

An exploratory analysis on Digital Service in the sustainable management :waste map for the management

Genni Perlangeli , PhD Università “La Sapienza” di Roma,
genni.perlangeli@uniroma1.it,

Andrea Rea, Professor Università “La Sapienza” di Roma,
andrea.rea@uniroma1.it,

Carlo Nardello, Professor Università “La Sapienza” di Roma,
carlo.nardello@uniroma1.it,

Roberto Marseglia, PhD e Alia Servizi Ambientali,
r.marseglia@aliaserviziambientali.it,

FULL

Abstract

Sustainable management takes the concepts from sustainability and synthesises them with the concepts of management.

Sustainability has three branches: the environment, the needs of present and future generations, and the economy. Using these branches, it creates the ability of a system to thrive by maintaining economic viability and also nourishing the needs of the present and future generations by limiting resource depletion.

Our analysis expands through the case study of Alia Servizi Ambientali Spa, an Italian multi-utility company using AI for waste management, and the inclusion of the use of digital research services in the circulation of sustainable services and the increase of the efficiency of such services. The new boundary is the use of artificial intelligence, it recognizes beyond the increase of innovation also the actuality of the research process. This study is exploratory through direct observation of academic resources and attempts to answer two research questions. The first is the structured mapping of artificial intelligence services in sustainable management and the second is a question about the impacts in the academic community of these services. After the first mapping, we investigated the services of digital and potential AI applications.

Keywords: digital services; sustainability; management.

1. Introduction

Europe will fail to meet its 2030 targets without urgent action over the next ten years to address the alarming rate of biodiversity loss, the increasing effects of climate

change and the overexploitation of natural resources. The European Environment Agency (EEA) report on the "State of the Environment", shows how Europe is facing urgent environmental challenges of unprecedented scale.

The World Health Organization (WHO) report of 2010 presented an annual estimate of 600 million foodborne illnesses and 420 000 deaths (Havelaar et al., 2015), whereas, in 2015, it ascribed the death of more than 2 million people including children to harmful food and water microbial and chemical contaminants (World Health Organization, 2015a, 2015b), some of which were from poorly managed waste streams.

Recognising persistent environmental and climate challenges at European and global scales, European environmental and climate policymaking is increasingly driven by long-term sustainability goals, as embedded in the EU's Seventh Environment Action Programme (7th EAP) 2050 vision, the 2030 agenda for sustainable development and the Paris Agreement on climate change.

In 2015, world leaders adopted the 2030 agenda for sustainable development, along with a set of 17 Sustainable Development Goals (SDGs) and 169 associated targets (UN, 2015b; Figure 2.1). Universal in scope, it applies to all countries at all levels of development, taking into account their 'different capacities and circumstances'. The setting of these goals built on the experience of the Millennium Development Goals (MDGs), which made an 'enormous contribution in raising public awareness, increasing political will and mobilising resources for the fight to end poverty' (EU, 2018).

Many SDGs embed a strong environmental dimension and have dedicated targets to progress on core environmental issues. In particular, SDG 13 promotes climate action, while SDGs 14 and 15 aim to advance the conservation of marine and terrestrial ecosystems and the sustainable use of their resources).

With population growth, capitalism dependent on growth pushes more and more consumption, waste production and its management challenges (disposal, inclusive). Waste disposal methods and other factors, including urbanisation, industrialisation and limited resources, together with governance and institutional policy issues, aggravate these challenges (Amugsi et al., 2022, Khan et al., 2021).

Europe has made significant progress in resource efficiency and the circular economy. Recent trends, however, point to a slowdown in some important areas such as reducing greenhouse gas emissions, industrial emissions, waste generation, and improving energy efficiency.

The concept of *sustainability* was introduced to balance the environmental, social and economic dimensions that altogether are referred to as the triple-bottom-line (TBL) framework. In recent years, the framework has been widely applied to entrepreneurial research because of the benefits that sustainability-oriented entrepreneurship can have in relation to sustainable development efforts. Such argument turns out to be complex and difficult above all in the within of the refusals like for the case ALIA SPA.

In total, 196 countries adopted the first-ever universal, legally binding global climate agreement, commonly referred to as the Paris Agreement, with the aim of

strengthening the global response to the ‘urgent and potentially irreversible threat [of climate change] to human societies and the planet’(UNFCCC, 2015a). Pursuing the objective of turning Europe into a resource-efficient, green and competitive low-carbon economy provides opportunities to harness synergies across different areas.

