The rationale for ISO 14001 certification: A systematic review and a cost-benefit analysis

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Abstract: This contribution presents the findings from a two-stage systematic review. It relied on PRISMA's methodical protocol to capture and analyze high-impact articles, that were focused on the International Standards Organization's ISO 14001 - Environment Management Systems. Whilst stage 1 shed light on the most cited publications since 1995, stage 2 narrowed down the search results between 2015 and 2021. The findings suggest that the use of this certifiable standard may result in operational efficiencies through better utilization of resources and waste management systems. It provides opportunities for practitioners to re-conceive their license to operate and to enhance their credentials with stakeholders. It considered potential pitfalls like high certification costs, time constraints as well as an increase in paperwork and red tape. Moreover, it recognizes that managers and employees may not be willing to implement changes as they may prefer the status quo or could not be knowledgeable enough to integrate the standard's environment management systems with existing practices.

Keywords: Environment management; ISO 14001; environmental performance; cost-benefit analysis; systematic review; PRISMA.

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1. Introduction

During the Paris Climate Conference (COP 21), one hundred ninety-six (196) countries pledged their commitment to implement environmental performance measures to reduce the effects of climate change. This conference has led to the development of the 'Paris Agreement' where signatories became legally bound to limit global warming to below 2°C, and possibly 1.5°C (Palea & Drogo, 2020; Secinaro, Brescia, Calandra & Saiti, 2020). They recognized the importance of averting and minimizing the environmental impact that is caused by climate change, by scaling up their efforts and support initiatives to reduce emissions, by building resilience among parties, and by promoting cooperation (Birindelli & Chiappini, 2021; Gatto, 2020).

In the aftermath of COP 21, many countries submitted their plans for climate action (these plans are also known as nationally determined contributions - NDCs), where they communicated about their tangible actions that were aimed to reduce their greenhouse gas emissions and the impacts of rising temperatures (Fatica & Panzica, 2021; Gerged, Matthews & Elheddad, 2021). Consequentially, intergovernmental organizations including the European Union (EU), among others, are increasingly establishing ambitious carbon neutrality goals and zero-carbon solutions to tackle climate change issues (Benz, Paulus, Scherer, Stryca & Trück, 2021).

Many countries are incentivizing businesses across different economic sectors, to reduce their emissions. For example, the EU member states are expected to reduce their greenhouse gas emissions by 40% before 2030, and by 60% prior to 2050 (EU, 2019). These targets would require the commitment of stakeholders from various sectors including those operating within the energy and transportation industries, among others.

The latest climate change conference (COP26) suggested that progress has been made on the signatories' mitigation measures that were aimed to reduce emissions, on their adaptation efforts to deal with climate change impacts, on the mobilization of finance, and on the increased

collaboration among countries to reach 2030 emissions targets. However, more concerted efforts are required to deliver on these four pledges (UNFCCC, 2021).

This contribution raises awareness on the use of environmental management standards that are intended to support organizations of different types and sizes, including private entities, not-for-profits as well as governmental agencies, to improve their environmental performance credentials. A thorough review of the relevant literature suggests that, over the years many practitioners have utilized the International Standards Organization's ISO 14001 environment management systems standard to assist them in their environmental management issues (Baek, 2018; Delmas & Toffel, 2008; Erauskin-Tolosa, Zubeltzu-Jaka, Heras-Saizarbitoria & Boiral, 2020; Melnyk, Sroufe & Calantone, 2003).

Many academic commentators noted that several practitioners operating in different industry sectors, in various contexts, are implementing ISO 14001 requirements to obtain this standard's certification (Boiral, Guillaumie, Heras-Saizarbitoria & Tayo Tene, 2018; Para-González & Mascaraque-Ramírez, 2019; Riaz, & Saeed, 2020). Whilst several researchers contended about the benefits of abiding by voluntary principles and guidelines (Camilleri, 2018), others discussed about the main obstacles to obtaining impartial audits, assurances and certifications from independent standard setters (Hillary, 2004; Ma, Liu, Appolloni & Liu, 2021; Robèrt, Schmidt-Bleek, Aloisi De Larderel ... & Wackernagel, 2002; Teng & Wu, 2018).

Hence, this research examines identifies the rationale for ISO 14001 certification (Carvalho, Santos & Gonçalves, 2020; Eltayeb, Zailani & Ramayah, 2011; Lee, Noh, Choi & Rha, 2017; Potoski & Prakash, 2005) that is supposedly intended to improve the organizations' environmental performance and to enhance their credentials. Specifically, this contribution's objectives are threefold. Firstly, it provides a generic background on voluntary instruments, policies and guidelines that are intended to promote corporate environmentally responsible behaviors. Secondly, it presents the results from a systematic review of academic articles that were

focused on ISO 14001 - environment management systems. Thirdly, it synthesizes the findings from high impact papers and discusses about the benefits and costs of using this standard. In conclusion, it elaborates on the implications of this research, it identifies its limitations and points out future research avenues.

In sum, this contribution differentiates itself from previous articles, particularly those that sought to investigate the introduction and implementation of environment management systems in specific entities. This research involves a two-stage systematic analysis. It appraises a number of empirical investigations, theoretical articles, reviews, case studies, discursive/opinion papers, from 1995-2021. Afterwards, it scrutinizes their content to shed more light on the pros and cons of using ISO 14001 as a vehicle to improve corporate environmental performance.

2. Regulatory instruments, principles and guidelines for good practice

Stakeholders expect organizations including businesses, governmental organizations as well as non-government organizations (NGOs), to do the right things and to communicate about their laudable activities. They must be seen operating in a responsible manner, by looking after their employees, by taking care of the environment, and by being good corporate citizens. When problems occur, businesses must act quickly to resolve problematic matters. While many governments and their policymakers have been the primary force for the promotion of financial reporting standards (Camilleri, 2017a; Weber, 2014), intergovernmental institutions like the United Nations Global Compact, the Organization for Economic Cooperation and Development (OECD) as well as a number of NGOs, including ISO, the Global Reporting Initiative (GRI) and the International Integrated Reporting Council (IIRC), among others, have

increasingly facilitated the growth and diffusion of non-financial reporting mechanisms (Camilleri, 2017b; Fortuna, Testarmata, Sergiacomi & Ciaburri, 2020).

