

Adoption and outcomes of ISO 14001: A systematic review

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Abstract

The objective of this paper is to analyze the adoption and outcomes of the ISO 14001 standard through a systematic review of the main studies on this issue published in peer reviewed journals between 1996 and 2015. The 94 papers analyzed make it possible to paint a comprehensive picture of the effectiveness of ISO 14001 in environmental management practices, performance in this area, and social aspects such as employee awareness. The systematic review also sheds more light on the main pitfalls and success factors of the standard. Nevertheless, the similarities and even redundancies of the literature in terms of objectives, approaches and methods used tend to produce quite predictable and optimistic results which do not reflect the complexity of the impact of ISO 14001. The paper highlights the importance of more diverse and critical approaches that might challenge the successful rhetoric of the dominant literature which tends to focus on positive aspects and be limited to a few countries that are not representative of the wide international distribution of certification. The findings of this systematic review can also help managers in making decisions on the adoption and renewal of certification.

Key words: ISO 14001, adoption, implementation, outcomes, impacts, environmental performance, systematic review.

Introduction

Certified in more than 300,000 organisations worldwide (ISO, 2014), the ISO 14001 standard has become the main reference in the field of corporate environmental management. Nevertheless, approximately 20 years after its initiation, and despite its popularity, the impact of the standard is still widely debated by academics and managers alike (Boiral and Henri, 2012; Heras-Saizarbitoria et al., 2011a; Heras-Saizarbitoria and Boiral, 2013). Although the impact of ISO 14001 has been the object of many empirical studies, the proliferation of these studies, often with contradictory findings, does not necessarily lead to a better understanding of the subject.

First, the studies of the adoption and outcomes of ISO 14001 are based on a large variety of dependent variables, such as improvement of corporate image, competitiveness, waste reduction,

or employee commitment. There is no real consensus on the way to measure environmental performance which can be based on very different and non-comparable indicators (Nawrocka and Parker, 2009; Boiral and Henri, 2012). From this perspective, the analysis of ISO 14001 impacts can lead to different results depending on the criteria and variables used. Second, ISO 14001 can be adopted in various organizations and sectors of activity around the world, and studies are conducted in heterogeneous contexts in terms of sector of activity, organizational size and region. Third, the adoption process of the standard is also far from monolithic and can lead to heterogeneous outcomes not related to the standard itself, but dependent on organizational and managerial aspects (Heras-Saizarbitoria et al., 2011a; Yin and Schmeidler, 2009; Boiral, 2007; Christmann and Taylor, 2006). Fourth, many studies on this issue are implemented for different purposes and are not necessarily based on clear or reliable methods. As a result, a review of the literature on the impact of ISO 14001 may be biased by the focus on specific surveys which are not necessarily reliable or representative of the most significant studies in this area.

Systematic review, which “attempts to minimize bias using systematic and explicit methods to identify, select, critically appraise and summarize relevant research” (Needleman, 2002, p. 6), can help to reduce those biases and develop a comprehensive view of the main findings presented in the literature. Prevalent in the field of medical sciences, systematic review is increasingly used in management (Becheikh et al., 2006; Pettigrew and Roberts, 2008). Taking into account this gap in the literature, the objective of this paper is to analyze the adoption and outcomes of the ISO 14001 through a systematic review of the empirical literature. More specifically, the impact of the adoption of ISO 14001, the problems associated with the adoption of ISO 14001, and the contingent factors that may influence the successful adoption of the standard are analyzed.

This study makes three main contributions to the literature. First, it assesses the adoption and outcomes of ISO 14001 based on the systematic analysis of a large number of empirical studies rather than on a narrative review of the literature or the conduct of a single study. Second, the study provides an overview of the trends and limits of the existing literature. Third, it provides accurate and relevant information on ISO 14001 impacts for managers and academics so that they do not need to refer to a large body of empirical research.

