

Article

SDGs and Innovation in the Business Context Literature Review

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Abstract: On 25 October 2015 the United Nations approved The 2030 Agenda for Sustainable Development and its 17 sustainable development goals (SDGs). It is an important event from different points of view: clear judgment was expressed on the unsustainability of current development models, not only on the environmental level, but also on the economic and social ones. The implementation of the agenda requires a strong involvement of all members of society, especially business. The article aims to provide a literature overview on the relationships between innovation and sustainable development objectives in the industrial context. SDGs are also analyzed in terms of stakeholders involved, reactions of companies and citizens and metrics recently proposed by researchers of PricewaterhouseCoopers (PWC). These preliminary results show that different stakeholders approach the SDGs differently, but also that the interest of companies toward SDGs is growing, confirming the considerations that emerged in literature. Furthermore, some SDGs appear to be more a prerequisite for achieving targets, than actual goals, while innovation has proven to be a driver for most SDGs.

Keywords: sustainable development goals; SDGs; innovation; industry; business; company; firm

1. Introduction

The seventeen objectives of The 2030 Agenda for Sustainable Development are a topic of increasing interest for research, not only due to the interdisciplinary nature of the problem, but also due to the concerns of many scientists regarding the estimates on the planet's resources depletion and the related social and economic issues. In this perspective, innovation might represent a way to realize the invoked change. It is important to note that the theme of sustainable objectives is not new. Indeed, since the 1980s and 1990s researchers have been interested in sustainable goals [1–8]. In subsequent years the interest has increased, also accepting themes that embrace political or ideological points of view [9–21] and from 2013 onward a formalization of the objectives was started gradually in forms similar to the ones we know today [22–32]. However, consistently with the objectives that we propose to pursue, we have chosen not to investigate the whole history of sustainability in general, but to focus only on the sustainable development goals (SDGs) in the form of 2015. The paper, in fact, aims at summarizing the specific literature on (1) the relationship between innovation and SDGs in the industrial context, and (2) the recent perceptions that stakeholders, especially companies, showed about SDGs. The contribution we intend to offer to research consists in the attempt to bridge the gap on the links between SDGs, innovation and business, by systematizing the studies so far conducted.

2. Material and Method

The research was performed in the month of June 2019 on the Scopus scientific database, also using the following string: TITLE-ABS-KEY ((SDG* OR “Sustainable Development Goals”) AND innovat* AND (industr* OR firm OR business OR company OR companies)) AND (LIMIT-TO (LANGUAGE,

“English”). The choice of carrying such a research is consistent with the aim of analyzing a very specific literature linked solely to SDGs born in 2015 and connected to innovation in the industrial field. From the over 100 documents found, after a careful reading of the overall content, about half of the papers were excluded, due to a lack of relevance as to the specific theme. Thereafter, about thirty works (especially business reports and annexed literature) were added to develop the section concerning firms’ and citizens’ perceptions about SDGs. Moreover, through a “snowball” analysis other contributes were added. Subsequently, there was the need to add further articles to better clarify imperative aspects emerged during the revision phase. In Tables 1 and 2 a brief overview of the research results is presented.

Table 1. Overview of works: year of publication.

Year	N°
2015	6
2016	25
2017	27
2018 ¹	79

¹ and until June 2019.

Table 2. Overview of works: type of publication.

Type	Rate
Article	61%
Confer. Paper	16%
Review	12.5%
Report/Book/Document	10.5%

3. Sustainability Development Goals and Innovation in Field of Companies: A Literature Review

During the period in which the SDGs were being determined, some authors identified four perspectives that should be reflected in the focus and contents of the goals: (1) “planetary boundaries” (the limits of growth), in which to give birth to a (2) “safe and just operating space” where an (3) “energetic society” can grow through a (4) “green competition” [33]. Subsequently, numerous authors conducted studies on the SDGs, analyzing them from different points of view. For example, some contributions [34], by comparing The 2030 Agenda with other similar or past documents - Agenda 21 (1992), Further Implementation of 2 (1997), The outcomes of the World Summit on Sustainable Development (2002), The Future We Want (2012), The AAAA Agreement (2015), and The Paris Agreement (2015)- through content analysis, noted that The 2030 Agenda is not the most complete reference document. Indeed, there seems to be a gap in comparison to the targets of other documents (i.e., Agenda 21, one of the most complete), such as those related to clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), climate change (SDG 13), life on land (SDG 15) responsible consumption and production (SDG 12) and industry, innovation, and infrastructure (SDG 9).

