to make products be fully renewable, recyclable or biodegradable, replacing linear materials that are derived from virgin resources, are not recyclable and are frequently toxic and polluting (Lacy et al. 2016; Dallocchio et al.n.d.). The model does not simply aim to minimise bad materials, but to produce something that has value, in the sense of the circular economy, and therefore makes economic sense (Lacy et al. 2016, 63). This means organising the business in such a way as to "do things right from the start" (Lacy et al. 2016, 85).

The second BM is the so-called "recovery and recycling" model according to which the waste, according to the linear economy model, "is reintroduced for other uses, effectively eliminating not only waste but the concept of waste itself"

(Lacy et al. 2016, 85). In this way, the wealth produced by the business derives not only from the final product but also from any by-products (Lacy et al. 2016, 85).

The third model is called "product life extension". According to the linear economy model, companies have organised their strategy with the objective of increasing product volume, following the logic that revenue increase depends solely on the increase in the number of units of product produced and sold: "The Product Life Extension business model extends the life cycle by generating revenue through longevity rather than volume" (Lacy et al. 2016, 107–108).

The fourth BM is the so-called "sharing platform" which connects, via a special platform, the owners of products with those interested in using them (Lacy et al. 2016, 131). Using the platform increases productivity by not leaving products unused and, at the same time, reduces the demand for new goods by allowing more customers to use the same resources (Lacy et al. 2016, 131).

The fifth BM for circular growth is the "product as a service" model, whereby ownership of the product remains with the producer who offers it to one or more customers as a service, including everything necessary to keep it in use (Lacy et al. 2016, 153). The customer is thus transformed from a consumer of the product into a user of the service (Lacy et al. 2016, 154).

However, although the models summarized above are compatible with the principles of the circular economy, they do not make the logical leap that enables the company to live in the three-dimensional space designed by the circular economy.

The problem posed by the circular economy is quite different, since it is a matter of designing and managing business activities with equal consideration for the economic, social and environmental aspects, detecting the demands that come from each of these poles and carrying out business activities in such a way as to coordinate and satisfy all the demands thus identified. The BM, structured in this way, evolves into the Sustainable Business Model (SBM), capable of defining the company's objectives "also in social and environmental terms and not only from an economic and financial point of view" (CSR Manager Network 2020, 29).

The adoption of an SBM, however, requires the research and management of a quantity of data that would be difficult to satisfy with the use of traditional techniques and, in any case, the adoption of such a model would imply a reconsideration of the value to be attributed to the adequacy of corporate structures. IA is the tool that can offer a solution to this need, since it is already considered crucial in the management of ESG factors (Montagnani 2020, 1006), due to its ability to process an enormous quantity of data and identify important correlations between them (Montagnani 2020, 1003), as well as its ability to adapt to the environment in which it operates.

The efforts required by companies, in terms of the amount of data to be acquired and processed, in order to operate in the dimension of the circular economy are, however, more intense than those required for the simple management of ESG risk factors, and this makes recourse to AI even more useful and, perhaps, indispensable.

CONCLUSION

It is clear, therefore, that the principles and rules that govern the company structure from the traditional organizational, technical, administrative and accounting points of view are inadequate, since they are essentially centered on the interests of shareholders and creditors, from a predominantly economic-financial perspective. This means questioning the essence of the company – which is no longer based on the notion of capital but also on the stakeholders, "that is groups and individuals who benefit from or are harmed by, and whose rights are violated or respected by, corporate actions" (Evan and Freeman 1988, 100).

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