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RESEARCH ARTICLE

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Analysing the use of tools, initiatives, and approaches to promote sustainability in corporations

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Abstract

Interest in sustainability from the corporate sector is evidenced by over 13,000 companies in 160 countries that have signed the United Nations Global Compact. In this context, a number of tools, initiatives, and approaches (TIAs), e.g., circular economy, corporate social responsibility, eco-efficiency, life cycle assessment, and sustainability reporting have been developed by and for corporations to engage and promote sustainability within their systems. Each of the TIAs has advantages when addressing sustainability issues and the company system's elements, but it has disadvantages in dealing with their complexities and interactions. Relying only on one TIA results in a limited contribution to sustainability, whereas using too many TIAs wastes resources and energy. The Corporate and Industrial Voluntary Initiatives for Sustainability (CIVIS) has been proposed to better combine the TIAs. A survey was developed to investigate the use of 24 TIAs. The survey was sent to a database of 5,299 organisations (of which 3,603 were companies), from which 202 responses were obtained. The responses were analysed using ratio analysis, principal component analysis, and cluster analysis. The responses show that some TIAs are well known and provide good results when used, for example, corporate social responsibility, corporate sustainability, and Global Reporting Initiative reports. The analyses show a number of groups of the TIAs that can help to better combine them. The paper updates the CIVIS framework in order to provide clearer guidance on how to combine the TIAs. A combination of between four and six initiatives appears to be most effective way to promote sustainability. The TIAs can help to promote sustainability in corporations, but they need to be combined correctly in order to address holistically the four dimensions of sustainability, the system elements, and stakeholders, while avoiding duplication of tasks and wasting resources.

KEYWORDS
corporate social responsibility, corporate sustainability, eco-efficiency, management systems, tools, initiatives, and approaches

1 | INTRODUCTION

Sustainability is aimed at addressing environmental and socioeconomic issues for this and future generations (World Commission on Environment and Development, 1987). In general, the sustainability literature has focused on environmental issues (e.g., Atkinson, 2000; Rees, 2002; Reinhardt, 2000), but a number of authors have also highlighted the importance of balancing the sustainability issues (i.e.,

economic, environmental, and social; Elkington, 2002b) and the time dimension, as well as their interconnections (Lozano, 2008) through a holistic perspective (see Escobar, 1999; Hjorth & Bagheri, 2006).

During the last three decades, a number of corporations have been engaging in becoming more sustainability oriented (Dunphy et al., 2003; European Commission, 1998; Fergus & Rowney, 2005). These corporations have engaged in efforts to integrate sustainability into their operations and better contribute to making societies more sustainable (Elkington, 2002b) and satisfy the needs of today's societies without compromising the needs of tomorrow's societies (*World Commission on Environment and Development*, 1987), that is, the time dimension. For a company to become more sustainable, it must include resource-efficient technologies, sustainability reporting schemes, while providing their clients with sustainable products, services, and product–service combinations (Siebenhüner & Arnold, 2007).

Interest in sustainability from the corporate sector is evidenced by over 13,000 companies in 160 countries (United Nations Global Compact [UNGC], 2019), up from 7,700 in 130 countries in 2010 (UNGC, 2010) that have signed the UNGC. Another indication of corporate interest in sustainability has been the number of tools, initiatives, and approaches (TIAs) developed by and for corporations, which have been gaining momentum for fostering sustainability by companies (Johnson, Redlbacher, & Schaltegger, 2018; Lozano, 2012b; Robèrt, 2000). This paper focuses on the use and performance of TIAs used to embed sustainability into companies.

The paper is structured in the following way: Section 2 discusses 24 TIAs; Section 3 presents the methods; Section 4 discusses the results; and Section 5 provides the conclusions.

2 | TOOLS, INITIATIVES, AND APPROACHES FOR SUSTAINABILITY

From the 1970s until the late 1990s, TIAs evolved from purely "end-of-pipe" solutions (which are usually costly and inefficient; Porter, van der Linde, & Linde, 1995; Sarkis & Cordeiro, 2001) towards whole-system approaches, by changing products, processes, services, and systems (Holliday, Schmidheiny, & Watts, 2002), so that waste is minimised, and resources are used more efficiently and effectively, in almost closed loops (McIntosh, Leipziger, Jones, & Coleman, 1998).

Twenty-four TIAs were selected. The TIAs belong to Robèrt et al.'s (2002) "Follow up/Tools" level, which is aimed at measuring, managing, and monitoring activities and "Approaches" and "Sub-systems" categories proposed by Glavič and Lukman (2007), which are the ones that are directly relevant for corporations. The 24 TIAs are based on the 16 discussed by Lozano (2012b), but with the following modifications: Environmental and social accounting and sustainable livelihoods were removed because they have fallen out of fashion. Circular economy, corporate sustainability, green marketing, integrated management systems, socially/sustainability investment, and sustainable supply chains were added because they have been more widely discussed in the literature and practice. Environmental management systems (EMS) were analysed in its two subcategories: ISO (International Organisation for Standardization) 14001 and EU EcoManagement, and Audit Scheme (EMAS). The same was done for sustainability reporting, which was done under the subcategories AccountAbility 1000 (AA1000), Social Accountability 8000 (SA8000), and Global Reporting Initiative (GRI) guidelines, plus the addition of ISO 26000.

The following sections present a brief overview of the TIAs. It should be noted that each TIA can be a subject on its own, and in some cases, entire books and journal are dedicated to it. It should be noted that each TIA might have overlaps with others, and each could be a study area in itself. The TIAs are presented in alphabetical order.

2.1 | Circular economy

Circular economy (CE) has been used since the 1930s in its original conception by Leontief (1928). CE has become one of the most recent proposals to address environmental sustainability (Murray, Skene, & Haynes, 2015). CE is based on "closing loops" through different types and levels of recovery (Yong, 2007; Yuan et al., 2008) by transforming material into useful goods and services through resource efficiency (Klettner, Clarke, & Boersma, 2013; Webster, 2013). In general, CE activities focus exclusively on one of three levels (Yong, 2007; Yuan, Bi, & Moriguichi, 2008): micro level, focusing on improving the environmental performance of individual companies or enterprises; meso-level, focusing on eco-industrial networks; and macro level, focusing on regions, cities, municipalities, or provinces.

2.2 | Cleaner production

Cleaner production (CP) is the continuous use of integrated preventive strategies to process products and services, utilising raw materials, for example, energy and water, efficiently to reduce waste at source, and minimising risks to the environment and society (DeSimone & Popoff, 2000; United Nations Environment Programme [UNEP], 2001). In general, CP focuses on achieving environmental improvement in processes and product development (Glavič & Lukman, 2007; Pauli, 1997).

2.3 | Corporate citizenship

Corporate citizenship is a concept where corporations have social rights and responsibilities to their stakeholders beyond wealth maximisation (Carroll, 1998; Leisinger, 2003; McIntosh et al., 1998). This includes compliance with all laws and regulations, ethical behaviour, and contributions to social and economic welfare (Birch & Littlewood, 2004; Carroll, 1998).

2.4 | Corporate social responsibility

Whereas corporate social responsibility (CSR) practices can be traced almost as far back as the French Revolution (Frankental, 2001), the origins of the "modern" form of CSR are subject to discussion. Academically, CSR began in the wake of the Great Depression, in the late

1920s (Dodd, 1932; Lantos, 2001). Since then, many CSR definitions have appeared, and the key points being addressed include the following: stakeholder engagement and participation (Commission of the European Communities [CEC], 2001; Holme & Watts, 2000); product impact; health and safety; corruption (Holme & Watts, 2000); human rights and freedom of association (CEC., 2001; Holme & Watts, 2000; UNGC, 2008; Welford, 2005); communication, reporting, disclosure, and transparency (Holme & Watts, 2000); and environmental protection and management of resources (CEC, 2001; Elkington, 2002a; Holme & Watts, 2000). CSR can be defined as "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life at the workplace and workers' families as well as the local community and the society at large" (Holme & Watts, 2000).

2.5 | Corporate sustainability

Corporate sustainability (CS) has been proposed as a framework to address the full array of sustainability challenges and issues (see Bartelmus, 1999; Dyllick & Hockerts, 2002). CS has to encompass a holistic perspective (Linnenluecke, Russell, & Griffiths, 2009; Lozano, 2013a) and include the four dimensions of sustainability (economic, environmental, social, and time), as well as their interactions (Lozano, 2008). In order for a company to become more sustainability orientated, it should engage in changes that include the introduction of resource-efficient technologies, sustainability reporting schemes, and provide sustainable products, services, and product–service combinations (Siebenhüner & Arnold, 2007).