Several NGOs developed predefined norms, procedures and guidelines to support organizations, including businesses, on social, environmental management and corporate governance issues (Boström & Hallström, 2010; Salomone, 2008). For example, ISO developed performance and/or process-oriented standards that can be applied across different industry sectors and geographic regions (Dissou, 2005). A few substantive standards can also provide certification for compliance as well as independent monitoring systems and assurance mechanisms (Husted, Montiel & Christmann, 2016).

However, in many cases, certifiable standards are adopted on a voluntary basis. They are considered as soft law solutions, as they are not legally-binding, although they may fill numerous governance and accountability gaps for which there is no applicable regulation or enforcement (Nakamura, Takahashi & Vertinsky, 2001). Their principles may eventually be internalized by practitioners as they allow them to improve their credentials with stakeholders (Husted et al., 2016) and to meet the expectations of society.

The organizations' stakeholders can make or break their reputation and standing (Park, 2019). Positive as well as adverse publicity that is generated through media events or during public protests can impact directly on corporate image and on revenues (Xu, Zeng, Zou & Shi, 2016). They can indirectly affect share prices and access to capital investment (Su, Swanson & Chen, 2018).

Consumers can impose direct economic costs on non-compliant companies by boycotting products or services in addition to negative word-of-mouth marketing. Stakeholders including the governments, regulatory authorities, NGOs and other organizations within the supply chain, may severely sanction irresponsible organizations if they do not respect societal norms and ethical values (Camilleri, 2016). Bad publicity could induce firms to adopt beyond-compliance

measures to engage in corporate citizenship (Wilburn & Wilburn, 2011). Arguably, private businesses are continuously expected to prove their social license to operate, and to avoid unnecessary criticism from stakeholders (Colwell & Joshi, 2013; Demuijnck & Fasterling, 2016).

The institutional theory posits that firms ought to respond to regulatory pressures in society (Clemens & Douglas, 2000). They have to do so to access critical resources or merely for social acceptance purposes (Ntim & Soobaroyen, 2013). The organizations' compliance with their operating environment's regulations enables them to improve their legitimacy among stakeholders (Beck, Dumay & Frost, 2017).

Hence, there is scope for them to anticipate hard legislation. They could impose stricter regulations on themselves to prevent irregularities, and/or to reduce their chances of legal violations (Hillary, 2004). If they do so, they will be perceived as credible and trustworthy. As a result, they would be in a better position to build their reputation, and to achieve a competitive advantage relative to their rivals (Khan, Yang & Waheed, 2019; Orsato, 2006; Yu, Kuo & Kao, 2017). Businesses can enhance their legitimacy with stakeholders by communicating about their non-financial performance (Balluchi, Lazzini & Torelli, 2021). They can disclose information on their corporate governance, social and environmentally sound behaviors in corporate social responsibility (CSR) or Sustainability reports (Duthler & Dhanesh, 2018; Ettinger, 2018).

The American Institute of Certified Public Accountants' Jenkins Report may be considered as one of the major documents that has provided the foundations for non-financial disclosures. Other guidelines that are focused on environmental management systems were developed by intergovernmental agencies as well as by standard setters (including ISO), to assist businesses and other organizations to improve their environmental responsibility credentials (Romito & Vurro, 2021).

For example, the EU's non-financial reporting directive (NFRD) law requires that large undertakings including corporations, listed businesses and government entities, among others, to disclose information on the way they operate and manage social and environmental challenges (Camilleri, 2015a). This helps investors, civil society organizations, consumers, policy makers and other stakeholders to be in a better position to evaluate the companies' non-financial performance (EU, 2014).

Recently, EU (2021) put forward its proposal for a Corporate Sustainability Reporting Directive (CSRD), which shall amend the existing reporting requirements of the EU's NFRD. In sum, this proposal extends the audit requirement to large entities including government agencies, listed businesses, financial organizations like banks and insurance companies, among others, in regulated markets (except listed micro-enterprises). They will be expected to introduce more detailed reporting requirements, according to mandatory EU sustainability reporting standards. At the time of writing this paper, it is envisaged that the first set of standards could be adopted by October 2022 (EU, 2021).

Regulatory principles and guidelines can help practitioners to identify, manage, monitor and control corporate environmental issues in a "holistic" manner (Melnik et al., 2003). Such instruments and substantive systems are meant to support organizations in their waste management, and in reducing pollution, while simultaneously improving their environmental and financial performance (Camilleri, 2021a; Rivera-Arrubla, Zorio-Grima & García-Benau, 2017).

For example, ISO 14000 family of standards as well as the European Union's Eco-Management and Audit Scheme (EMAS) cover different aspects that promote greener environmental management performance. EMAS raises awareness on sustainable energy generation capacities through renewable sources, regular assessments on the co-generation of heating facilities, periodic material disclosures and monitoring on energy efficiencies, et cetera. Moreover, ISO

standards are purposely devised to address perennial issues including greenhouse gas emissions, water and air pollution prevention, among others.

2.1 ISO family of standards

ISO 14000 family of environmental management standards (EMSs) are developed by the International Standards Organization's Technical Committee ISO/TC 207 and its various subcommittees. They comprise principles and guidelines to help organizations to: (i) minimize their impact on the environment, (ii) comply with relevant legislation and regulations, and (c) to foster continuous operational improvements in their environmental management practices. ISO 14001 - Environmental management systems - Requirements with guidance for use (October 2015) is a voluntary, certifiable standard that specifies the requirements for an effective environmental management system.

This standard encourages practitioners toward achieving continuous improvements in their organizational approaches to minimize their impact on the environment (Klassen & Vachon, 2003; Kitazawa & Sarkis, 2000). It recommends that environmental management issues ought to be embedded within the organizations' strategic planning processes (Delmas, 2001, Eltayeb, Zailani & Ramayah, 2011). ISO 14001 specifies that leaders have to pledge their commitment to implement sustainable initiatives, to protect the environment and to mitigate climate change (Bravi, Santos, Pagano & Murmura, 2020; Chiarini, 2019). This standard raises awareness on the importance of promoting corporate environmentally responsible behaviors through different media and of forging relationships with different stakeholders. A number of other ISO standards are focused on specific aspects of the environment, including ISO 4226, ISO 6107 and ISO 10381, among others. Table 1 provides a non-exhaustive list of ISO's environmental standards.