At the same time, it also poses challenges in terms of recognising and addressing trade-offs. The ESG (environment, society, and governance) concept is often applied to measure the sustainability performance of enter-prises . TBL model, it considers three pillars—environment, social issues, and corporate governance, it refers to top management decisions on how to address sustainability issues . The advantages for sustainable management have many advantages . It has been shown that the implementation of sustainability-oriented values have positive implications for employee performance (Mondal, Singh, Gupta, 2023). The main objective of this study is to develop a set of criteria to assess levels of competence in sustainable management.

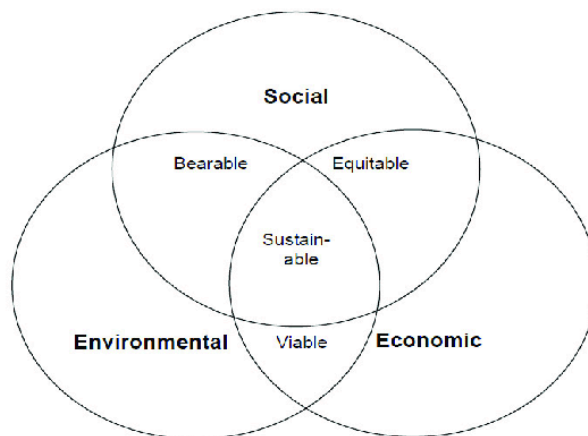


Figure-1: *Dimensions of sustainability: Triple Bottom Line* (Gupta, Singh, Dangayach)

2. Materials and Methods

2.1 Systematic Literature Review

SLRs are conducted to study and evaluate studies of the particular area of interest ‘systematic review process’ (Tranfield et al., 2003).

To achieve the objective of this study, methods of analysis of monographic and secondary data were applied to conduct a literature review. The systematic literature review (SLR) method was used to synthesise the literature, selected based on keywords, timeframe, type of document and language.

The articles were selected from various databases, including Scopus, Web of Science, Research Gate, and Google Scholar, JSTOR using LSS and Boolean syntax (AND/OR) as shown in Step 2

According to keyword search terms “Sustainability”, according to keyword search terms “sustainable management”, “TBL”, “ESG”.

The articles were further filtered based on the year of publication to include articles published from 2019 to 2024. Publications have been published since 1996, but not focused on the topic of the research. All available and relevant publications were restricted to only peer-reviewed articles written in English. Journals were selected with the relevance of the topic. TAB1.

The raw data include information on papers and further information on their references. After selecting the basic data, the next required step was data cleaning. This step involved a number of analyses for data problems, such as plural or singular, misspelling, nonstandard characters, and inconsistent terms.

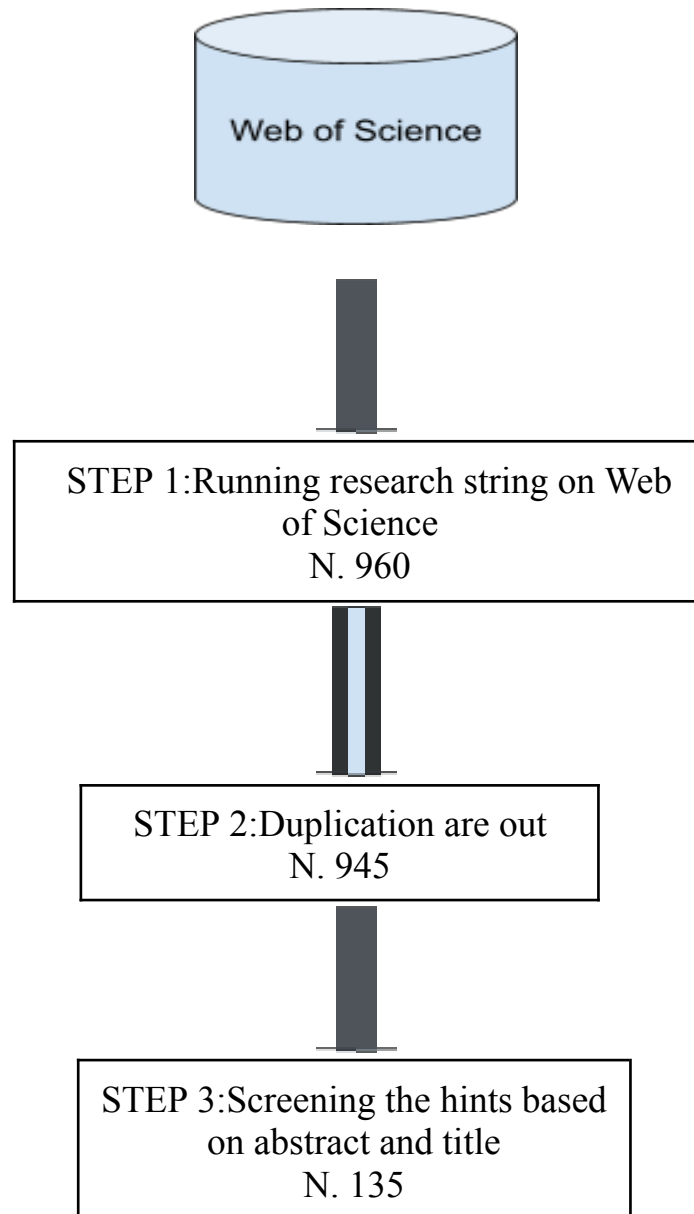
Table 1.