2.6 | Design for the Environment

Design for the Environment, also known as eco-design, refers to the inclusion of environmental factors and considerations (such as material elimination or substitution, process optimisation, energy reduction, and product reuse; DeMendonça & Baxter, 2001) in the design of the product or service (Holliday et al., 2002) so that it becomes easier to recover, reuse, or recycle (Anastas & Breen, 1997; Ashley, 1993; DeMendonça & Baxter, 2001). This has mainly emanated as a response to increased consumer environmental awareness and tougher competition in the market respecting the environmental impacts of products (Hallstedt, 2008).

2.7 | Eco-efficiency

The term eco-efficiency is a contraction of ecological and economic efficiency (Willard, 2002a). It is fundamentally a ratio of some added economic value in relation to some measure of environmental impact (J. R. Ehrenfeld, 2005). Eco-efficiency's aim is to link environmental and business excellence, that is, making profits by using fewer natural resources, with less waste and emissions within the earth's carrying capacity (DeSimone & Popoff, 2000; Ekins, 2005; Hamann, 2003). It is one of the concepts most widely accepted as the business link to sustainability (Dyllick & Hockerts, 2002; Korhonen, 2003). Eco-efficiency is quite similar to CP. The former started as an initiative of the World Business Council for Sustainable Development (2000), whereas the latter is of the UNEP (2001; World Business Council for Sustainable Development & UNEP, 1998).

2.8 | Ecolabelling

Ecolabelling is based on a market approach to the protection of the environment (Hale, 1996; Organisation for Economic Co-operation and Development, 1997). It aims to inform consumers of the environmental impacts throughout the production, consumption, and waste phases of products and services and to a great extent, influence consumers' behaviour towards more environmentally friendly consumption patterns (Hale, 1996; Nadai, 1999; Rex & Baumann, 2007). It also aims to encourage producers, governments, and other agents to increase the environmental standards of products and services (Galarraga Gallastegui, 2002).

2.9 | Environmental management systems

EMS are administrative tools aimed at assessing the environmental impact of the operations of organisations, mainly corporations, and in improving their environmental performance (Brorson & Larsson, 1999; Robèrt et al., 2000). Five main elements can be found common to all EMS: (a) identifying company impacts on the environment; (b) understanding current and future legal obligations; (c) developing plans for improvement; (d) assigning responsibility for implementation of plans; and (e) periodic monitoring of performance (DeSimone & Popoff, 2000). Two of the most recognised EMS are the ISO 14000 series and the EMAS (Brorson & Larsson, 1999; Robèrt et al., 2000). The two schemes are fairly similar, with both following the five main elements aforementioned. The main differences are that ISO is internationally recognised, whereas EMAS is solely European, and EMAS sets stricter requirements in some areas (; Brorson & Larsson, 1999).

2.10 | Factor X

Factor X refers to the eco-efficiency initiatives Factor 4, Factor 5, Factor 10, and Factor 20, developed by the Wuppertal Institute (Robèrt et al., 2000; United Nations University, 2007; von Weizsäcker, Lovins, & Lovins, 1998). They are based on reductions in turnover of resources on a global scale (Robèrt et al., 2000), that is, increasing by a factor of "x" the amount of wealth that is extracted from one unit of a natural resource (DeSimone & Popoff, 2000; Holliday et al., 2002; von Weizsäcker, Hargroves, Smith, Desha, & Stasinopoulos, 2009).

2.11 | Green chemistry

Green chemistry (GC) follows principles similar to those of Design for the Environment, but its focus is on the use of chemical techniques to reduce or eliminate the use or generation of feedstocks, products, by-

products, solvents, reagents, or other hazardous chemicals that are, or might be, dangerous to human health or the environment (Anastas & Breen, 1997). GC is aimed at preventing waste before it is ever formed by considering the environmental impact or potential impact of a product or process (Anastas & Warner, 1998). GC relies on 12 rules based on five principles (waste minimisation, renewable resources, eco-efficiency, degradation, and health and safety) that are aimed at designing or modifying chemical reactions to be more environmentally friendly (Glavič & Lukman, 2007).

2.12 | Green marketing

Green marketing involves "marketing activities which attempt to reduce the negative social and environmental impacts of existing products and production systems, and which promote less damaging products and services" (Peattie, 2001), that is, to shape consumer requirements and provide consumers with appropriate choices (Sheth, Parvatiyar, Sharma, & Sheth, 1995). It calls for the integration of holism in green marketing (Peattie, 1995). Green marketing focuses on promoting re-consumption, influencing consumer choice behaviour, aligning the marketing mix of existing products with sustainability issues, promoting appropriate changes in corporate structure, and engaging all stakeholders (Sheth et al., 1995).

2.13 | Industrial ecology

Industrial ecology refers to the restructuring of industry in the form of an ecosystem with materials (including raw materials and wastes) flowing through interconnections of production processes (Ehrenfeld, 2004; Isenmann, 2003; Lowenthal & Kastenberg, 1998). The object of industrial ecology is to treat materials and energy, considered as by-products or waste, as raw materials by other companies (DeSimone & Popoff, 2000; Heeres, Vermeulen, & de Walle, 2004; Lowe & Evans, 1995). This is done at the following levels: the company level, with design for environment, pollution prevention, eco-efficiency, and green accounting; across firms, with industrial symbiosis, life-cycle analysis, and industrial sector initiatives (Gibbs & Deutz, 2007); and the regional/global level, including budgets, materials and energy flow studies, dematerialisation, and decarbonisation (Jacobsen, 2006; Warhurst, 2002).

2.14 | Integrated management system

Integrated management system (IMS) is an approach to manage processes or activities that transform inputs of resources into a product or service, which meet an organisation's objectives and equitably satisfy the stakeholders' quality, health, safety, environmental, security, ethical or any other identified requirement (Jørgensen, Remmen, & Mellado, 2006; Olaru, Maier, Nicoară, & Maier, 2014) IMS is designed to engage with stakeholders and cater to their needs (Asif, Searcy, Zutshi, & Fisscher, 2013). IMS is considered the best management practice when an organisation has multiple management systems in place (Bernardo, 2014).

2.15 | Life cycle assessment

Life cycle assessment (LCA) refers to the evaluation of all processes in the life cycle of a product or service, from downstream (i.e. extraction) to upstream (i.e. disposal), including use (DeSimone & Popoff, 2000; Holliday et al., 2002; Robèrt et al., 2000). It focuses primarily on quantifiable information that can help in the decision-making process (Hale, 1996).

2.16 | Sustainability reporting

Sustainability reporting is a voluntary activity with two general purposes: (a) to assess the current state of an organisation and (b) to communicate to stakeholders the efforts and progress in the economic, environmental, and social dimensions (Dalal-Clayton & Bass, 2002).

Dalal-Clayton and Bass (2002), Cole (2003), and Lozano and Huisingh (2011) offer comprehensive sustainability reporting tools and guideline lists, with their advantages and disadvantages. The most widely used include the following: the ISO14000 series and EMAS, covered in the EMS section; the AA1000, the SA8000 standard (Social Accountability International [SAI], 2007); and the GRI sustainability guidelines (Kuehr, 2007). A more recent addition is the ISO 26000.

AA1000 helps to establish a systematic stakeholder engagement process to ensure greater transparency and effective responsiveness to stakeholders (Institute of Social and Ethical Accountability, 1999). It involves stakeholder management throughout the entire process (Lozano & Huisingh, 2011b). Its emphasis is on innovation over compliance and possibility to chart their own course as opposed to being guided (Leipziger, 2003).

SA8000 is an auditable certification standard based on international workplace norms of International Labour Organisation conventions, the Universal Declaration of Human Rights, and the United Nations Convention on the Rights of the Child (SAI, 2007). It addresses human and labour rights explicitly throughout the company. It raises public awareness about the company's efforts (SAI, 2007).

The GRI sustainability guidelines are one of the most complete and worldwide recognised guidelines available (Hussey, Kirsop, & Meissen, 2001; Lozano & Huisingh, 2011). They are voluntary guidelines for reporting on economic, environmental, and social performance. They have general and sector-specific indicators.

ISO 26000 was developed for the purpose of giving guidance on the social responsibility of organisations (Hahn & Weidtmann, 2012; Schwartz & Tilling, 2009). ISO 26000 is an important step in improving sustainability performance (Hahn, 2013) because it focuses on the needs of its direct users and also on the needs of all groups of society (Hahn & Weidtmann, 2012). ISO 26000 has to date only been in use for a limited time (Hahn, 2013; Hahn & Weidtmann, 2012).