3.1. Innovation and SDGs from Idea Generation to after Marketing

The interplay between innovation and SDGs is strongly supported by literature in all the phases of innovation. A first study [35] within the field of innovative design recalls the 39 parameters of the TRIZ (Teoriya Resheniya Izobretatelskikh Zadatch, literally: “theory of the resolution of invention-related tasks”) matrix, used during the idea generation process, to seven eco-efficiency elements named REDUCES:

- Reduce material intensity,
- Energy intensity minimized,

- Dispersion of toxic substances is reduced,
- Undertake recycling,
- Capitalize on use of renewable resources,
- Extend product durability,
- Service intensity is increased,

creating a “green design” matrix (7x39) to achieve SDGs. Other authors link the possibility of pursuing SDGs through the sustainability-oriented service innovation within the after-sale period, [36]. It was also noted that, in order to achieve the sustainability objectives of companies, business models have to be prepared accordingly. The need to fit with SDGs and globalization has made competition among companies more and more complex, with conventional business models struggling to find appropriate solutions to survive. In this context, the alternative concept of a sustainable business model may bring competitive advantage to organizations by enhancing conventional business models to achieve sustainable development while maintaining profitability and productivity [37]. In the context of urban transition, it was highlighted that a series of initiatives and programs created to involve European cities in the effort of a low-carbon future and an improvement in the quality of life through sustainable economic development have generally been successful and led to the commitment of a growing number of cities toward SDGs [38]. Other authors focused on the possible upstream causes of the problem [39]: for example, it has been noted that neoliberalism has greatly increased inequalities and accentuated the imbalance of power between north and south countries. Through textual analysis, industrial ecology (IE) has been recognized as one of the innovative methods acting as a bridge to the gap between traditional business practices and SDGs. Indeed, three areas of connection between IE, business strategy, and sustainable development literature are identified [40]: 1. efficient use of energy and resources, 2. innovation research and 3. mitigation and adaptation to climate change. It was realized that the old linear conception of extracting, constructing and divesting proved to be completely ineffective for the pursuit of SDGs [41], leaving room for an innovative circular concept: repairing, reducing, reusing, recycling, recovering [42].

3.2. Innovation and SDG beyond the Product/Service: An Innovative Education

In other studies, links between the SDGs and the sustainable human resource management are also hypothesized [43]. Some authors dealt with the philosophical and epistemological aspects, highlighting the ethical question before the economic, social and environmental issues and providing practical tools for the adoption of sustainable practices in higher education institutions, in order to increase the objectives related to SDG 4, SDG 17, SDG 12, and SDG 13 [3]. Other studies concern the political corporate social responsibility and business and human rights, considering them as possible drivers for SDGs [44]. For other authors, social entrepreneurship has emerged as a successful strategy for pursuing sustainable development goals [45]. With reference to entrepreneurial training, it was understood that educating managers toward SDGs is a critical issue, potentially very useful for pursuing corporate sustainability [46]. The training of managers obviously affects the reactions of companies to the adoption of SDGs-oriented strategies, which are mainly classified in three ways [47]: 1. defensive/compliance (limited integration), when the incidence of cost constraints is high (perceived); 2. accommodative (integration), in the case of a rather cautious modification of internal processes; 3. proactive (full integration), if companies integrate the SDGs as part of the main corporate strategy in order to contribute to the sustainable development of the economy and society. With a similar methodological approach, other studies [48] classify companies into followers, pursuers, leaders, innovators, starters, and outsiders depending on the strategy adopted. Therefore, core concepts such as cost and risk definitions are modified in order to consider also negative externalities (i.e., social and environmental costs and risks). In this regard, a series of problems have been identified that could lead to a difficult implementation of SDGs [49], such as: a strong ambivalence toward the meaning of goals, decentralized power and control, myopia of the ruling class, uncertainty about possible long-term

effects and, therefore, a danger of stalling or attempting to solve a problem without considering its complexity (in a “global optimum” manner), but rather through the resolution of many sub-problems (in “local optimum” mode). Nevertheless, the thesis of some authors is that, since it is impossible to define procedural guidelines for the implementation of sustainable development policies in a clear and uniform way, it is necessary to start from a local and regional level [50].