The Top Journal List. Title	No. of publications	Year
1. Journal of Marketing	96	2019-2024
2. Marketing Theory	18	2019-2024
3. Journal of Marketing Management	182	2019-2024
4. Journal of Business Research	274	2019-2024
5. Journal of MacroMarketing	183	2019-2024
6. International Journal of Research in Marketing	91	2019-2024
7. International Journal of Management Reviews	116	2019-2024
		960 TOT

Our initial search on the Web of Science returned 960 results. We first filtered the papers by reading the abstract, key words, and title.

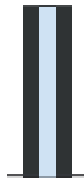
Papers for which the reading of such a field did not lead to a conclusive decision, the full text was content analysed. As indicated above, to represent the diversity of subjects covered, we included papers embracing several perspectives and methodologies and excluded those that failed to meet our criteria. Ultimately, 62 papers were selected by reading the full text of the papers as coherent studies for this review. We recorded the reasons why we included or excluded each paper, enabling us to further discuss and assess whether a particular paper should be included. Figure 1

schematizes the steps of the search process and the number of selected studies in each step.





STEP 4: Papers which are irrelevant
or based just on environmental
perspective excluded
N. 95



STEP 5: Read Full Paper and Critically
appraise work.
N.62

A secondary method of data analysis has been used to narrow the many factors. Having reached a single list of criteria concerning the level of competence in management, four dimensions have been identified: environment, social, economic and management.

The following three research questions (RQs) are formulated to explore the multifaceted challenges, including socioeconomic and environmental implications. The way forward combines technological innovation and sustainable progress .

RQ1. What unintended consequences can emerge from the implementation of AI for Sustainability ?

(RQ2. How much is wasted in the world?)

RQ3. How can it be monitored with AI

RQ1

Artificial Intelligence contributes to the recent developments in Industry 4.0 . Since the rapid development and evolution of AI for I4.0 technologies, a series of doubts has arisen regarding the environmental and social implications (Dieste et al., 2023; Dohale et al., 2023). The new ESG challenges underline the importance of sustainability principles in the implementation of I4.0 technologies, which align with the Sustainable Development Goals (SD) (Dohale et al., 2024;UN, 2015).

The Alia Environmental Services participates in the achievement of these objectives through 9 of the 17 SDGs on which it is carrying out projects, actions, and commitments. In particular, through Objective 11, "sustainable cities and communities", which sees Alia consciously engaged in environmental protection strategies and sustainability in management of urban waste, with the decisive contribution of the communities served.

OBJECTIVES -

ESG	N.19	points	ESG	rating
<hr/>				
N.3		Is active from 10 years the convention Unisalute for the coverage of medical expenses 369,610 hours of smart working.		
N.4		77,347 students trained in sustainable development issues.		