Generally speaking, this systematic review fills a gap in the scholarly literature. Although several empirical articles (e.g. Heras-Saizarbitoria et al., 2011a; Zobel, 2013, 2016) have included a quite detailed analysis of previous studies on ISO 14001, they mostly focus on specific subthemes and do not use a systematic methodology to identify, select and evaluate the results of previous studies. Although two referenced publications have reviewed empirical studies on ISO 14001 (Nawrocka and Parker, 2009; Heras-Saizarbitoria and Boiral, 2013), they have had a very different focus and has not been based on an extensive systematic review of the literature. Nawrocka and Parker (2009) carried out a meta-study based on 23 papers and analyzed the impact of environmental management systems (EMS) to improve environmental performance; then, the scope of the review was more limited. Furthermore, the reviewed articles — a limited sample of papers published between 1996 and 2008 — were not specifically focused on ISO 14001 and, contrary to the approach of a systematic review, the inclusion and exclusion criteria for filtering the collected papers were not clarified. The more recent work by Heras-Saizarbitoria and Boiral (2013) analyzed the main conclusions and substantial advances made in the general research field of meta-standards, where ISO 9001 is more prominent. The scope of this paper also differs because this work carried out an integrative literature review of both theoretical and

empirical works aimed at establishing a research agenda for the field of study of meta-standards. Although, this paper illuminates the main themes, trends and knowledge gaps to be addressed in the literature on ISO 9001 and ISO 14001, it was not aimed to analyse the adoption and outcomes of the later.

The rest of the paper is organized as follows. First, the controversies around ISO 14001 impacts and the relevance of a systematic review are presented. Second, the methodological framework, including research questions, selection procedures and review protocol is described presented. Finally, the mapping of the relevant literature, its main findings on the impact of ISO 14001, and pitfalls and contingent factors affecting the adoption of the standard are analyzed.

The scattered literature on ISO 14001 impacts

The outcomes of the standard: is further empirical research really needed?

Developed by the International Organization for Standardization to encourage the implementation and external recognition of a certifiable environmental management system (EMS), the ISO 14001 standard is generally presented by its promoters (ISO, 2014), the practitioner literature (Cascio, 1996; Whitelaw, 2004) and by the mainstream scholarly literature (e.g. Link and Naveh, 2006; Morrow and Rondinelli, 2002; Testa et al., 2013; Poksinska et al., 2003) as an effective tool to improve environmental practices and organizational effectiveness.

The growth of the number of certified organisations worldwide, increasing at an average rate of about 10% per year (ISO, 2014), seems to confirm the popularity of ISO 14001. Several scholarly studies have described the positive impact of the standard on various aspects such as corporate image (Sambasivan and Fei, 2008; Poksinska et al., 2003; Strachan et al., 2003), regulatory compliance (Potoski and Prakash, 2005; Morrow and Rondinelli, 2002) and waste minimization (Psomas et al., 2011). Other studies have questioned the positive impacts of the standard on environmental performance (Prajogo et al., 2012; King et al., 2005; Zobel, 2013; Boiral and Henri, 2012), claiming that the adoption of ISO 14001 does not lead to significant improvements. Generally speaking, various studies have shown that the growth of management practices and standards such as ISO 14001 can be driven by various institutional pressures and is not indicative of their real effectiveness (e.g. Røvik, 2011; Aravind and Christmann, 2011; Boiral, 2011; Castka and Prajogo, 2013). Moreover, a number of studies have shown that ISO 14001 certification could even have perverse effects by increasing bureaucracy and costs or by threatening corporate profitability (Turk, 2009; Paulraj and de Jong, 2011; Cañón-de-Francia and Garcés-Ayerbe, 2009; Boiral, 2007, 2011). Finally, the critical literature has highlighted the lack of internalization of the standard and a failure to connect to daily activities of many certified organizations (Heras-Saizarbitoria et al., 2011a; Yin and Schmeidler, 2009; Boiral, 2007).

These disagreements in the literature could, on their own, justify further empirical research on the impact of ISO 14001. Nevertheless, the addition of new empirical studies on this issue could simply add more confusion for various reasons. In the absence of standardized and commonly used indicators to measure ISO 14001 impact, new studies in this area would add more contingent and non-comparable results based on specific dependent variables. Moreover, the diversity of organizations, sectors and areas in which ISO 14001 has developed increase the high

context-dependency of its impact and make it more difficult to take a step back to view its the overall effectiveness. Numerous studies on the effectiveness of ISO 14001 have already been conducted and, in the absence of a comprehensive vision of the results and context of those studies, the development of more empirical studies on the subject is not likely to improve our understanding of the outcomes. Furthermore, as highlighted by the literature on information overload, an abundance of studies and data on a specific issue does not necessarily enhance the readability, relevance and usefulness of the available information (Edmunds and Morris, 2000; O'Reilly, 1980). It might even have perverse effects by increasing the confusion related to the accumulation of contingent, non-conclusive and conflicting information related to context-dependent and non-generalizable studies.