3.3. Linkages between SDGs

Consistently with the vision according to which the objectives should be tackled throughout the world as a whole [47] and not in a single or local way [50], different authors have noticed that there are some interrelations between the SDGs [51–53] and it is possible to group them into organic macro-categories, while other interventions already take account of these interlinkages [54–57].

For example, Engelmann et al. [58] noted that reducing inequalities (SDG 10) also implies a gender equality (SDG 5), just as a low emission of carbon dioxide impacts on both SDG 7 and SDG 13. In this way, the 17 goals can be reduced into eight categories. Other authors have classified the SDGs in only four technological fields [59] or sustainability dimensions [60], others in 15 categories of impact [61]. As regards the objectives linked to the environment—such as water quality, climate, and life on earth (SDG 13, SDG 15)—it was noted that they are strongly related to providing the necessary access to energy and safe drinking water (SDG 7, SDG 8), which in turn are a key to improving the health situation (SDG 3). All this is linked to the future of cities and infrastructures (SDG 9, SDG 11), with consumption patterns that interact with production (SDG 12). Green technology markets also provide opportunities to create new jobs (SDG 8), the consequence of which is the reduction of inequality within and between generations (SDG 10) [59]. In Figure 1, we have summarized how the various authors [58–61] classified and linked the 17 SDGs in a SDGs/groups matrix.

SDGs/Groups	1 NO POVERTY	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	4 QUALITY EDUCATION	5 GENDER EQUALITY	6 CLEAN WATER AND SANITATION	7 AFFORDABLE AND CLEAN ENERGY	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION	14 LIFE BELOW WATER	15 LIFE ON LAND	16 PEACE, JUSTICE AND STRONG INSTITUTIONS	17 PARTNERSHIPS FOR THE GOALS
TECHNOLOGICAL FIELD																	
Energy efficiency			✓				✓		✓				✓				
Green energy supply							✓		✓			✓	✓				
Material efficiency			✓						✓			✓			✓		
Water technologies			✓			✓					✓	✓		✓			
SUSTAINABILITY DIMENSIONS																	
Governance																✓	✓
Economy								✓	✓	✓	✓	✓					
Society	✓	✓	✓	✓	✓												
Planet						✓	✓						✓	✓	✓		
IMPACT CATEGORIES																	
Poverty	✓																
Health			✓														
Education				✓	✓								✓				
Sanitation						✓											
Food supply		✓															
Water supply						✓											
Energy supply							✓										
Land use													✓				
Acidification		✓													✓		
Climate change						✓								✓			
Nutrition														✓			
Forest															✓		
Resources												✓					
Chemicals			✓			✓						✓					
Waste												✓					
CLASSIFICATION CRITERIA																	
Equality					✓					✓							
Low carbon							✓						✓				
Resource efficiency											✓	✓					
Eco-innovation									✓		✓						
Social equity	✓	✓	✓	✓													
Good governance																✓	✓
Environmental protection						✓							✓	✓			
Economic added value								✓	✓								

Figure 1. Sustainable development goals (SDGs)/groups matrix according to [58–61].

3.4. SDGs's Stakeholders

Multiple actors are involved in the pursuit of the SDGs, consistently with the spirit of cooperation advocated in the SDG 17. Some authors [62,63] concentrate their studies on training institutions and how these are able to contribute more or less directly to the achievement of some goals. A goal directly related to educational institutions is certainly the SDG 4 [64], which aims to ensure a quality, fair and inclusive education and the possibility for everyone to achieve it. Some papers note that there is a lack of capacity for higher education institutions to integrate the principles and practices of SDGs into all the aspects of education and learning, which hinders the ability to act as an entrepreneurial university [62]. Others, after a comparative analysis between the keywords contained in the SDGs and those contained in the programs of the various faculties, investigate the possible link between education for sustainable development and SDGs [63].