Table 1. A list of ISO environmental standards

ISO 4226	Air Quality
ISO 6107	Water Quality
ISO 10381	Soil quality — Sampling
ISO 14001	Environmental management systems - Requirements with guidance for use
ISO 14002	Environmental management systems - Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area - Part 1: General
ISO 14004	Environmental management systems - General guidelines on implementation
ISO 14005	Environmental management systems - Guidelines for a flexible approach to phased implementation
ISO 14006	Environmental management systems - Guidelines for incorporating eco-design
ISO 14015	Environmental management - Environmental assessment of sites and organizations (EASO)
ISO 14020	Environmental labels and declarations - General principles
ISO 14021	Environmental labels and declarations: Self-declaration of environmental claims: guidelines, definitions and usage of terms
ISO 14024	Environmental labels and declarations - Type I Environmental labelling - Principles and procedures
ISO 14030	Environmental performance evaluation - Green debt instruments — Part 1: Process for green bonds
ISO 14031	Environmental management - Environmental performance evaluation - Guidelines
ISO 14040	Environmental management - Life cycle assessment – Principles and framework
ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines
ISO 14050	Environmental management – Vocabulary
ISO 14062	Environmental management - Integrating environmental aspects into product design and development
ISO 14063	Environmental management - Environmental communication - Guidelines and examples
ISO 14064	Greenhouse gases; measuring, quantifying, and reducing greenhouse gas emissions
ISO 14065	General principles and requirements for bodies validating and verifying environmental information
ISO 14067	Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification
ISO 14090	Adaptation to climate change — Principles, requirements and guidelines
ISO 15099	Thermal performance of windows, doors and shading devices
ISO 15270	Plastics — Guidelines for the recovery and recycling of plastics waste
ISO 17029	Conformity assessment
ISO 50001	Energy management system

3. Methodology

This research adopted PRISMA's robust protocol (Moher, Shamseer, Clarke, Gherzi, Liberati, Petticrew ... & Stewart, 2015) to systematically extract and scrutinize the content from academic sources that were indexed in Scopus. Hence, this review was carefully planned and documented in all stages, to ensure that its accountability, integrity, and transparency. The search query considered only those articles that were published in peer-reviewed journals. The contributions that were published in books, book series, conference proceedings and trade journals were excluded from this analysis - as they were not considered as rigorous as academic journals (Boiral et al., 2018).

Scopus featured a list of contributing authors and identified their articles' titles, publisher, subject areas and keywords. The researcher sorted the publications from highest to lowest number of citations. Figure 1 clarifies the methodology that was used to capture, analyze and synthesize the findings for this systematic review.

Figure 1: The PRISMA protocol that was used for this systematic review

The systematic review considered publications that featured “ISO 14001” in their title, abstract and keywords, as of January 2022. The search revealed that there were 2,273 contributions since 1995.

According to the systematic analysis (stage 1), there were 1,367 journal articles that were written in English. According to Scopus, the top 10 subject areas of these articles were related to Environmental Science (667); Business, Management and Accounting (661); Engineering

(436); Social Sciences (308); Energy (240); Economics, Econometrics and Finance (125); Medicine (83), Agriculture and Biological Sciences (63), and Materials Science (57).

The Journal of Cleaner Production has published 151 articles on this topic. It was followed by Business Strategy and the Environment (39); Environmental Quality Management (38); Sustainability Switzerland (28); Corporate Social Responsibility and Environmental Management (27); Corporate Environmental Strategy (22); Journal of Environmental Management (22); Greener Management International (19); Management of Environmental Quality: An International Journal (19), and Quality Progress (16).

Over time, the most used keywords included: ISO 14001 (505); Environmental Management (452); Environmental Management Systems (243); Sustainable Development (155); Standards (146); Environmental Protection (143); Environmental Management System (142); Environmental Impact (130), Certification (119) and Sustainability (109).

Table 2 presents a list of 35 most-cited articles on “ISO 14001” that accumulated more than 200 citations in Scopus (to date). It endorses the contributing authors, describes their methodological approaches, and features the keywords of their research.

Table 2. List of most-cited academic articles on ISO 14001

Scopus		Research			
Rank	Authors	Year	Source title	Type	Keywords
1	Melnyk, S.A., Sroufe, R.P., Calantone, R.	2003	Journal of Operations Management	Empirical	Decision analysis; Empirical research; Environmental management systems; ISO 14001; Regression; Survey.
2	Delmas, M.A., Toffel, M.W.	2008	Strategic Management Journal	Empirical	Environmental strategy; Institutional theory; ISO 14001; Stakeholder influence; Structural equation modeling; Voluntary environmental programs.
3	King, A.A., Lenox, M.J., Terlaak, A.	2005	Academy of Management Journal	Empirical	ISO 14001; Decentralized institutions; Certified management standards.
4	Hillary, R.	2004	Journal of Cleaner Production	Review	EMAS self-regulation; Enterprise ISO 14001; Environmental management system; EU; SME
5	Robèrt, K.-H., Schmidt-Bleek, B., Aloisi De Larderel, J., Basile, G., Jansen, J.L., Kuehr, R., Price Thomas, P., Suzuki, M., Hawken, P., Wackernagel, M.	2002	Journal of Cleaner Production	Review	Backcasting; Cleaner production (CP); Ecological footprinting; EMAS; EMS; ISO 14001; Life cycle assessment (LCA); Natural capitalism; Strategic planning; Sustainability; Sustainable development; Sustainable technological development (STD); System conditions; Systems thinking; The natural step (TNS); Upstream thinking; Zero emissions (ZE).
6	Eltayeb, T.K., Zailani, S., Ramayah, T.	2011	Resources, Conservation and Recycling	Empirical	Certified manufacturing companies; Green supply chain; Green supply chain outcomes; Malaysia.
7	Potoski, M., Prakash, A.	2005	American Journal of Political Science	Empirical	ISO 14001; Voluntary governance; Regulatory compliance.