Most studies on the impact of ISO 14001 draw on a non-replicable traditional or narrative literature review in which the sources mentioned have not been selected and analyzed according to systematic criteria. Considering the large body of empirical research on the impact of ISO 14001 from the professional and academic literature alike, the limited and arbitrary selection of references can lead to biased and non-representative selection of previous studies. Generally speaking, narrative literature reviews are poorly suited to the analysis of the main findings and limitations of current research (Tranfield et al., 2003; Becheikh et al., 2006). From this perspective, the design and findings of new empirical studies may only connect tangentially with the existing body of literature.

The conduct of a systematic review on the impact of ISO 14001 can help to address those limitations and suggest new avenues of research.

Relevance of a systematic review of ISO 14001

A systematic review can be defined as “a specific methodology that locates existing studies, selects and evaluates contributions, analyses and synthesizes data, and reports the evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known” (Denyer and Tranfield, 2009, p. 671). Unlike narrative approaches, systematic reviews are based on replicable methods and minimize bias related to the identification, selection and analysis of studies (Needleman, 2002). Although they are increasingly used in social sciences, systematic reviews remain relatively infrequent in the management disciplines, as most papers in management are based on narrative literature review, including those related to environmental issues.

A systematic review of the adoption and impact of ISO is justified for at least three main and complementary reasons. First, the main findings of the increasing academic and professional literature on this issue have not been systematically analyzed. Such analysis would make it possible to understand the outcomes of the standard better, detail the proportion of studies that found a positive impact on different aspects, and the possible drawbacks, by providing a comprehensive overview that cannot be produced by a single study. Second, a systematic review of the literature on the impact of ISO 14001 would provide a synthesis of numerous papers for managers and researchers who rarely have the time to identify and read the full scope of research in this area systematically. Third, systematic review helps to identify the most relevant papers in connection with the specific subject under study. Considering the large amount of research on ISO 14001 based on various methods and objectives, this selection is almost impossible in the

absence of specific inclusion and exclusion criteria. Similar remarks apply to the analysis of results of those multiple studies, which needs to be based on specific criteria and a clearly defined categorization grid.

Method

The specificity of the ISO 14001 standard and multiplicity of studies on its adoption and impact are well-suited to systematic review, which “provide(s) information about the effects of some phenomenon across a wide range of settings and empirical methods” (Kitchenham, 2004, p. 2). Systematic reviews are generally based on three main steps (Oliver et al., 2005; Tranfield et al., 2003; Macpherson and Holt 2007):

- Setting the research question and review protocol;
- Searching for relevant studies using inclusion and exclusion criteria;
- Data extraction and analysis.

Review protocol

The research followed the approach used in most systematic reviews (e.g. Legros et al., 2013; Pullin and Stewart, 2006). This research was limited to empirical studies published in journals with a peer review system between 1996 and 2015. 1996 was chosen because it was the year in which ISO 14001 was launched. With the focus on the period 1996-2015 two decades were covered by the review. Only articles written in English were considered because of the dominance of this language in the literature. To search for articles, the term "ISO 14001" was included together with keywords such as: certification, adoption, outcomes, impact, performance, barriers, drawbacks, success factors. The references of each article were exported to EndNote software to facilitate inventory management and referrals. The search for articles was carried out by two researchers. One of the researchers used three electronic databases commonly used in the field of management and covering most of the peer-reviewed journals in this field: Science Direct, ABI / INFORM and ProQuest Business Source Premier (EBSCO). The other researcher conducted the same search for relevant articles through Google Scholar. Relevant references included in the articles identified were also considered by the two researchers. Although the use of those two complementary search processes led to similar results, the use of two procedures reduced the risk that papers would be overlooked accidentally.

Searching for relevant studies using inclusion and exclusion criteria

The selection of papers is an essential aspect of systematic review and helps to exclude biased or irrelevant studies. According to Pettigrew (2008), this selection is based on two steps: practical and the methodological screening. Those two steps have been independently carried out by two researchers who compared and discussed their results at the end of the selection process. Practical screening applies the criteria for inclusion and exclusion of items in order to focus on those that fit with the objectives of the search, namely the assessment of the adoption and outcomes of ISO 14001 (see Table 1). The practical screening was not only focused on the measurable benefits of ISO 14001 but also included the studies covering the contingent factors influencing the

successful adoption of the standard and the problems associated with its adoption (see Table 1). This inclusion made it possible to provide a more comprehensive and less biased image of the adoption and impact of ISO 14001, which cannot be reduced to its observable benefits. In line with the objectives of the systematic review, theoretical articles and those that did not clearly deal with the adoption of ISO 14001 were excluded. Similarly, given the many studies on ISO 14001 published in the professional literature in which the methodology is unclear, the systematic review focused on articles published peer-reviewed journals. The practical screening was essentially achieved through the analysis of the abstract and publication features of the papers (language, year of publication, source, title, keywords).