As to business stakeholders, after a classification of 49 motivations for which a company should embrace sustainable development, it was noted that most firms move on the SDGs side only to find possible benefits in terms of greater market shares and profits [65], whereas pressures of employees and consumers associations are far less important. A possible attribution of The 2030 Agenda objectives, therefore, seems to be the following: SDG 1-2-10-14-16 specific, at the organization level; SDG 5-7-8-9-12-13 general, at the country level; all divided among the actors involved (society, companies, people) [66].

3.5. Innovation with a Focus on Individual SDGs

In this section, we have synthesized and described the contributions concerning the relations of specific SDGs with different forms of innovation (Table A1).

3.5.1. SDG 1

SDG 1 in the business context should be connected to innovating the curricula of managers, not sufficiently updated on the poverty problem [67]. Indeed, it would be necessary to involve public and private educational institutions in the development of innovative curricula, in order to make companies and entrepreneurs catalysts of not only profitable approaches, but also innovatively responsible for poverty reduction. An innovation from a political point of view appears as one of the solutions to problems that have their roots in religious and traditional questions, as in the case of India [68], where the persistence of the ideology underlying the concept of "caste" has led to the absence of norms oriented to social equality. Other authors focus on the consideration according to which an innovative vision of the future foresees not only an absolute decrease of poverty in the world, but also a relative reduction, in terms of greater redistribution of wealth [69].

3.5.2. SDG 3, SDG 4, and SDG 17

According to some works [70], it would be possible to map the SDGs initiatives using data analysis and innovative technologies. This is especially true regarding the achievement of SDG 3 (which is regarded as one of the most important) and considering SDG 17 as an aid to pursue it. Such a view is also common to other authors, who consider SDG 17 necessary for innovating teaching and enhancing behaviors useful for the pursuit of SDG 4 [71].

3.5.3. SDG 7

As highlighted by some authors, the SDG 7 seems to be a real multiplier for the other ones and should be pursued through an "energy access innovation center" [72] supported by the World Bank's Climate Innovation Centers. Furthermore, in richest countries, SDG 7 is integrated through some innovative elements of industry 4.0, such as digitization, real-time monitoring and data collecting big data analytics [73]. On the other side, in the poorer and rural areas of the Sub-Saharan Africa other authors believe that certain policies, strategies, and innovations can contribute to the pursuit of SDG

4 [74] and that it is possible to electrify those areas with new government policies, new renewables and innovative business models [75]. Furthermore, a truly innovative and long-term approach design energy services is needed [76].

3.5.4. SDG 11

As regards the SDG 11, one of the ways in which it can be pursued is an innovative city planning approaches for sustainable energy planning that take place in every sector (integrative smart city planning project) and which use a multi-criteria decision analysis [38]. Other methods relate to the design of new dwellings by using completely innovative solutions that respect economic, ethical, and environmental objectives, as in the case of the invention of housing domes dedicated to poor and rural populations [77]. Implementation of nature-based solutions also seem to be an innovative [78–80] opportunity to pursue SDG 11 [81].

3.5.5. SDG 12, SDG 13, and SDG 15

The thrifty - carefully and not wastefully - use of the resources previously mentioned contributes to the pursuit of the SDG 12 [71]. Furthermore, the adoption of cleaner production practices through technological innovations is oriented not only to SDG 12, but also to SDG 15 [82]. Maintenance management policies, taking into account the well-being of workers which affects human reliability [83], as well as environmental aspects, seem to contribute to a more sustainable production [84]. Moreover, as some authors suggest, in a long-term scenario SDG 12 and SDG 13 are favored by the adoption of some of the innovative industry 4.0 practices [73], also through sustainable maintenance [85]. All the cases so far discussed, therefore, do not refer to ecological modernization, fiercely opposed by certain ideologies [13,14,27,86], but rather refer to sustainability in all its aspects.