2.17 | Sustainable supply chains

Sustainable supply chain deals with the planning, execution, and control by integrating economic, environmental, and social issues to improve the long-term performance of an individual company and its supply chain (Stindt, 2017). This involves the management of materials, information, capital flows, and cooperation among companies (Seuring and Muller, 2008). Ahi and Searcy (2013) defined sustainable supply chains as "the creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organisational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organization over the short- and long-term."

2.18 | Socially/sustainable responsible investment

Socially/sustainable responsible investment is aimed at integrating environmental, social, and governance criteria into the investment decision-making process (Chava, 2010; Eurosif, 2014; Wai, Cheung, & Cheung, 2017). The integration includes social performance (e.g., employment quality, safety and health, training, and development), environmental performance (including emission reductions, resource reduction, and product innovation), economic performance (such as client loyalty, performance, and shareholder loyalty), and corporate governance performance (including board structure, compensation policy, and vision and strategy; Escrig-olmedo, Rivera-lirio, Jesús, & Angeles, 2017).

2.19 | The Natural Step

The Natural Step is an international educational organisation dedicated to accelerating society's movement towards sustainable development (Robèrt et al., 2002; Willard, 2002b), with a framework to aid in this transition (Robèrt et al., 2000). The framework aims to redirect people's attention from detailed environmental problems far "downstream" in cause-effect chains (e.g., addressing every new chemical with a new risk assessment), instead of focusing upstream on the unifying causes behind many problems (such as the general increase in the systematic concentration of man-made chemicals in nature; Doppelt, 2003). The Natural Step is built on backcasting, that is, envisioning a desirable future and working to move to that point (Robèrt et al., 2002).

2.20 | The triple bottom line

The triple bottom line focuses on incorporating environmental and social performance indicators, while complementing and balancing the economic indicators into company management, measurement, and reporting processes (Atkinson, 2000; Elkington, 2002a; Frankental, 2001; Wilenius, 2005). The triple bottom line aims to question a company's values, strategies, and practices and how these can be used to achieve sustainable development (Milne, Kearins, & Walton, 2003).

2.21 | Tools, approaches, and initiatives discussion

The majority of TIAs have focused on the economic and environmental dimensions (as discussed by Atkinson, 2000; Lozano, 2012a; Reinhardt, 2000) and on technocentric and managerial ploys (Lozano, 2015). Each TIA has advantages with respect to the sustainability dimensions and the company's systems elements, but it has certain disadvantages when it comes to dealing with the complexity and broadness of sustainability. Relying on one TIA can result in a limited and narrow contribution to sustainability and curtail coverage of the company's system, whereas using too many TIAs wastes resources and energy due to duplication in tasks (Lozano, 2012b). It should be noted that each TIA might have overlaps with others.

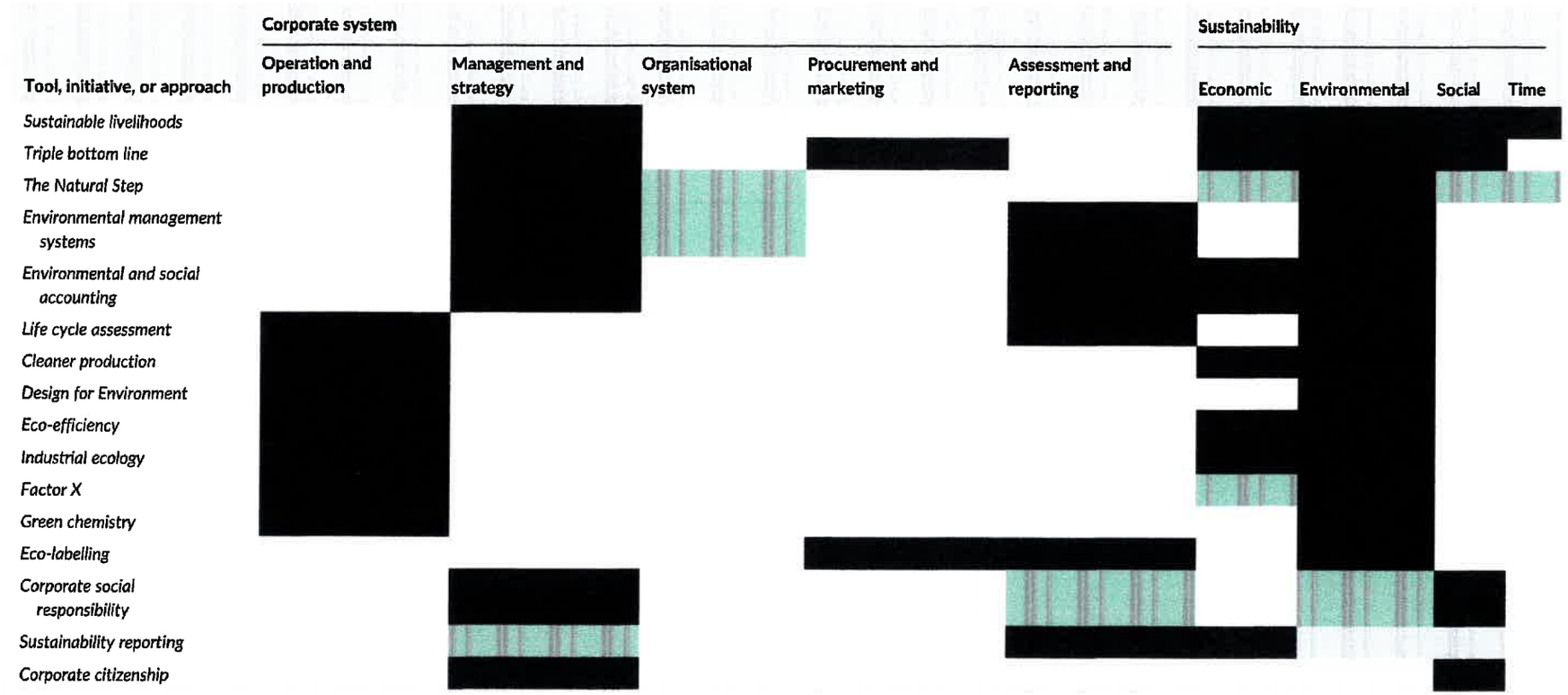
The TIAs have been limited in capturing the full spectrum of sustainability and its implications of and for corporations (Oskarsson & von Malmborg, 2005). In most cases, they have been poorly linked to each other, leading to company leaders and decision makers being increasingly confused about how they could fit together or how they should be used (Ny, 2009). Attempts to provide guidelines on the best use and potential synergies have been offered by Robèrt et al. (2000) and by experts in different tools (see Robèrt et al., 1997, 2002). However, there has been little research on the use of such TIAs (with the exception of Windolph, Schaltegger, & Herzig, 2014 focusing on the dissemination of sustainability management "tools" and institutional factors that drive their application) or how they should be combined.

Lozano (2012) proposed to the following elements of a company system, in order to analyse the TIAs: operations and production; management and strategy; organisational systems; procurement and marketing; and assessment and reporting. He analysed 16 TIAs using the Corporate Integration of Voluntary Initiatives for Sustainability (CIVIS) framework (see Table 1), based on this system and the four dimensions of sustainability (economic, environmental, social, and time). The analysis highlighted that none of the TIAs, on its own, covers the full organisation system or the aforementioned four dimensions of sustainability; therefore, a combination of TIAs is needed. In subsequent publications (Lozano, 2018; Lozano, Suzuki, Carpenter, & Tyunina, 2017), governance and collaboration were added to the system, and procurement and marketing was renamed sustainable supply chains.

3 | METHODS

A survey was developed to investigate the importance of how sustainability has been embedded in organisations. The survey was applied using the online survey tool Qualtrics (2018). The data collection took place over the period from May to November 2018. The survey consisted of seven sections (this paper focuses on sections 1, 2, 3, and 5):

TABLE 1 Corporate and Industrial Voluntary Initiatives for Sustainability framework



Colour coding
Full contribution
Limited contribution
Variable contribution

1. Organisation characteristics, including country of origin, size, and product–service focus;
2. Role of sustainability for the organisation and role of the respondent in the company;
3. Sustainability questions, such as importance of environmental, economic, and social issues;
4. Organisational change towards sustainability and incorporation of sustainability;
5. Sustainability tools, initiatives, and approaches;
6. Stakeholders' role in the organisation's sustainability engagement; and
7. Supply chain issues.