N.5	29% of the company's population is composed of women, with 48% between employees and 16% between managers.
N.7	The relationship between energy produced/consumed is equal to 67% Over 24.8 million KWH of electricity produced . In 2023: interventions completed revamping to 2 cogenerators a biomass of the Estra group; installed photovoltaic panels in 3 locations Extracts; the constituent acts of 3 signed energy communities in the territory served.
N.8	92% of permanent workers . The accident severity index is 1,14. The accident incidence index is equal to 5.3% . 90% of workers are involved in at least one training course.
N.9	n.8 treatment plants waste managed by Alia including Anaerobic in phase of testing.
N.10	The relationship between overall remuneration annually

	female/male is equal to ; .268 employees have benefited from parental leave of which 124 women 115 workers use part time, of which 92 women.
N.11	69% separate collection ; 64% recycling ; 90% organic fraction recycling ; 94% cellulosic fraction recycling ; 67% plastic glass recycling cans
N.12	69% separate collection 64% recycling
N.13	8 waste treatment plants of properties located at a short distance

"ESG rating" assessment required to be able to undertake a path of sustainable finance and, in the redefinition and implementation of its business plan, is considering to implement, in agreement with the funding stakeholders, green covenants dedicated to monitoring the Group's sustainability performance.

SD goals live the sustainability challenges with the Triple-Bottom-Line (TBL) to guarantee a responsible future (Kumar, 2017; Susitha & Nanayakkara, 2023). TBL is an approach that considers three variables of performance: financial, social, and environmental (Alhaddi, 2015). This approach improves the study. This research is a primary aspect of this topic through this Systematic Literature Review (SLR), classification of different types of plastic materials for ALIA SPA and third part to

analyse the AI I4.0 in waste disposal. AI helps businesses to predict shifts in the markets to maximise the supply chains.

The study aims to discover a framework to understand the mixed theory of AI for sustainability progress and TBL sustainability concerns.

RQ2 In the analysis of ALIA SPA is most important the part of *Composition and types of plastic materials for ALIA SPA*

The waste is classified as hazardous and not hazardous ; municipal waste and special waste;

- a) *domestic waste*, whether or not bulky, from premises and places used for residential purposes; *special waste* from agricultural and agro-industrial activities, pursuant to art. 2135 c.c. (these are the activities of the farmer, that is, cultivation of the land, forestry, animal husbandry and related activities);
- b) *non-hazardous waste* from premises and places used for other uses than those referred to in the letter. a), treated as municipal waste by quality and quantity, pursuant to Art. 198, c. 2, lit. g); *waste resulting* from demolition, construction and hazardous waste resulting from excavation activities, subject to the provisions of art. 184a as regards by-products;
- c) *waste from road sweeping*; *waste from industrial processing*
- d) *waste of any nature or origin*, lying on roads and public areas or on roads and private areas in any case subject to public use or on maritime and lake beaches and on the banks of water courses; waste from artisanal processing;
- e) *plant waste* from green areas, such as gardens, parks and cemetery areas; waste from commercial activities;
- f) *waste from exhumations and estumulations*, as well as other waste from cemetery activities other than those referred to in letters. b), c) and e) ; waste from service activities

In the summary 2022 - 2023 the organisation will waste domestic composting from 2020 waste from separate collection (t) 220.766 has reached 217.008 with a deviation of 2%. paper , glass, plastic , cans instead 144.633 .

In 2022 the company served 58 municipalities for a total of 1,476,550 resident inhabitants. Production per capita of the inhabitants served is equal to 569 kg/ab. for a total production of municipal waste of 840.657 t. Compared to the previous year there was a decrease in the quantity of about 13,669 t while there was an increase of 5,873 t compared to 2020.

RQ3 In the area of Tuscany , ALIA SPA the company provides 58 municipalities, 4.844Kmq, 1476012 residents, 2.815 employers.

AREA



The recycling network is composed of 834.304 t ;69% of recycling; 64% waste for recycling ; 7% active installations.