3.5.6. SDG 9

In many works [82,87–89], innovation and SDGs have proven to be closely connected, especially in the industrial sector [73], starting from the patenting process [59,90], passing through the strategies of open innovation [91], up to a focus on the frugal [92,93] and reverse innovation [94]. There is also a link between sustainability and the market [91], product and process innovation [95], and the possibility to connect the concept of innovation to each SDG [96]. From the analysis of literature, it emerges that innovation could be configured not only as an objective to be pursued, but also as a prerequisite for implementing the changes (in all areas) necessary for the pursuit of SDGs. Consistent with the need of adopting cooperative strategies at all levels (as hoped for by SDG 17), contrary to the neoliberal model of competitiveness that restrains the adoption of the SDGs [39], some works have focused their interest on open innovation like one of the most important forms of collaboration in the industrial context, starting from the idea-generation phase [97,98] (also with the help and participation of citizens [99,100]) and from the start-up phase [101], up to the development [102–104] and patenting process [105–109] and trying to measure it [109,110]. Other innovative forms of collaboration and knowledge sharing that can aid in the achievement of sustainability are represented by open-source intelligence tools [111].

4. Explorative Analysis on the Perceptions of SDGs: Practical Confirmations of the Theoretical Implications

Some works propose metrics for the evaluation of SDGs. For example, the statements on the visions and missions of the top 25 companies in the BRICS (Brazil, Russia, India, China, and South Africa) countries are compared with the 17 goals of sustainable development through content analysis [112]. Detailed quantitative indicators for each of the targets in which the SDG 11 is divided are also defined [81]. Other reports analyzed over 700 of the most influential companies in the world, interviewed about a thousand citizens across the globe and measured data using qualitative and quantitative indicators [113]. Comparing the perception of SDGs by citizens and businesses and the actual application of SDGs by companies over the years [113–116], it was possible to obtain an

overview of the general trend of SDGs from their year of birth up to 2018. In Figure 2, the propensity of companies to embrace SDGs is illustrated.

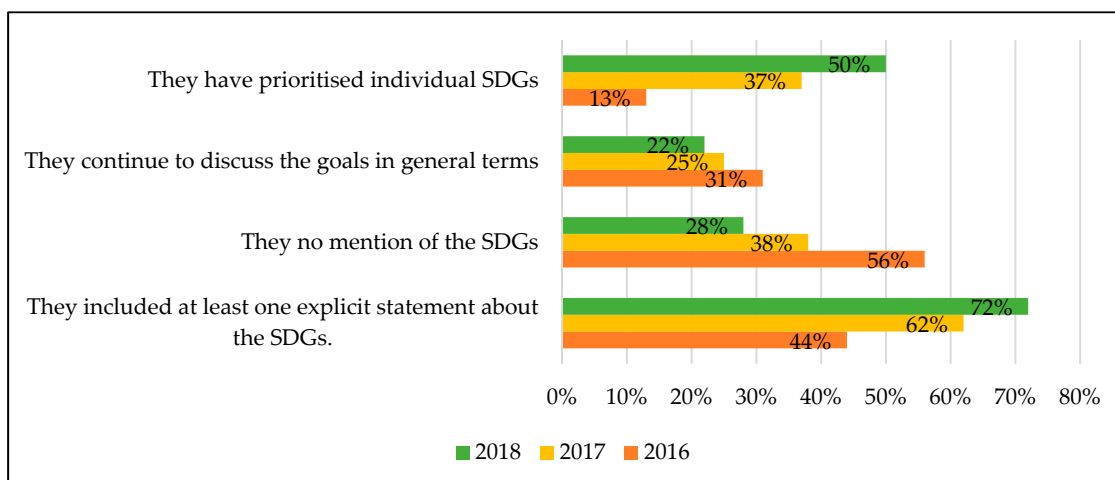


Figure 2. Business attitudes toward the SDGs (our processing of PWC data).

This graph corroborates the considerations that had emerged in literature: firstly, the interest in the industrial sphere toward the SDGs, in today's form of 2015, is growing over the years; secondly, not only this interest is growing, but it is also becoming less generic. For this reason, the topic of SDGs and their practical implications is very interesting for scientific research. Figure 3 shows the priority level attributed by companies and citizens to each SDG.