The survey was sent to a database of 5,299 (of which 3,603 were companies) contacts from different organisations obtained from the GRI list of organisations worldwide and personal contacts. In addition, 107 anonymous links were sent out. Three reminders were sent out, one in July 2018, one in September 2018, and one in October 2018. From the total list of emails, 616 emails bounced back. From the total, 202 full responses were obtained for the question about the TIAs in Section 5, with a response rate (after removing the ones that bounced back) of 5.61%.

The variables for the TIAs had the following potential answers: 6 points for company (1 to 49 employees, 50 to 249, 250 to 499, 500 to 999, 1,000 to 4,999, and more than 5,000 employees); 6-point scale for the time working with sustainability (less than 1 year, between 1 and 3 years, between 3 and 5 years, between 5 and 10 years, between 10 and 15 years, and more than 15 years); and 5 points for the use of the TIAs ("not used/do not know it," "negative results," "no perceived results," "some results," and "good results").

The data were analysed using descriptive analysis: Friedman test combined with quintiles to detect rankings; a ratio analysis between results ("good" and "some") versus no results ("no perceived" and "negative" results); principal component analysis (PCA); and cluster analysis (see Jupp, 2006; Moore & McCabe, 2006). These were complemented with an analysis of the number of tools used based on a combination of the ratio analysis and cluster analysis. The aim of PCA is to explain the correlation matrix with as few factors as possible (Jupp, 2006; Linting, 2007). Cluster analyses generate a numerical classification of groups or "clusters" of objects, so that profile differences between objects within a cluster are minimised, and profile differences are maximised (Jupp, 2006). The analyses were done using SPSS (International Business Machine, 2016).

3.1 | Limitations of the methods

The internal validity of this research might have been limited by the survey, which tried to cover many topics of sustainability in organisations. The Likert scale may suffer from acquiescence problems and desirability. The number of respondents (202) may not allow a complete generalisation to all corporations. The generalisability of results to all organisations may be limited to the application of a non-random sampling procedure and the focus on companies listed in the GRI Disclosure Database with additional input from personal contacts and "snowballing" methods. A non-response bias may be caused by companies from sectors that were contacted but declined to complete the survey. Generalisability could be improved by a study based on a randomly selected sample drawn from the total number of corporations active in sustainability. Most of the respondents were from Europe, which may not represent the reality in other regions. The cluster analysis may suffer from reification, that is, whether the variables do correspond to reality, or are they constructs with no real existence. The PCA and the cluster analyses are based on linear techniques, which may not depict fully the phenomena.

4 | RESULTS

Most of the responses were from European countries, as seen in blue in Figure 1. This may be due to European companies being more active in sustainability (see Kolk, 2008; Lozano, 2013b), their willingness to respond to the survey, or that the original database (based to a great extent on the GRI database) contained more European countries. The countries with the highest number of responses were Sweden (27), Germany (23), Spain (18), and the Netherlands (15).

Figure 2 shows the percentage of responses from industrial sectors, with the highest responses from financial services (25), manufacturing (18), and energy (17). As it can be seen, the responses were from a wide range of sectors.

The company size was two-tailed: 31 with 1 to 49 employees, 11 with 50 to 249 employees, 10 with 250 to 499 employees, 8 with 500 to 999 employees, 55 with 1,000 to 4,999 employees, and 31 more than 5,000 employees.

Most of the respondents indicated that their company has been working with sustainability for more than 5 years (61 companies between 5 and 10 years, 44 between 10 and 15 years, and 60 more than 15 years); 26 indicated that their company has been working with sustainability between 3 and 5 years, 9 between 1 and 3 years, and 2 less than a year.

Figure 3 shows the use and results of the TIAs. The two TIAs most widely known are CSR and corporate sustainability, followed by sustainability reporting (GRI report), and eco-efficiency. These four also have the highest results, followed by cleaner production, environment management systems (ISO 14000 series), corporate citizenship, and sustainable supply chain. The two least known TIAs are Factor X and The Natural Step, followed by sustainability reporting (SA8000), sustainability reporting (ISO26000), industrial ecology, sustainability reporting (AA1000), green/sustainable chemistry, and triple bottom line.

Four similar TIAs are used in different ways: CSR and CS are used almost equally with good result, and thus could be used interchangeably (depending on the context); corporate citizenship is used slightly less with fewer results, whereas the triple bottom line is seldom used in practice. Two other TIAs, cleaner production and eco-efficiency, have very similar results and thus could potentially be used interchangeably.

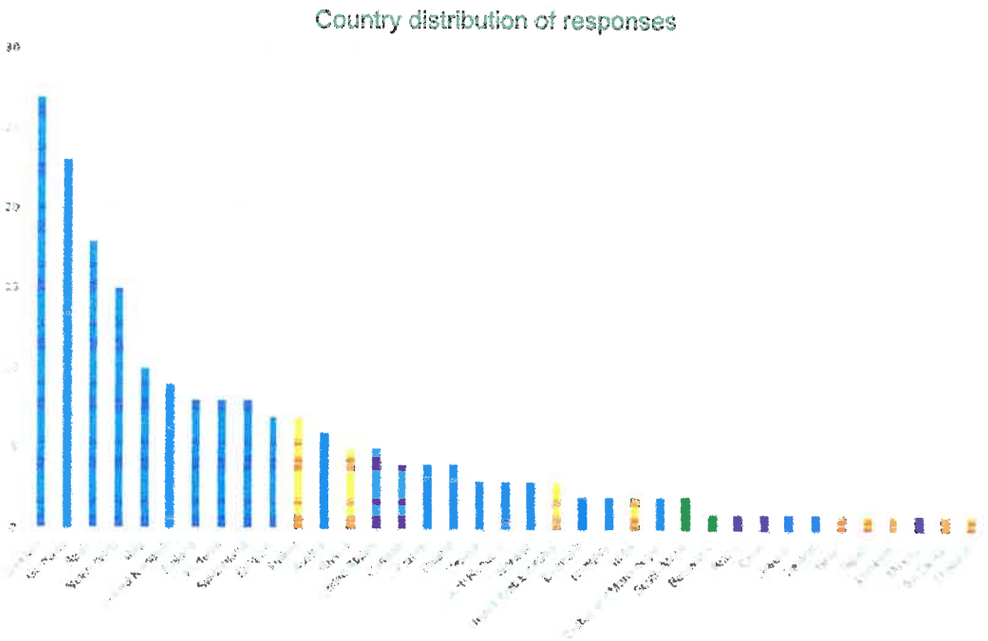


FIGURE 1 Survey responses per country, European countries in blue, Asian in orange, American in purple, and African in green [Colour figure can be viewed at wileyonlinelibrary.com]