8	Boiral, O.	2007	Organization Science	Case study	Environmental performances; ISO 14001; Organizational hypocrisy; Rational myths; Ritual integration; Social legitimacy.
9	Jacobs, B.W., Singhal, V.R., Subramanian, R.	2010	Journal of Operations Management	Empirical	Awards; Certifications; Environmental initiatives; Environmental performance; Market value; Stock market reaction.
10	Klassen, R.D., Vachon, S.	2003	Production and Operations Management	Empirical	Environmental management; ISO 14001; Pollution control; Pollution prevention; Supply chain management.
11	Delmas, M.A.	2002	Policy Sciences	Review	Environmental management; Industrial regulation; Institutional framework; Standard; Waste management.
12	Morrow, D., Rondinelli, D.	2002	European Management Journal	Case study	EMAS; EMS; Energy; Environment; Environmental management; Gas; ISO 14001.
13	Rennings, K., Ziegler, A., Ankele, K., Hoffmann, E.	2006	Ecological Economics	Empirical	Economic performance; Environmental innovations; Environmental management systems; Sustainability.
14	Orsato, R.J.	2006	California Management Review	Discursive	Competitive advantage; Competitive environmental strategies; Eco efficiency; Beyond compliance leadership; Eco-branding; Environmental cost leadership.
15	Bansal, P., Hunter, T.	2003	Journal of Business Ethics	Empirical	Early adoption; ISO 14001; Strategic realignment; Strategic reinforcement.
16	Potoski, M., Prakash, A.	2005	Journal of Policy Analysis and Management	Empirical	Environmental performance; ISO 14001; Third party audits.
17	Prakash, A., Potoski, M.	2006	American Journal of Political Science	Empirical	Environmental governance; ISO 14001; Environmental regulations.

18	Tsai, W.-H., Chou, W.-C.	2009	Expert Systems with Applications	Empirical	Analytic network process (ANP); Decision Making Trial and Evaluation Laboratory (DEMATEL); Management system; Sustainable development; Zero-one goal programming (ZOGP).
19	Rondinelli, D., Vastag, G.	2000	European Management Journal	Case study	Certification; Environmental Management; ISO 14001; Quality Management.
20	Heras-Saizarbitoria, I., Boiral, O.	2013	International Journal of Management Reviews	Review	ISO 14001; ISO 9001; Management system standards; Meta-standards; Global governance.
21	Ljungberg, L.Y.	2007	Materials and Design	Review	Design; Ecology; Environmental impact; Materials selection; Recycling; Sustainable product development.
22	Robèrt, K.-H.	2000	Journal of Cleaner Production	Review	Sustainable development; Sustainability; Systems thinking; Backcasting; Strategies; Strategic planning; Ecological footprinting; ISO 14001; EMAS; EMS; System conditions; The Natural Step (TNS).
23	Jiang, R.J., Bansal, P.	2003	Journal of Management Studies	Empirical (qualitative)	Environmental management systems; ISO 14001; Paper industry.
24	Delmas, M.	2001	Production and Operations Management	Empirical	Competitive advantage; Natural environment; Organizational capability; Resource-based view; Stakeholders; Structural equation modeling.
25	Govindan, K., Khodaverdi, R., Vafadarnikjoo, A.	2015	Expert Systems with Applications	Case study	DEMATEL; Green performances; Green practices; Green supply chain management (GSCM); Intuitionistic fuzzy set (IFS).

26	Kitazawa, S., Sarkis, J.	2000	International Journal of Operations and Production Management	Case study	Environmental management systems; International standards; Organizational centre; TQM.
27	Jørgensen, T.H., Remmen, A., Mellado, M.D.	2006	Journal of Cleaner Production	Review	Compatibility; Coordinated generic processes; Integrated management systems; Integration; ISO 14001; ISO 9001; Management system; OHSAS 18001; SA 8000.
28	Bansal, P.	2002	Academy of Management Executive	Empirical (qualitative)	ISO 14001; Sustainable development; International environment systems; In-house environmental systems.
29	Chan, E.S.W., Wong, S.C.K.	2006	Tourism Management	Empirical	Discriminant analysis; EMS; Hotel industry; ISO 14001; Predictive model.
30	Hsu, C.-C., Tan, K.C., Zailani, S.H.M., Jayaraman, V.	2013	International Journal of Operations and Production Management	Empirical	Design for environment; Emerging economy; Green purchasing; Green supply chain; Malaysia; Newly industrialised economies; Reverse logistics; Supply chain management; Sustainable development.
31	González, P., Sarkis, J., Adenso-Díaz, B.	2008	International Journal of Operations and Production Management	Empirical	Automotive industry; Environmental management; International standards; Spain; Supply chain management.
32	Zeng, S.X., Shi, J.J., Lou, G.X.	2007	Journal of Cleaner Production	Empirical	Environment; Health and safety; Integrated management system; ISO 14001; ISO 9001; OHSAS 18001; Quality; Synergy.
33	Nakamura, M., Takahashi, T., Vertinsky, I.	2001	Journal of Environmental Economics and Management	Empirical	Decision making; Environmental economics; Industrial regulation; Strategic approach.

34	Bansal, P., Bogner, W.C.	2002	Long Range Planning	Empirical	ISO 14001; Costs; Benefits; Environmental responsiveness; Institutions.
35	Laosirihongthong, T., Adebanjo, D., Choon Tan, K.	2013	Industrial Management & Data Systems	Empirical	Performance; Institutional theory; Green supply chain management.

Note: Sorted from highest to lowest number of citations.

Additional analyses through this systematic review revealed that several researchers discussed about the rationale for using ISO 14001. The findings reported that there were 404 documents results when the keywords “ISO 14001” AND “Benefits” were included in the search query. On the other hand, there were 328 document results when “ISO 14001” AND “Costs” were used (according to the results from the systematic review - stage 1).