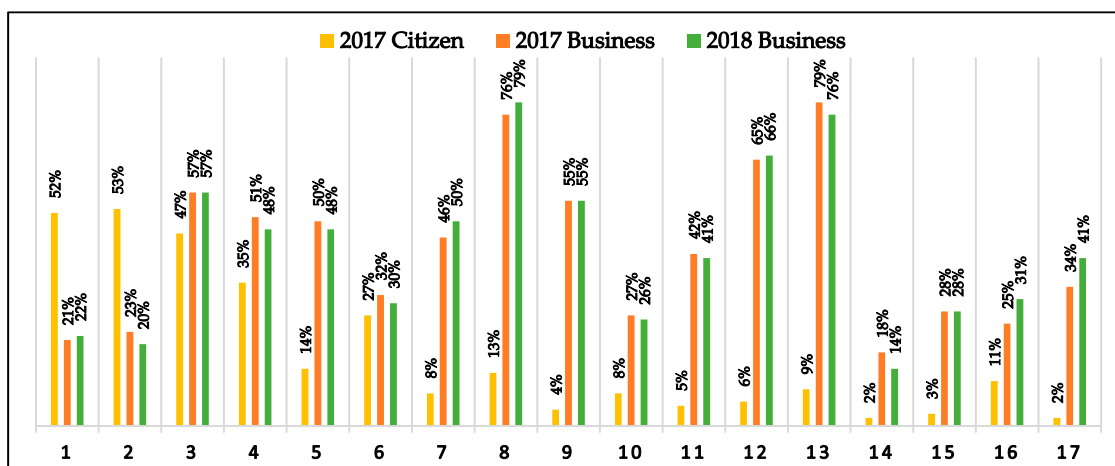


Figure 3. Prioritization of SDGs from 1st to 17th (our processing of PWC data).

Also in this case the considerations emerged in literature seem to be strengthened by this exploratory investigation: companies are interested in some SDGs in a priority way compared to other actors involved, such as citizens. For example, for industries, SDG 9 is one of the top five SDGs, which confirms the importance of innovation as a possible driver for pursuing sustainable economic development. Figure 4 reports the average score obtained by the companies as regards the realization of the SDGs, while in Figure 5 the ratio between the energies spent to reach an objective (the priority given to them) and the results obtained is reported.

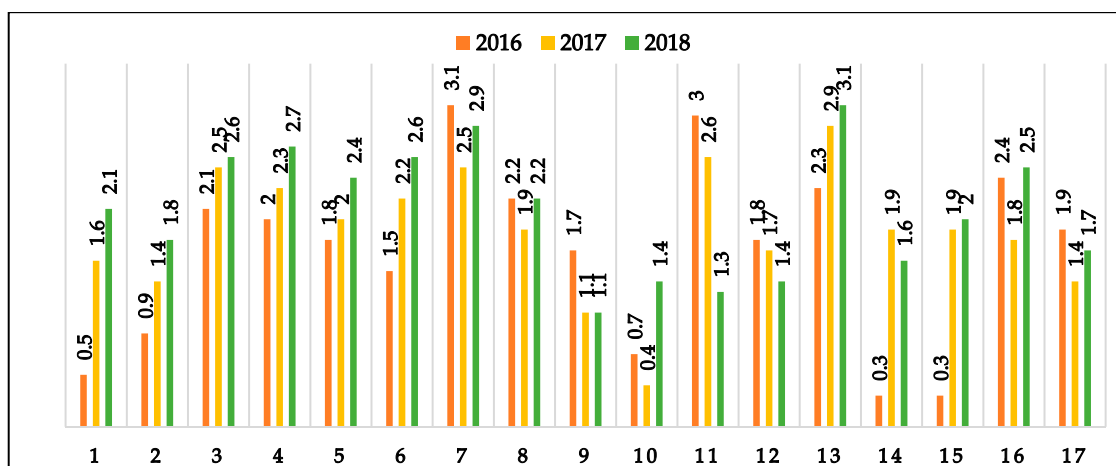


Figure 4. Average score (out of 5) of SDGs from 1st to 17th (our processing of PWC data).