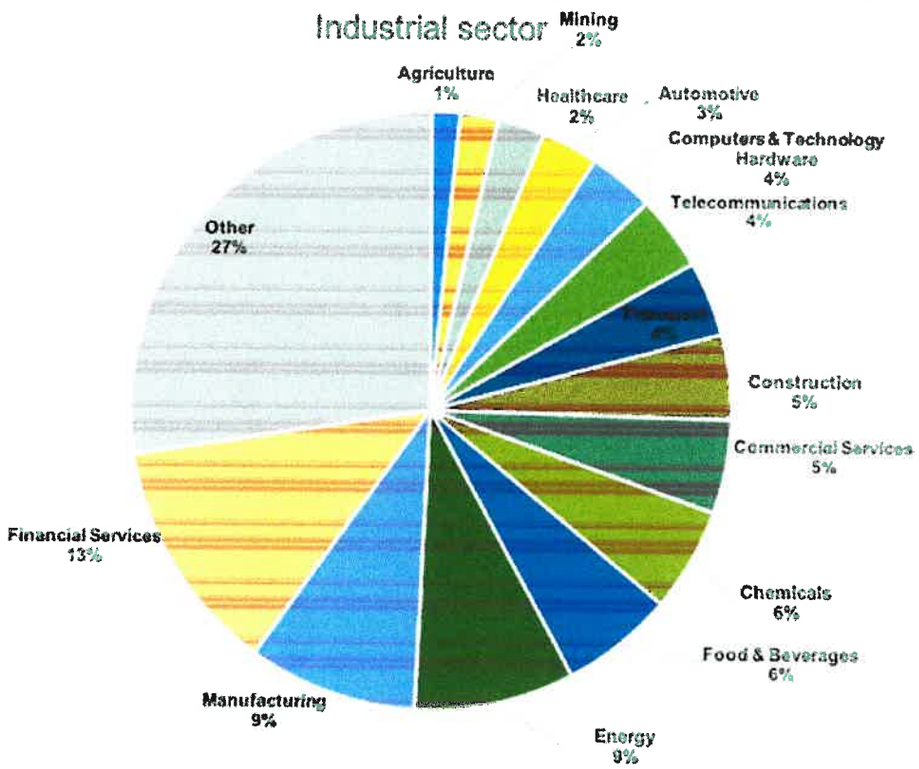
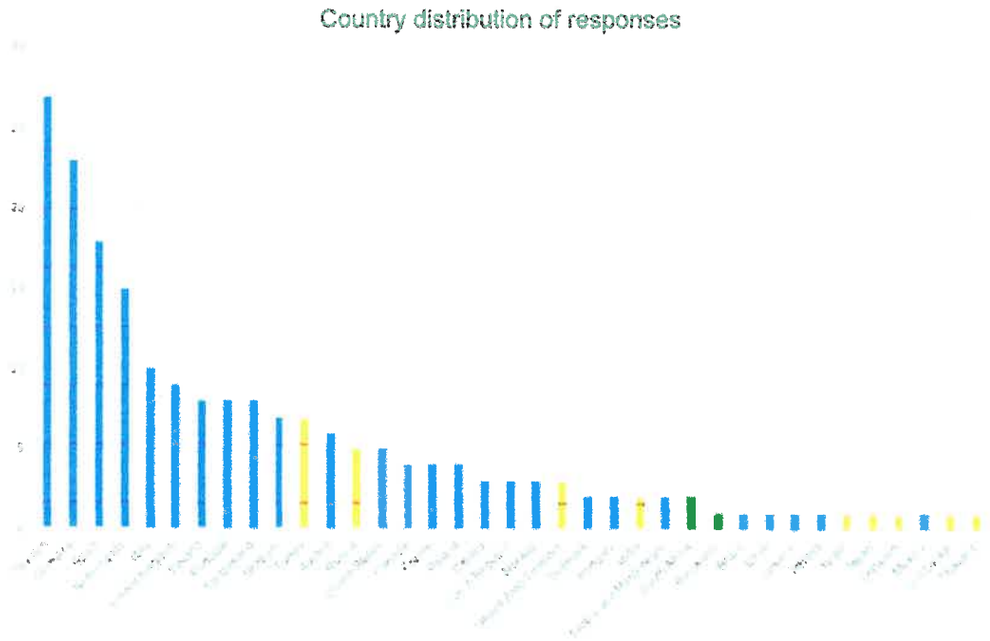


FIGURE 2 Survey responses per industrial sector [Colour figure can be viewed at wileyonlinelibrary.com]



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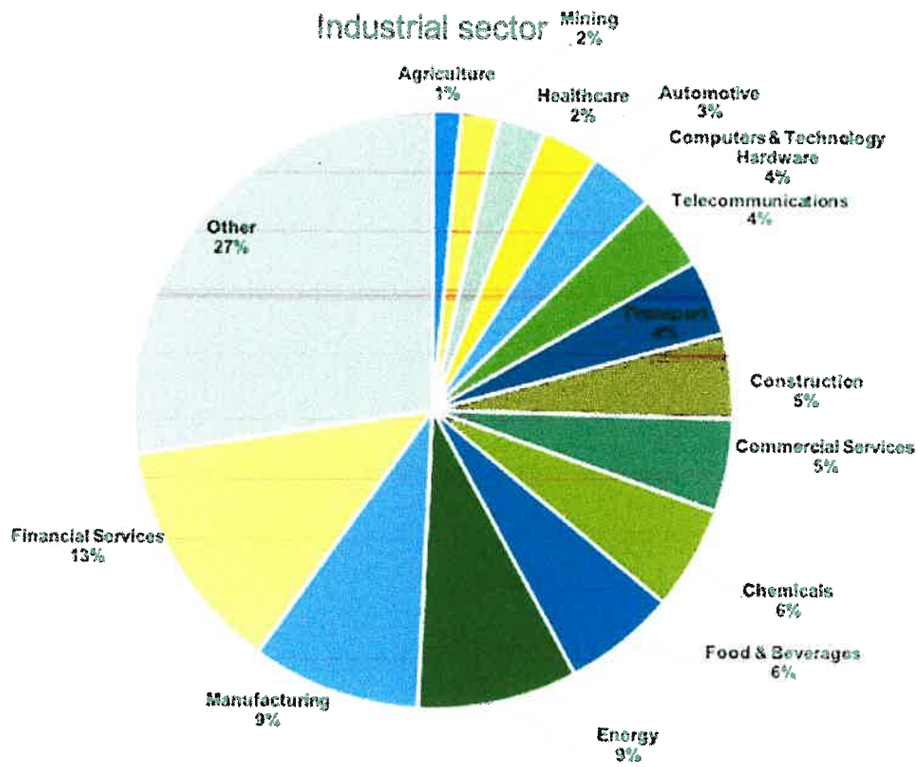

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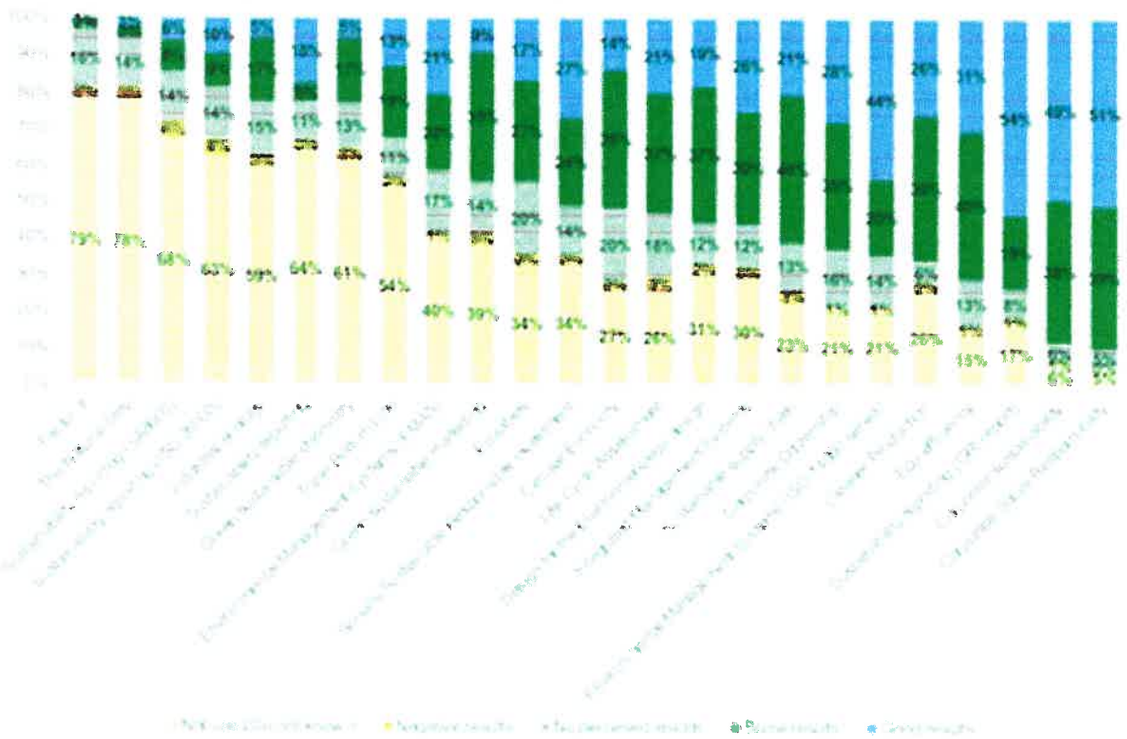


FIGURE 3 Results obtained from the use of tools, initiatives, and approaches by companies [Colour figure can be viewed at wileyonlinelibrary.com]

Figure 4 presents the ratio of the results ("good" and "some," blue and green colours in Figure 3) obtained by the TIAs versus the "no perceived results" (grey colour in Figure 3). From these results, it can be seen that CSR and corporate sustainability have the highest ratios (between 8 and 18), followed by cleaner production and sustainability reporting (GRI report). These are followed by (between 4 and 6) eco-efficiency, Design for the Environment/eco-design, environmental management systems (ISO 14000 series), sustainable supply chain, and integrated management systems. The ones with a ratio between 2 and 4 include corporate citizenship, socially/sustainable responsible investment, green/sustainable marketing, triple bottom line, life cycle assessment, and circular economy. The TIAs with the