Methodological screening aims to ensure the quality and rigour of the articles, including the levels of sample selection, data collection, and analysis (Fink, 2013). The methodological screening of the literature required a more complete reading and analysis of the selected papers. For example, articles where the methodology used was not clearly described, or where the analysis was not given in sufficient detail, were not used. Relevant qualitative studies were included for three main reasons. First, more and more systematic reviews include qualitative studies, which provide a complementary perspective to quantitative approaches and contribute to developing a deeper understanding of difficult to measure aspects (Evans and FitzGerald, 2002; Hannes et al., 2013). Second, the qualitative studies on the impact of ISO 14001 can shed more light on the difficulties and perverse effects of this standard, which were considered in the systematic review. As a result, the inclusion of those studies helps to give a more balanced and less optimistic view on the complex outcomes of this standard. Third, since the outcomes observed can be influenced by methodological aspects, it was logical not to arbitrarily restrict the methodological approaches included in the review. First, the search for relevant studies by keywords led to the identification of 2,796 potentially relevant papers (see Figure 1). Second, the practical screening of those papers resulted in the selection of 263 articles focused on the adoption and impacts of ISO 14001 and clearly in line with the objective of the study. Third, the methodological screening of the selected papers led to the selection of 94 papers (3.4% of all papers considered in the practical screening) that met the requirements of the systematic review in terms of quality and rigor. This proportion of papers selected in each stage of the process is similar to that observed in other systematic reviews (Bélanger-Gravel et al., 2011; Halilem, 2010). Figure 1 describes the process for the selection of articles.

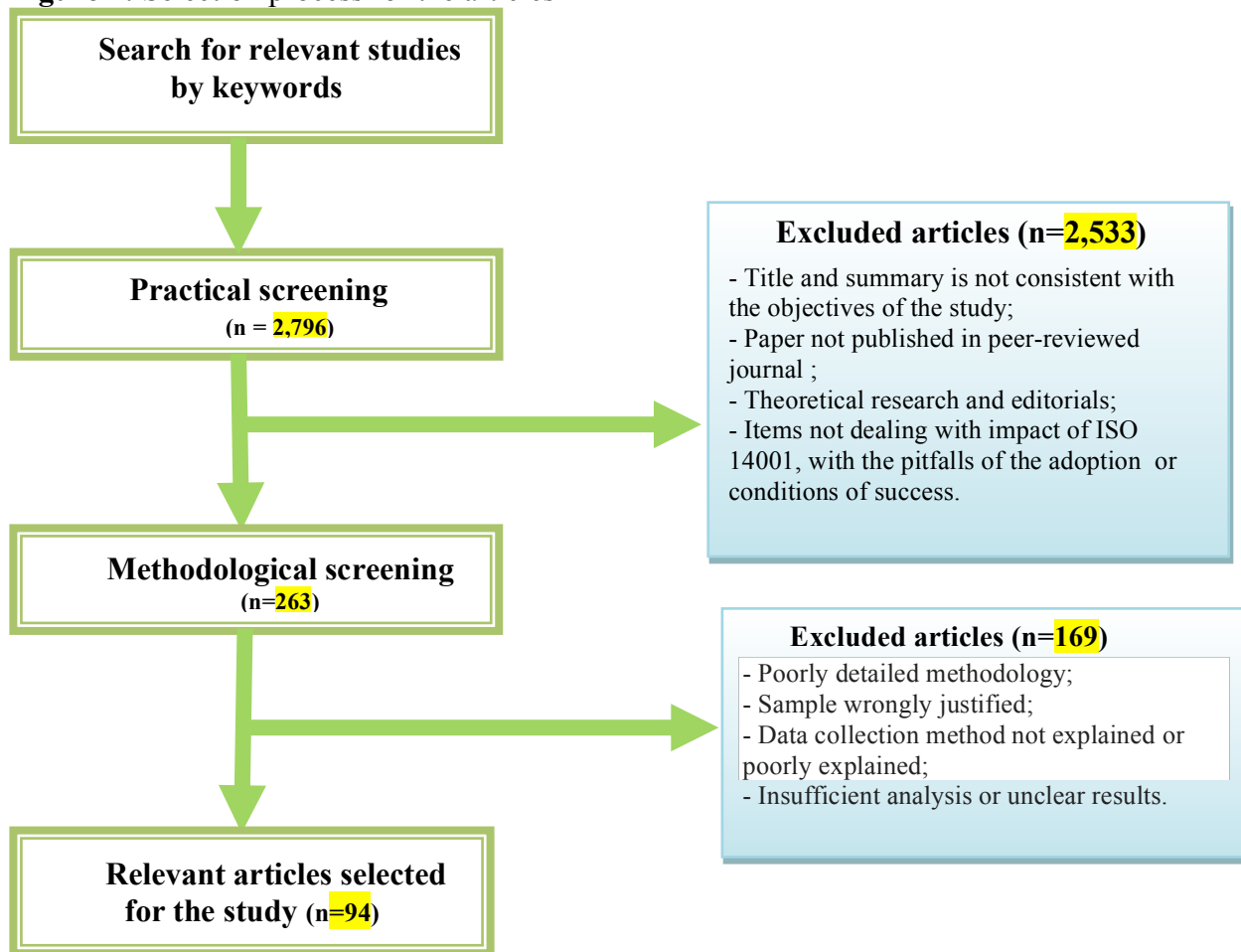
Table 1: The criteria for inclusion and exclusion of articles¹