Furthermore, the systematic analysis (stage 2) sheds light on the latest contributions that were published in the last 7 years, specifically between January 2015 and December 2021. ISO published its third edition of ISO 14001 in October of the same year. During this period, there were 497 articles that were published in English, in peer reviewed journals. The review indicated that the top 10 subject areas were related to Business, Management and Accounting (250); Environmental Science (244); Engineering (138); Social Sciences (127); Energy (117); Economics, Econometrics and Finance (55); Decision Sciences (50); Computer Science (28); Medicine (22) and Chemical Engineering (18).

Again, with 57 publications, the Journal of Cleaner Production was ranked as the top journal. Other outlets included Sustainability Switzerland (28); Business Strategy and the Environment (23); Quality Access to Success (12); Corporate Social Responsibility and Environmental Management (10); Environmental Engineering and Management Journal (9); Total Quality Management and Business Excellence (9); International Journal for Quality Research (8); TQM Journal (8); and Environmental Quality Management (7). Table 3 presents a list of 35 most-cited articles between January 2015 and December 2021. To date, these contributions accumulated more than 50 citations in Scopus.

Table 3. List of most-cited academic articles on ISO 14001 - between 2015 and 2021

Scopus Rank	Authors	Year	Source title	Research Type	Keywords
1*	Govindan, K., Khodaverdi, R., Vafadarnikjoo A.	2015	Expert Systems with Applications	Empirical	DEMATEL; Green performances; Green practices; Green supply chain management (GSCM); Intuitionistic fuzzy set (IFS).
2	Abdul-Rashid, S.H., Sakundarini, N., Raja Ghazilla, R.A., Thurasamy, R.	2017	International Journal of Operations and Production Management	Empirical	Economic performance; Environmental performance; Social performance; Structural equation modelling; Sustainability performance; Sustainable manufacturing practices.
3	Teixeira, A.A., Jabbour, C.J.C., De Sousa Jabbour, A.B.L., Latan, H., De Oliveira, J.H.C.	2016	Journal of Cleaner Production	Empirical	Brazil; Green human resource management; Green supply chain; Green training; Sustainable management; Sustainable operations.
4	Miroshnychenko, I., Barontini, R., Testa, F.	2017	Journal of Cleaner Production	Empirical	Financial performance; Green product; Green supply chain management; ISO 14001; Pollution prevention.
5	Testa, F., Boiral, O., Iraldo, F.	2018	Journal of Business Ethics	Empirical	Environmental management system; Environmental strategy; Greenwashing; Institutional complexity; Stakeholders.
6	Latan, H., Chiappetta Jabbour, C.J., Lopes de Sousa Jabbour, A.B., Wamba, S.F., Shahbaz, M.	2018	Journal of Cleaner Production	Empirical	Corporate environmental performance; Environmental management accounting; Environmental strategy; Perceived environmental uncertainty; Top Management's commitment.
7	Bernardo, M., Simon, A., Tarí, J.J., Molina-Azorín, J.F.	2015	Journal of Cleaner Production	Review	Benefits; Integrated management system; ISO 14001; ISO 9001; Literature review; Performance.

8	Boiral, O., Guillaumie, L., Heras-Saizarbitoria, I., Tayo Tene, C.V.	2018	International Journal of Management Reviews	Review	ISO14001 impacts; inclusion criteria; exclusion criteria; ISO14001 outcomes; ISO14001 adoption.
9	Jabbour, C.J.C.	2015	Journal of Cleaner Production	Empirical	Brazil; Environmental management; Environmental training; Green human resource management; ISO 14001; Sustainability.
10	Abu Seman, N.A., Govindan, K., Mardani, A., Zakuan, N., Mat Saman, M.Z., Hooker, R.E., Ozkul, S.	2019	Journal of Cleaner Production	Empirical	Environmental; Environmental performance; Green innovation; Green supply chain management (GSCM); Manufacturing industry.
11	Souza, J.P.E., Alves, J.M.	2018	Journal of Cleaner Production	Empirical	Corporate sustainability; ISO 14001; ISO 26000; ISO 9001; Lean manufacturing; OHSAS 18001.
12	Scur, G., Barbosa, M.E.	2017	Journal of Cleaner Production	Case Study	Electrical–electronic industry; Green practices; Green supply chain management; Home appliance.
13	Martín-de Castro, G., Amores-Salvadó, J., Navas-López, J.E.	2016	Corporate Social Responsibility and Environmental Management	Empirical	Environmental management systems; Environmental policy; Firm performance; Green corporate image; ISO 14001; Natural resource-based view; Stakeholder engagement.
14	Husted, B.W., Montiel, I., Christmann, P.	2016	Journal of International Business Studies	Empirical	Corporate social responsibility; Emerging markets/countries/economies; Geographic distance; Liability of foreignness; Location strategy.
15	Campos, L.M.S., De Melo Heizen, D.A., Verdinelli, M.A., Cauchick Miguel, P.A.	2015	Journal of Cleaner Production	Empirical	EMS; Environmental management system; Environmental performance indicators; ISO 14001; Survey research.
16	Nguyen, Q.A., Hens, L.	2015	Journal of Cleaner Production	Empirical	Cement; Environmental management systems; Environmental performance; ISO 14001; Vietnam.

17	Lee, V.-H., Ooi, K.-B., Chong, A.Y.-L., Lin, B.	2015	Production Planning and Control	Empirical	Competitive advantage; Environmental performance; Greening the supplier; Malaysia.
18	Zorpas, A.A.	2020	Science of the Total Environment	Review	Circular economy; European Green Deal; LCA; PESTEL analysis; Prevention strategy; Strategy development; SWOT analysis; Waste strategy; Zero waste approach.
19	Heras-Saizarbitoria, I., Arana, G., Boiral, O.	2016	Business Strategy and the Environment	Empirical	EMAS; environmental management; environmental management systems; ISO 14001; Spain.
20	Arimura, T.H., Darnall, N., Ganguli, R., Katayama, H.	2016	Journal of Environmental Management	Empirical	Certification program; Discrete choice model; Endogeneity; Environmental performance; ISO 14001, environmental management system; Voluntary environmental program.
21	Vijayvargy, L., Thakkar, J., Agarwal, G.	2017	Journal of Manufacturing Technology Management	Empirical	Emerging economies; Empirical study; Green supply chain management; Organizational size.
22	Oliveira, J.A., Oliveira, O.J., Ometto, A.R., Ferraudo, A.S., Salgado, M.H.	2016	Journal of Cleaner Production	Empirical	Cleaner production; Environmental management system; Industrial companies; ISO 14001.
23	Su, H.-C., Dhanorkar, S., Linderman, K.	2015	Journal of Operations Management	Empirical	Absorptive capacity; Competitive strategy; Early mover advantage; ISO 14001; ISO 9001; Management standards.
24	Ikram, M., Zhang, Q., Sroufe, R., Shah, S.Z.A.	2020	Sustainable Production and Consumption	Empirical	CO2; Emission; GRA; Grey TOPSIS; ISO 14001; Renewable energy; Sustainability.
25	Iatridis, K., Kesidou, E.	2018	Journal of Business Ethics	Empirical (qualitative)	Economic crisis; Environmental management; Greece; Internalization; ISO 14001; Motivations.
26	Nunhes, T.V., Ferreira Motta, L.C., de Oliveira, O.J.	2016	Journal of Cleaner Production	Review	Integrated management system; ISO 14001; ISO 9001; Management systems; OHSAS 18001.