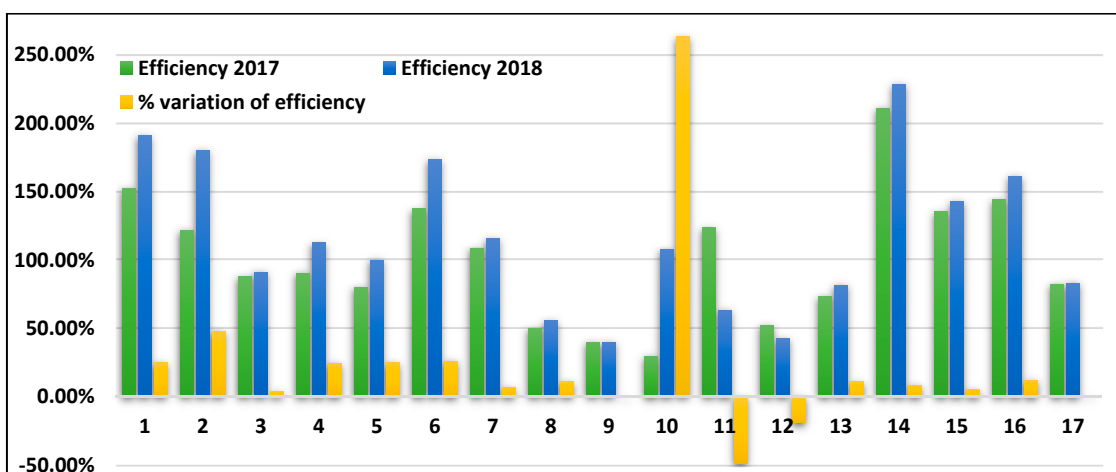


Figure 5. Efficiency in implementation of SDGs from 1st to 17th (our processing of PWC data).

The graphs show that the average capacity of companies to actually commit to SDGs is, on average, increasing over time. As for the relationship between the level of prioritization and the actual commitment, the preliminary investigations conducted show that the greatest improvements were made for SDGs 10, while the worst were for SDG 11.

5. Conclusions

From the analysis of the literature, different considerations emerged. For example, each stakeholder is able to contribute more effectively to certain SDGs instead of others, but, in the field of research, we still highlight a number of different proposals for applying SDGs and sustainable development in general. Some argue that it is impossible to act simultaneously and, therefore, we need to focus on individual targets; others believe that it is imperative to pursue them all together. A compromise view considers that some targets must necessarily be implemented locally, while others are at a global level. Moreover, in the industrial context, innovation appears as a fundamental driver for the pursuit of SDGs at every stage. Furthermore, the different ways in which open innovation is applied represent the spirit of collaboration hoped for in SDGs, above all in SDG 17. Another interesting aspect concerns the different meaning about “objective, purpose” and “assumption, condition”: some of the so-called objectives, are actually configured as a *modus operandi* or a *conditio sine qua non* for the achievement of some specific targets. For example, it was found that SDG 17 appears as a *conditio sine qua non* especially in a hyperconnected and globalized world. Another essential objective is the SDG 4, which represents the foundations of the awareness of the generations that will have to embrace a sustainable

weltanschauung even before trying to implement it. In this perspective, social sustainability should be a priority over economic sustainability and a condition for coordinating toward environmental sustainability objectives. Yet, if this objective appears very important in the field of research, it is far less important for civil society and even less for companies.

The preliminary exploratory analysis confirms some considerations that have emerged in literature. For example, the various stakeholders are differently interested in SDGs: citizens prefer aspects related to poverty and hunger (SDG 1, SDG 2), companies to profit and savings aspects (SDG 8), while both are scarcely interested in some environmental aspects (SDG 6, SDG 14, SDG 15). It is important to emphasize that the survey refers to the past (2017) and that now a stronger sensitivity is emerging about the problem of climate change. Indeed, overall the average interest toward SDGs appears increased over the years, as emerged in literature.

5.1. Limitation

The main limitation concerns the metrics with which assessments were carried out on sustainability, still being developed by both the UN and the research world: it seems that the most difficult aspects to quantify concern the conditions of society well-being and the ethical issues rather than the quantification of environmental impacts or economic measures.

5.2. Further Developments

Future studies will consider research on additional search engines beyond Scopus, try to find a common synthesis about sustainability metrics and, above all, propose innovative solutions for reach SDGs, not only reacting to the effects of problems, but providing tools to identify its causes and eliminate them.

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Appendix A

Table A1. Summary of literature contributions.

																
[67–69]		[70]	[71]			[72–76]		[73, 82, 95]		[38, 77, 81]	[71, 73, 82]	[73]		[82]		[70, 71]

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