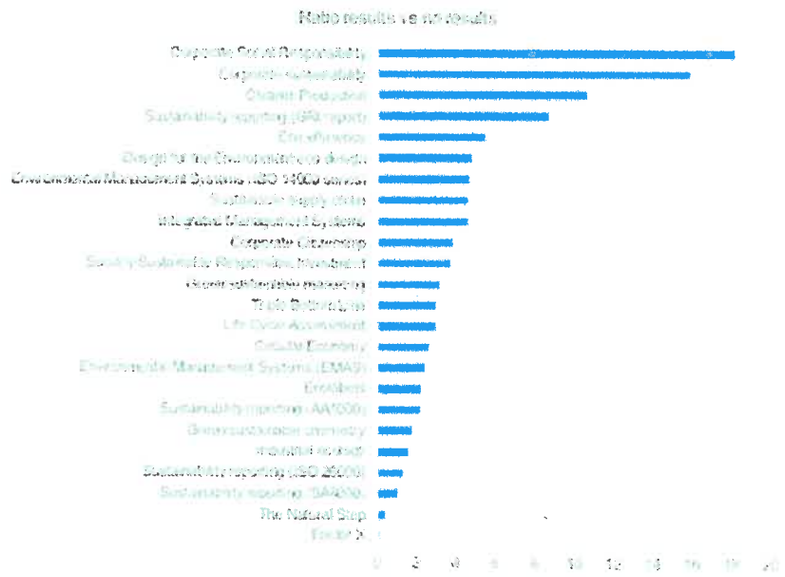


FIGURE 4 Ratio of results obtained from the use of tools, initiatives, and approaches by companies against the no results [Colour figure can be viewed at wileyonlinelibrary.com]

lowest ratios (between 0 and 2) are green/sustainable chemistry, industrial ecology, sustainability reporting (ISO26000), sustainability reporting (SA8000), the Natural Step, and Factor X.

The Friedman test showed the relative ranking between the 24 TIAs, which were then divided into quintiles (Figure 5):

- First quintile: CSR; Corporate sustainability; and sustainability reporting (GRI report);
- Second quintile: eco-efficiency; cleaner production; environmental management systems (ISO 14000 series); and corporate citizenship;
- Third quintile: sustainable supply chain; design for the environment/eco-design; socially/sustainable responsible investment; circular economy; life cycle assessment; integrated management systems; ecolabels; environmental management systems (EMAS);
- Fourth quintile: green/sustainable marketing; triple bottom line; green/sustainable chemistry; sustainability reporting (AA1000); and
- Fifth quintile: industrial ecology; sustainability reporting (ISO 26000); sustainability reporting (SA8000); The Natural Step; and Factor X.

As it can be observed in Figure 5, there are differences between the quintiles, but not so much within them. This points out to a possible categorisation of five groups.

Figure 6 shows the ratio analysis comparing the TIAs' results ("some" and "good") versus the "no" and "negative" results. The "not used/do not know it" responses were not taken into consideration for the analysis. The results provided a categorisation of the TIAs into four groups:

- High ratio: CSR (18.10); corporate sustainability (14.50); cleaner production (8.47); GRI report (7.74);
- Medium high ratio: eco-efficiency (5.04); environmental managements systems (ISO 14000 series; 4.33); Design for the Environment/eco-design (4.04); integrated management systems (3.76); and socially/sustainable; and responsible investment (3.30);
- Medium low ratio: corporate citizenship (3.73); sustainable supply chain (3.72); green/sustainable marketing (2.58); life cycle assessment (2.44); circular economy (2.40); environmental management systems (EMAS; 2.25); and Ecolabels (2.00); and
- Low ratio: triple bottom line (2.48); green/sustainable chemistry (1.45); AA1000 (1.72); industrial ecology (1.27); sustainability reporting (ISO 26000; 1.03); sustainability reporting (SA8000; 0.79); The Natural Step (0.32); and Factor X (0.15).

In general, the four more widely known TIAs have a good ratio of results versus no results. There are some TIAs that are less well known (e.g., The Natural Step or Factor X), which also tend to have fewer results.

Table 2 presents the PCA. It should be noted that a difference of less than 0.3 indicates a relation between the groups. The table shows six clear groups that are, to a great extent, independent with the exceptions of green/sustainable marketing that connects Groups

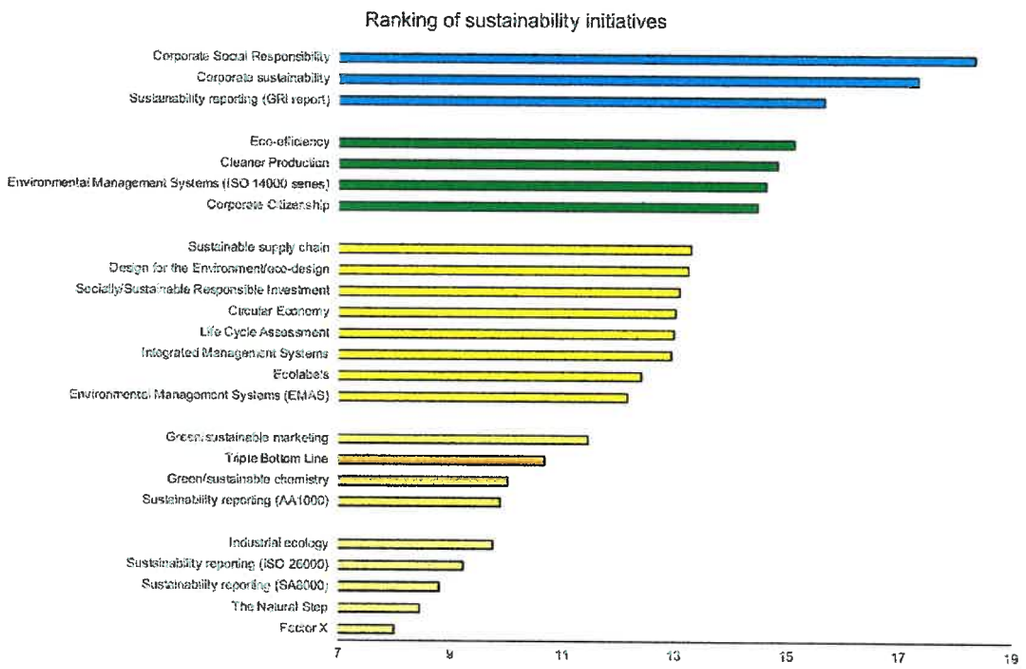


FIGURE 5 Ranking of the sustainability tools, initiatives, and approaches using Friedman test and divided into quintiles [Colour figure can be viewed at wileyonlinelibrary.com]

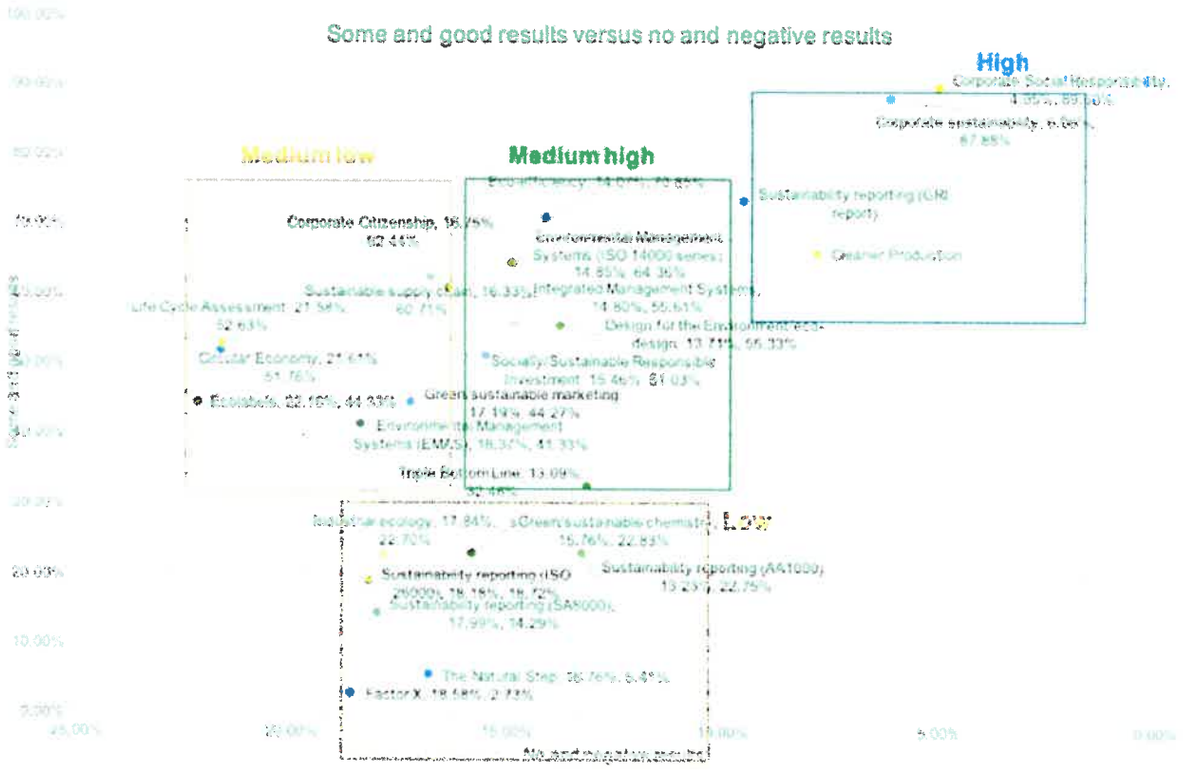


FIGURE 6 Ratio analysis of the tools, initiatives, and approaches results (some and good) versus the no and negative results [Colour figure can be viewed at wileyonlinelibrary.com]

1 and 2 and integrated management systems that connects Groups 4 and 5. The PCA shows that companies currently use the TIAs in a compartmentalised way.