27	Shaharudin, M.R., Govindan, K., Zailani, S., Tan, K.C., Iranmanesh, M.	2017	Journal of Cleaner Production	Empirical	Activities; Closed-loop supply chains; Effectiveness; Product returns; Reverse supply chains.
28	Singh, M., Brueckner, M., Padhy, P.K.	2015	Journal of Cleaner Production	Empirical	Environmental management systems; Environmental performance; ISO 140001; Policies; Small and medium-sized enterprises; Waste minimisation.
29	Ikram, M., Mahmoudi, A., Shah, S.Z.A., Mohsin, M.	2019	Environmental Science and Pollution Research	Empirical	Competitive advantage; Doubling time; Environmental sustainability; Forecasting; ISO 14001; Relative growth rate
30	da Fonseca, L.M.C.M.	2015	Journal of Industrial Engineering and Management	Review	Environmental management systems; ISO 14001 revision; Standardization; Sustainability.
31	Jabbour, C.J.C, Seuring, S., Lopes de Sousa Jabbour, A.B., (...), Latan, H., Izeppi, W.C.	2020	Journal of Environmental Management	Empirical	Circular economy; Stakeholders; Sustainable business models; Sustainable innovation; Sustainable performance.
32	Ahmed, W., Najmi, A.	2018	Management of Environmental Quality: An International Journal	Empirical	External green collaboration; Green supply chain management; Institutional pressures; Internal green practices; Structural equation modelling.
33	Hojnik, J., Ruzzier, M., Manolova, T.S.	2018	Journal of Cleaner Production	Empirical	Eco-innovation; Firm performance; Internationalization; ISO14001; Mediating effect; Sustainability.
34	Xu, X.D., Zeng, S.X., Zou, H.L., Shi, J.J.	2016	Business Strategy and the Environment	Empirical	Environmental violation events; Event study; Media coverage; Shareholders' wealth.

35	Salim, H.K., Padfield, R., Hansen, S.B., (...), Tham, M.H., Papargyropoulou, E.	2018	Journal of Cleaner Production	Review	Bibliometric analysis; Environmental management system; ISO 14001; Multi-stakeholder framework; Thematic trends.

Note: Sorted from highest to lowest number of citations.

*Govindan et al. (2015) was also reported in Table 2

In the past seven years, the most used keywords included: ISO 14001 (224); Environmental Management (150); Environmental Management Systems (98); Sustainable Development (66); Sustainability (64); Environmental Management System (59); Environmental Performance (57); Certification (51); ISO 9001 (42) and EMAS (28).

This extended list indicated that there were much fewer contributions whose keywords were focused on society's contentious sustainability issues including climate change (9), pollution (7), carbon footprint (6) and greenhouse gas emissions (5), among other topics.

Furthermore, the search results (between 2015-2021) indicated that there were 95 documents results when the keywords "ISO "14001" AND "Benefits", and just 56 documents were retrieved when "ISO 14001" AND "Costs" were inserted in the query.

4. A benefit-cost analysis of ISO 14001

4.1 Benefits

The findings revealed that practitioners developed, implemented, managed, coordinated and monitored their environmental activities to improve their competitive position/competitive advantage (Ikram et al., 2019; Hojnik et al., 2018; Oliveira et al., 2016;) and profitability (Delmas, 2002). Standards like ISO 14001 are meant to support organizations in the development of environmental objectives, delegation of responsibilities, the provision of training and development, as well as in formulating performance management audits (Santos, Rebelo, Lopes, Alves & Silva, 2016; Bernardo et al., 2015; Da Fonseca, 2015; Delmas, 2002; Hojnik et al., 2018; Hsu et al., 2013; Nunhes et al., 2016; Oliveira et al., 2016; Su et al., 2015). ISO has created a system whereby third-party auditors can certify the organizations' conformity with relevant environmental standards. Practitioners can use ISO 14001 as a framework to evaluate

their environmental practices and externalities. They can compare them across various industries and jurisdictions (Boiral et al., 2018).

4.1.1 ISO 14001 raises awareness on compliance requirements with relevant legislation

ISO 14001 can help organizations to embed environmental management issues in their corporate strategies and in their day-to-day operations. Businesses can use its substantive environment management systems to adopt beyond-compliance measures. They could even anticipate their jurisdiction's regulatory requirements (Boiral et al., 2018; Husted et al., 2016) (to confirm that they are reducing their pollution levels for the purpose of avoiding sanctions). They may follow ISO 14001 guidelines to better identify certain aspects of their organization's activities to determine their significance, priorities and impact on the environment.

4.1.2 ISO 14001 can facilitate planning, organization, leadership and control of environmental management systems

Practitioners can establish a program to implement environment management policies (with a disciplined process of evaluating and achieving target performance levels) while seeking continuous improvements (Camilleri, 2019b, Delmas, 2001; Santos, et al., 2016; Sharudin et al., 2017; Vijayvargy et al., 2017). They are bound to increase the involvement of their managers and have to delegate employees with a clear assignment of duties, to pursue responsible environmental behaviors. Organizational leaders should allocate relevant resources and foster facilitating conditions to implement ISO 14001, including the provision of ongoing training and development to employees, to achieve the standards' underlying objectives, including increasing operational efficiencies and cost savings (Camilleri, 2021b). They are expected to regularly review and audit their environment management systems and to identify opportunities for improvement, in terms of environmental performance.