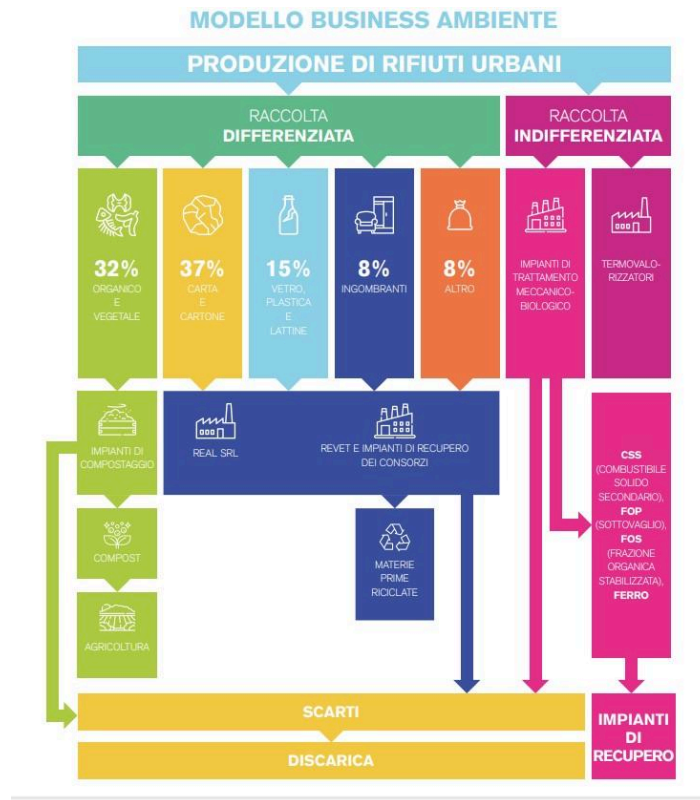


An interesting aspect on which to analyse the Alia case is the management of the integrated cycle of municipal waste, as the protagonist of a system aimed at coordinating the entire waste cycle - including production, collection, transport, treatment, destination final - with the purposes of recovery of raw materials and energy, and search for a management that is - as much as possible - sustainable for the environment and for the health of the inhabitants of the managed territories. The management of this aspect is also delegated to the TBL approach.

The principle of the "waste hierarchy", introduced in the European Union by Directive 2008/98/EC is the main guideline. The waste hierarchy principle has existed for approximately 40 years.

MODELLO BUSINESS ALIA

PRODUCTION OF MUNICIPAL WASTE	WASTE SEPARATION	GENERAL WASTE
32%	ORGANIC PLANT	
37%	PAPER	
15%	GLASS PLASTIC CANS	
8%	HEAVY WASTE	
8%	OTHERS	
		MECHANICAL BIOLOGICAL TREATMENT PLANTS
		INCINERATORS



The waste hierarchy has no indicators for its actual assessment. The existing indicators aimed to quantify the performance of separate collection, recovery and recycling, with targets set out in EU directives on waste. According to Price and Joseph (2000), the recycling rate is the most widespread indicator, being simple to quantify and able to demonstrate movement up (or down) the hierarchy.

Using waste hierarchy (WH; reduce, reuse, and recycle) and circular economy (EC) concepts, we have updated a waste conceptual framework.

The reduction of waste production and reuse are the subject of environmental education projects that Alia constantly carries out in schools of every order and grade.

The management is therefore oriented to increase the percentage of waste sent to recovery and reduce the amount of waste sent to landfill, trying to give "new life" to the waste, transforming them into new products and new materials.

Alia launched in 2021 a process of digitalization of tools at the service of its business, the hygiene of the area of waste as part of an increasingly important transition to the circular economy and digitalization with the decision to focus on customer service. The year 2023, as well as 2021 and 2022, has been characterised by discontinuities linked to the development and entry into operation of the new digitization services of the company.

Redesign of waste collection services. Waste of any kind has a considerable and varied social, environmental and economic impact (Eriksson et al. 2017; Principality et al. 2020, 2021; Vandermeersch et al. 2014). It can be concluded that the top management, as an internal control mechanism, assures that all internal objectives related to sustainability are reached.

RESULTS

After the results of the literature review, we indicate TBL approach is not clear and comprehensive to illustrate the sustainable entrepreneurship model. The top management department of ALIA, as an internal control mechanism, guarantees the achievement of all internal sustainability objectives. From the previous analyses the scholars have found some macro aspects in support of this thesis: first is the function of control of the top management ; second the relationship between the top management's actions and the results; third the resources and the capabilities. Sustainable management is inside the corporate and is the important construct of sustainable theory about the relationships of the stakeholders. Measuring environmental, social and economic performance indicators was the suggested way to estimate and explain sustainable entrepreneurship. This may affect their efficiency of the company on the effectiveness of the reach of business goal - could be have to approach the theme of sustainability .Sustainability in this type of company is also actively involved in the life of citizens and this will be another research to study.

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