A cluster analysis was carried out to detect the proximity of the TIAs, as seen in Figure 7. This analysis resulted in five clusters, including the following: (a) circular economy, cleaner production, Design for the Environment/eco-design, eco-efficiency, ecolabels, and life cycle assessment; (b) corporate citizenship and sustainable supply chain; (c) CSR, corporate sustainability, and sustainability reporting (GRI report); (d) environmental management systems (EMAS), environmental management systems (ISO 14000 series), and integrated management systems; and (e) Factor X, green/sustainable chemistry, green/sustainable marketing, industrial ecology, socially/sustainable responsible investment, sustainability reporting (AA1000), sustainability reporting (ISO 26000), sustainability reporting (SA8000), The Natural Step, and triple bottom line. Cluster 1 is mainly composed of TIAs that have, or are predominantly, focused on operations and production and the environment. Cluster 2 is composed of TIAs that are mainly focused on management and strategy and supply chains. Cluster 3 is composed of TIAs focusing on management and strategy, and assessment and reporting. Cluster 4 is composed of TIAs on focusing on management and strategy and assessment and reporting, with some links to organisational systems. Cluster 5 is composed of the remainder of the TIAs. The cluster analysis shows that categorising the TIAs into five groups may be valid.

Figure 8 combines the cluster analysis with the ratio analysis results (the results of each TIA divided by the sum of the negative and no results). The x axis presents each of the five clusters and the y axis (as well as the size of the bubble) the ratio. As it can be seen, Group 3 is the one that provides the highest results, followed by Group 1. Groups 2, 4, and 5 have, on average, similar results, but it should be noted that some TIAs in Group 5 (e.g., The Natural Step and Factor X) yield low results.

The responses were analysed to detect if the right number of TIAs are being used, that is, between four and six. There were 46% of companies using too many (more than 15), 45% companies with many (more than seven), 3% with too few (less than three), and 6% with, apparently, the optimal combination of TIAs, that is, between four and six.

The analyses served to update the CIVIS framework (see Figure 9), which includes coverage of the corporate system elements and sustainability dimensions by each TIA, the cluster to which they belong, and the ratio of "results" versus "no results". As it can be observed, the environmental dimension is the most frequently addressed, followed by the economic one. The least addressed

TABLE 2 Principal component analysis of the TIAs used by companies

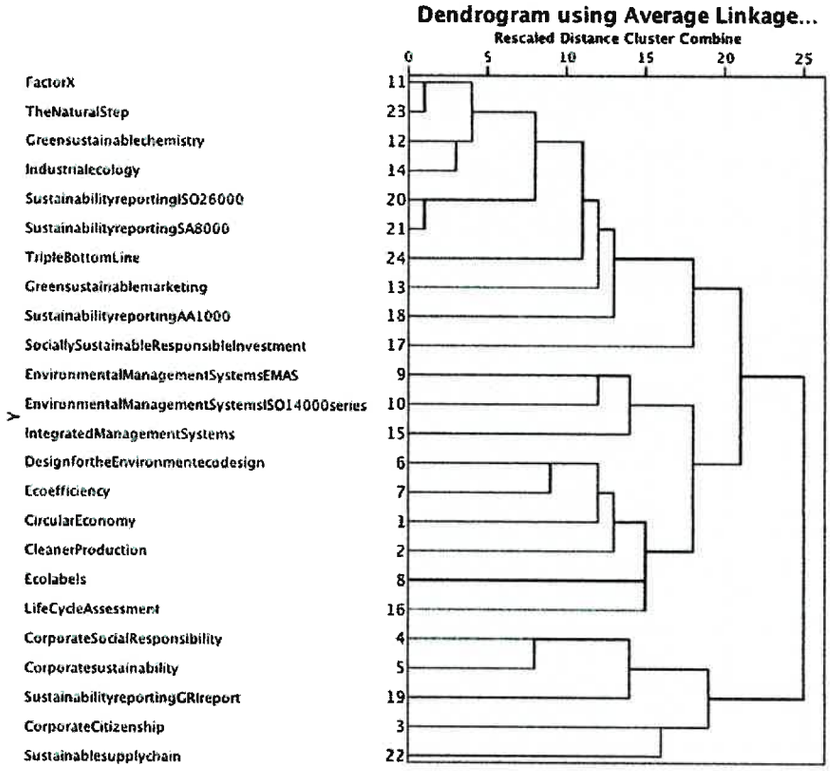
	Rotated component matrix[a]					
	Component					
Tool, initiative, or approach	**1**	**2**	**3**	**4**	**5**	**6**
Design for the environment/eco-design	0.748					
Eco-efficiency	0.695					
Circular economy	0.636					
Cleaner production	0.568					
Corporate sustainability	0.562					
Life cycle assessment	0.533					
Ecolabels	0.528					
Green/sustainable chemistry		0.795				
Factor X		0.788				
Industrial ecology		0.785				
Green/sustainable marketing	**0.363**	**0.537**				
Sustainability reporting (SA8000)			0.815			
Sustainability reporting (ISO 26000)			0.734			
Sustainability reporting (AA1000)			0.732			
Socially/sustainable responsible investment			0.518			
Triple bottom line				0.651		
The Natural Step				0.591		-0.364
Integrated management systems				**0.574**	**0.463**	
Sustainability reporting (GRI report)				0.523		
Sustainable supply chain				0.508	-0.377	
Environmental management systems (EMAS)					0.760	
Environmental management systems (ISO 14000 series)					0.742	
Corporate social Responsibility						0.782
Corporate citizenship						0.771

Note. Bold indicates relationship between the components. Rotation method used was Varimax with Kaiser Normalization.
Abbreviations: AA1000, AccountAbility 1000; EMAS, U EcoManagement, and Audit Scheme; GRI, Global Reporting Initiative; ISO, International Organisation for Standardization; SA8000, Social Accountability 8000
[a]Rotation converged in eight iterations

dimension is time, followed by the social dimension. The system elements most addressed are operations and process, management and strategy, and assessment and reporting. The least addressed elements are organisational systems, sustainable supply chains, collaboration, and governance. The TIAs focus generally on operations and production, management and strategy, and assessment and reporting. Governance and organisational systems tend not to be addressed by the TIAs; therefore, other steps need to be taken to address these. The TIAs have limited coverage on organisational systems, governance, and stakeholder engagement.

The cluster analysis resulted in five characteristic groups, whereas the PCA showed a clear separation into six groups, where only green/sustainable marketing and integrated management systems serve as links between groups. The cluster analysis and PCA groups can serve as guides to decide which TIAs to combine in order to address the company system and sustainability dimensions. A combination between five and six TIAs should provide the most efficient way to address sustainability. According to Lozano (2012a), the minimum number should be three, but this restricts the TIAs to just a few. Another option that he proposed, which provides a broader range of combinations, is four. Therefore, this research proposes that between four and six TIAs are used by corporations to embed sustainability into their systems. The updated CIVIS framework can help companies to choose their optimum combination. It should be noted that some of the system elements are not addressed by the TIAs discussed, and other approaches must be used to address them.