4.1.3 ISO 14001 can be used to monitor and reduce externalities including pollution and emissions

The standard's certification ought to confirm that practitioners are implementing responsible practices to improve their facilities' environmental performance, by reducing their pollution emissions (Garrido, González & Orcos, 2020; Ikram et al., 2020; Oliveira et al., 2016; Potoski & Prakash, 2005a, 2005b, Prakash & Potoski, 2006). ISO 14001 clearly identifies the operational requirements that have to be taken on board by companies to minimize their environmental impact, by reducing pollution and emissions (Su et al., 2015).

4.1.4 ISO 14001 can be used to establish and maintain ongoing communications with stakeholders

Practitioners are expected to utilize ISO 14001 to raise awareness about their environment management systems with interested parties. Their corporate communications can help them alleviate their constituents' concerns about environmental performance. Like other standards, the development of ISO 14001 facilitates exchanges and communications among a wide array of stakeholders (Da Fonseca, 2015; Nunhes et al., 2016; Salim et al., 2018; Su et al., 2015).

4.1.5 ISO 14001 can be used to increase the legitimacy of practitioners in society

The adoption of environmental management practices can improve corporate reputation and may enhance the practitioners' transparency credentials with stakeholders (Da Fonseca, 2015; Oliveira et al., 2016; Su, et al., 2015). Firms can manage their legitimacy by conveying (material) information regarding operational improvements in their processes and by clearly demonstrating their ongoing commitment to the environment (Camilleri, 2021b; Mtapuri, Camilleri & Dłużewska, 2021; Santos et al., 2016).

4.1.6 ISO 14001 can create shared value to corporate financial performance and to the environment

Previous research indicated that stakeholders recognized (and awarded) practitioners for their environmental performance credentials. Very often, responsible corporate environmental practices led to a positive financial performance (Martín-de Castro et al., 2017) and to a significant increase in the companies' stock market values (Shaharudin et al., 2017; Su et al., 2018). Eco-efficient companies are increasingly rewarding their shareholders with a greater return on investment (Melnik et al., 2003). Notwithstanding, investing firms are recommending positive impact, financial portfolios that are based on the firms' environmental records (Camilleri, 2021c; Su et al., 2018).

Green supply chain initiatives have a direct impact on the firms' performance outcomes as well as on their external environment (Miroshnychenko et al., 2017; Vijayvargy et al., 2017). Businesses can safeguard the natural environment by reducing the utilization of raw materials, by minimizing waste from manufacturing processes, and by reusing "waste" resources when designing products (Camilleri, 2019a, 2020, Scur & Barbosa, 2017; Delmas, 2002; Shaharudin, et al., 2017; Souza & Alves, 2018; Vijayvargy et al., 2017). Such responsible behaviors can also translate to economic benefits, operational efficiencies and less costs for the producers of goods (Curkovic & Sroufe, 2011; Govindan et al., 2015; Iatridis & Kesidou, 2018; Laosirihongthong et al., 2013; Scur et al., 2017; Souza & Alves, 2018; Teixeira et al., 2016). Previous research confirmed that the businesses' credentials in corporate environmental performance can improve the value of their firm (Kong et al., 2015) and could be in a better position to attract new shareholders (Angelia & Suryaningsih, 2015; Heras-Saizarbitoria et al., 2016).

4.2 *Costs*

4.2.1 ISO 14001 requires significant investments in time and money

Prospective practitioners ought to consider the opportunity costs before implementing ISO 14001. They have to ascertain whether it would be profitable for their company to invest resources, in terms of time and money, before committing themselves to certify their facilities (Delmas & Toffel, 2008). Failure to comply can result in fines (in some jurisdictions) for not meeting the environmental standards' criteria, as well as in increased interventions from the part of regulators (Melnik et al., 2003). The certification of ISO 14001 would necessitate that organizations pay an initiation fee as well as ongoing membership dues. They are expected to adhere to the requirements of the substantive standard and for annual recertification audits (Potoski & Prakash, 2005).

4.2.2 Lack of information on the difference between certified and uncertified ISO 14001

Little is known about how outsiders interpret the certification of voluntary standards (Arimura et al., 2016; Camilleri, 2019b; Husted et al., 2016). Although ISO 14001 maps out an assurance mechanism for effective environment management systems; it does not clarify the exact requirements (in detail) on how to obtain its certification. ISO clearly specifies that this generic standard can be used by any organization (in any industry) that wants to improve its resource efficiency and cost savings, minimize waste, emissions and pollution to the environment (Eltayeb et al., 2011; Hsu et al., 2013; Melnik et al., 2003; Morrow & Rondinelli, 2002; Nunhes et al., 2016; Shaharudin, et al., 2017).

ISO 14001 does not constrain the operations of practitioners although they may be pressurized by institutions and by other stakeholders to adopt certified management standards. Therefore, businesses are encouraged to certify their premises to conform to acceptable

environmental practices. Such certification would enable them to prove their social license to operate (Demuijnck & Fasterling, 2016; Hsu et al., 2013; Soewarno et al., 2019; Wilburn & Wilburn, 2011).

4.2.3 Stakeholders exert their pressures on corporate businesses and organizations to adopt environmental management practices

Organizations may be intrigued to adopt ISO 14001 to appease different stakeholders including governments, activists, local communities, trade associations, investors, and customers, each of which possess their own culture, interests and conception of legitimate environmental management practices (Ahmed & Najmi, 2018; Bansal & Bogner, 2002; Colwell & Joshi, 2013; Delmas & Toffel, 2008). Previous research indicated that many companies participate in such environment management programs to forge closer relationships with the government and its agencies (Clemens & Douglas, 2005; Delmas, 2002; Jabbour et al., 2020; Morrow & Rondinelli, 2002).

Practitioners may experience institutional pressures during periods of uncertainty, before formalizing their organizations' environmental practices in corporate social responsibility reports (or when they are preparing their integrated disclosures of financial and non-financial performance) that they may have to submit to regulatory authorities (Ntim & Soobaroyen, 2013; Testa et al., 2018).

4.2.4 ISO 14001 necessitates continuous commitment from the part of management and employees

Organizational leaders are expected to communicate with management and employees about their environmental management compliance objectives and strategies (Testa et al., 2018; Santos et al., 2016; Zorpas, 2020). They have to clarify their courses of action before applying

for ISO 14001 certification, whilst they are implementing it, and when they are measuring and controlling its effectiveness (Latan et al., 2018). Hence, they should organize training and development opportunities for their members of staff, to instill their motivation to pursue cultural changes, and to foster continuous improvements in environmentally responsible behaviors (Boiral, 2007; Colwell & Joshi, 2013; Heras-Saizarbitoria & Boiral, 2013; Jabbour, 2015). Employees ought to be incentivized to contribute to the achievement of their organizations' environmental performance targets (Abdul-Rashid et al., 2017; Agan et al., 2016; Darnall, 2006; Jacobs et al., 2010; Ljungberg, 2007; Potoski & Prakash, 2005; Rennings et al., 2006; Russo, 2009; Testa et al., 2014; Zailani et al., 2012).

4.2.5 Lack of consensus on the actual effectiveness of ISO 14001

Various academic commentators clearly pointed out that there are different shades of opinion on the effectiveness of ISO 14001 (Boiral et al., 2018; Iatridis & Kesidou, 2018; Testa, et al., 2018; Zorpas, 2020). This environment management standard comprises a set of principles and guidelines that may be perceived as a 'rational myth' that spurs the organizations' 'ceremonial behaviors' (Nunhes et al., 2016). Many researchers argued that although ISO 14001 provides a certification from an independent body about the existence of an environmental management system, this voluntary instrument does not necessarily translate to superior performance (Arimura, Darnall & Katayama, 2011; Boiral et al., 2018; Prakash & Potoski, 2006). Under these circumstances, ISO's norms may not always play a significant role in promoting environmentally responsible behaviors, unless businesses are compelled by regulatory authorities to adopt ISO 14001's standardized practices and to report about their performance in corporate non-financial disclosures (Camilleri, 2015b; EU 2021).

5. Conclusions and implications

This research reported that ISO 14001's environment management systems can be employed by small, medium or large businesses operating in various industry sectors, in different contexts. A thorough literature review revealed that the adoption of ISO 14001 may be triggered by institutions and stakeholders. The governments and their regulatory authorities can exert their pressures on organizations to follow their rules, norms and ethical principles.

The practitioners' compliance with legislation, regulatory guidelines and principles can increase their legitimacy among stakeholders and could validate their social license to operate. Hence, there is scope for businesses and other organizations to be proactive by anticipating legislation. This way, they can achieve a competitive advantage by proving their environmental credentials with stakeholders.

The systematic review suggested that compliance with ISO 14001 may result in a number of benefits to practitioners like improving their facilities' environmental performance through resource efficiencies. At the same time, they could minimize their externalities to the environment. This research confirmed that such certifiable standards, can create synergistic value to the businesses' financial performance and to the environment. It reported that green supply chain initiatives as well as a better utilization of resources and waste management practices may translate to lower costs and to an improved financial performance.

In many cases, several authors clarified that practitioners could enhance their environmental management through waste reduction, circular economy approaches, increased productivities (cost savings, improved systemization practices and management control, improved employee results, reduction in mistakes and rework, shorter lead times) and the like. Other research reported that the practitioners' environmental credentials resulted in an improved corporate image among external stakeholders including customers, suppliers and regulatory authorities.

Notwithstanding, this contribution suggested that it is in the interest of practitioners to communicate about their adoption of prescriptive environmental management systems and to shed light on their environmental performance. Their corporate environmental disclosures can boost their reputation, increase their trustworthiness and credibility among stakeholders, particularly if they promote their environmentally responsible behaviors through different media whilst forging relationships with different stakeholders.

On the other hand, various researchers noted that the main obstacles to ISO 14001 certification are related to high certification costs, superficial adoption, an increase in paperwork and red tape, time constraints, as well as the employees' resistance to change, and/or their lack of capabilities to comply with the standard's requirements, among other contentious issues. Very often, they argued that the implementation of ISO 14001 would necessitate an ongoing support and commitment from the part of managers as well as the involvement of employees, to integrate the standard's environment management systems with existing practices.

Organizational leaders who are considering the introduction of such environment systems are expected to communicate about their strategic plans with their management and members of staff. They have to motivate and incentivize each employee to achieve their corporate objectives and environmental performance targets.

Limitations and future research directions

Previous studies examined the stakeholders' perceptions about different aspects of ISO 14001, including on the implementation of ISO 14001, internal management support, integrated management systems, supply chain management, et cetera. Very often, their data was collected from employees and managers of certified entities.

This systematic review appraises previous articles that were focused on environment management systems. It reported some of the most cited papers since 1995, where it identified the

authors, the publication outlets and the type of methodology that was used to capture the data. In addition, it indicated the keywords that were related to the articles' topics. Furthermore, this contribution provided a synthesis of the findings as it clarified the benefits and costs of using ISO 14001's environment management systems.

This contribution implies that for the time being, just a few contributions explored how, where and when organizations were using ISO14001 to address the latest global challenges including the effects of waste and pollution on climate change. For example, the systematic analyses revealed that few articles sought to explore how ISO 14001 could be used to minimize the carbon footprint and/or greenhouse gas emissions.

This paper calls for further empirical studies that rely on quantitative and/or qualitative approaches as well as discursive and/or theoretical papers on environment management systems and their related topics. Prospective research can utilize different research methods, sampling frames and analytical techniques to investigate the impacts of certified organizations and the efficacy of their performance indicators in different contexts. There is scope to shed more light on the companies' environmental credentials, particularly those operating in growing economies like China. A recent ISO survey indicated that China represented 48.25% (almost half) of the total ISO 14001 certifications that were issued in 2020 (ISO, 2021). Perhaps, longitudinal studies may be used to provide a better understanding of the long-term effects of ISO 14001 on the organizations' economic and operational performance in different industry sectors.

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