Using the updated CIVIS framework, a combination of cleaner production (ratio 8.47), sustainable supply chain (3.72), corporate sustainability (14.50), environmental management systems (4.33), and socially/sustainable responsible investment (3.30) would most



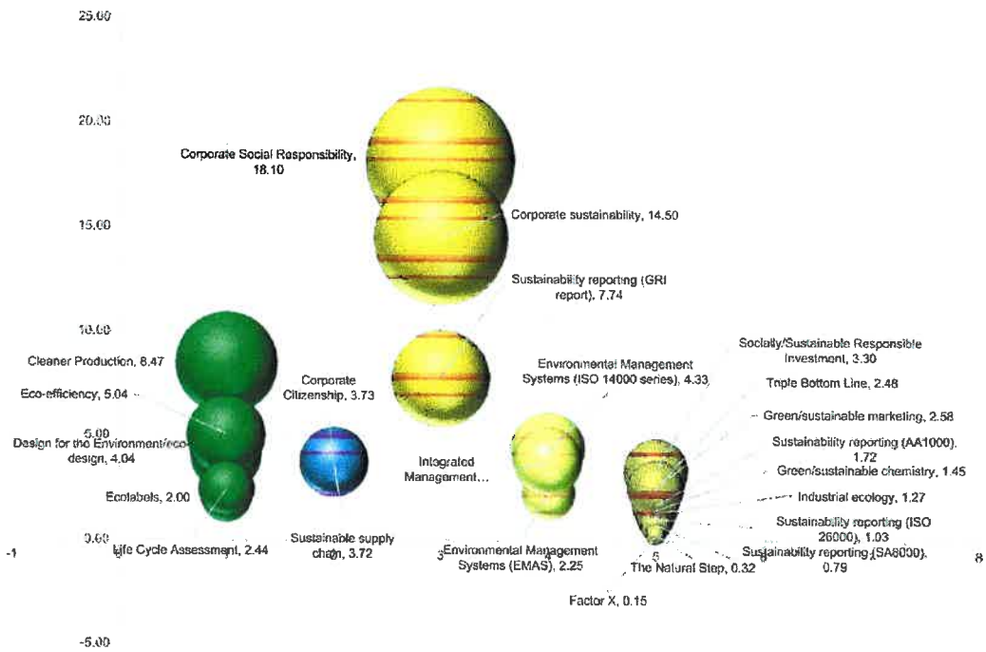
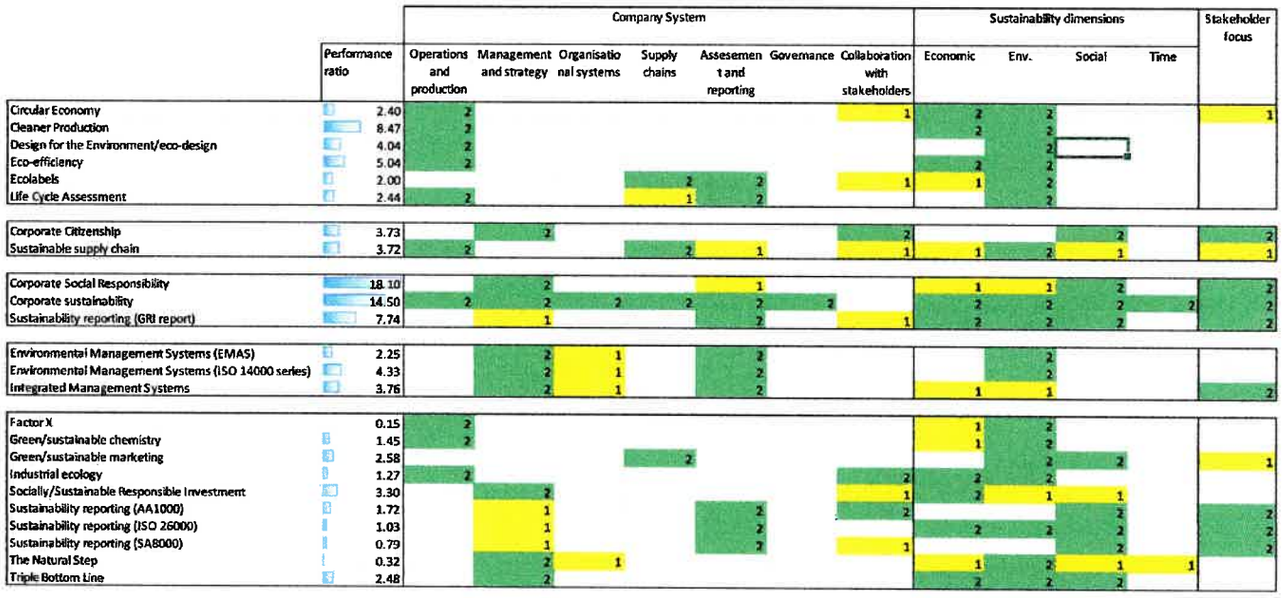


FIGURE 7 Dendogram of the cluster analysis using average linkages between the responses to the survey on the tools, initiatives, and approaches section

FIGURE 8 Cluster and ratio analysis showing the results of the tools, initiatives, and approaches in each cluster (depicted in the y axis and in the size of the bubble) [Colour figure can be viewed at wileyonlinelibrary.com]

likely cover all the company system elements, sustainability dimensions, and stakeholder focus. It should be noted that the context of the company plays an important role in the combination of tools, for example a chemical industry would benefit more from green chemistry than a company focusing on services, such as a consultancy.



	Performance ratio	Company System: Operations and production	Management and strategy	Organisational systems	Supply chains	Assesement and reporting	Governance	Collaboration with stakeholders	Sustainability dimensions: Economic	Env.	Social	Time	Stakeholder focus
Circular Economy	2.40	2						1	2	2			1
Cleaner Production	8.47	2							2	2			
Design for the Environment/eco-design	4.04	2								2			
Eco-efficiency	5.04	2							2	2			
Ecolabels	2.00				2	2		1	1	2			
Life Cycle Assessment	2.44	2			1	2				2			
Corporate Citizenship	3.73		2					2			2		2
Sustainable supply chain	3.72	2			2	1		1	1	2	1		1
Corporate Social Responsibility	18.10		2			1			1	1	2		2
Corporate sustainability	14.50	2	2	2	2	2	2		2	2	2	2	2
Sustainability reporting (GRI report)	7.74		1			2		1	2	2	2		2
Environmental Management Systems (EMAS)	2.25		2	1		2				2			
Environmental Management Systems (ISO 14000 series)	4.33		2	1		2				2			
Integrated Management Systems	3.76		2	1		2			1	1			2
Factor X	0.15	2							1	2			
Green/sustainable chemistry	1.45	2							1	2			
Green/sustainable marketing	2.58				2					2	2		1
Industrial ecology	1.27	2						2	2	2			
Socially/Sustainable Responsible Investment	3.30		2					1	2	1	1		
Sustainability reporting (AA1000)	1.72		1			2		2			2		2
Sustainability reporting (ISO 26000)	1.03		1			2			2	2	2		2
Sustainability reporting (SA8000)	0.79		1			2		1			2		2
The Natural Step	0.32		2	1					1	2	1	1	
Triple Bottom Line	2.48		2						2	2	2		

FIGURE 9 Updated Corporate and Industrial Voluntary Initiatives for Sustainability framework [Colour figure can be viewed at wileyonlinelibrary.com]

5 | CONCLUSIONS

During the last three decades, a number of corporations have been engaging in becoming more sustainability oriented. Sustainability has been considered a precondition for doing business and has to encompass a holistic perspective including the four dimensions (economic, environmental, social, and time), as well as their interactions. In this context, a number of TIAs have been developed by and for corporations to better promote sustainability within their systems.

The TIAs can help to promote sustainability in corporations; however, the majority of such efforts have focused on the economic and environmental dimensions;and on operations and production, management and strategy, and assessment and reporting. Relying on one TIA can result in a limited and narrow contribution to sustainability and curtail coverage of the company's system, whereas using too many TIAs wastes resources and energy due to duplication in tasks. The TIAs need to be combined efficiently in a holistic way to address the company and sustainability dimensions. The combination should take into consideration the company context, including its industrial sector and its focus on product/service combinations.

This research proposes that between four and six TIAs are used by corporations to embed sustainability into their systems. This research also provides an update to the CIVIS framework using empirical data from the use of the TIAs by 202 corporations. The updated CIVIS framework provides details on the coverage of the corporate system elements and sustainability dimensions by each TIA, the cluster to which they belong, and the ratio of results versus no results. The updated CIVIS framework can provide guidance to help to choose the right combination of TIAs.

The TIAs can help to promote sustainability in corporations, but they need to be combined correctly in order to address holistically the four dimensions of sustainability, the system elements, and stakeholders, while avoiding duplication of tasks and wasting resources.

Further research should be carried out for specific cases, countries, and specific sectors. The use of tools by other organisations should also be explored, as well as the reasons why the tools are used.

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