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • Article published between 1996 and 2015; • Article published in peer-reviewed 	<ul style="list-style-type: none"> • Theoretical and conceptual articles (not empirical), systematic reviews, meta-analyses and editorials;

¹ The interdependence between certain criteria helped the selection process. For example, most papers on the impacts of ISO 14001 published in academic and peer-reviewed journals – in particular top-ranked journals - were relatively detailed with regard to their methodology and data analysis. Those papers were selected in our systematic review. Conversely, most papers with unclear methodology or based on success stories that were not rigorous were published in professional journals without peer-reviewing system. Those papers were not selected in our study.

<p>journals;</p> <ul style="list-style-type: none"> • Article addressing the impact of the adoption of ISO 14001, the problems associated with the adoption of ISO 14001 and / or the contingent factors that may influence the successful adoption of the standard; • Article based on a methodology rigorous and clearly described (qualitative, quantitative or mixed). 	<ul style="list-style-type: none"> • Books, memoirs and unpublished theses as an article; • Success stories about ISO 14001 not based on a balanced analysis of the impact of the standard; • Articles published in a language other than English.
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Figure 1: Selection process for the articles²



² Data presented in the figure are related to the search through the Science Direct, ABI/INFORM and EBSCO databases.

The final step of the systematic review is to extract and analyse the relevant data from the selected papers. This extraction and analysis process was based on the method of content analysis, which can be defined as “a research technique for making replicable and valid inference from texts (or other meaningful matter) to the context of their use” (Krippendorff, 2012, p.403). Content analysis is based on the interpretation of data in relation to a systematic codification process to consolidate information around themes or recurring concepts (Schilling, 2006). This information coding approach makes it possible to synthesize systematically essential data from various articles and quantify certain trends (Elo and Kyngäs, 2008). The content analysis method has been used in this systematic review for two main reasons. First, like most systematic reviews, content analysis is based on the development of a coding grid and on the categorization of the information according to that grid (Schilling, 2006). Second, content analysis can convert some qualitative data into a quantitative form to facilitate their exploitation (Dixon- Woods et al., 2005). This conversion was necessary to analyse more rigorously certain outcomes of ISO 14001, notably in studies based on qualitative methods. The analysis of data was based on three steps: development of a categorization grid, extraction of information according to the grid, and interpretation of results.

Table 2: Main themes and subthemes evidenced in the systematic review

Themes	Subthemes
Outcomes of ISO 14001	<ul style="list-style-type: none"> • environmental management outcomes (rigour and effectiveness of practices, regulatory compliance, documentation control, greening of supply chain, performance monitoring, other); • environmental indicators (environmental performance in general, air pollution, waste minimization and management, environmental risks and safety issues, energy and resource consumption, water contamination, other); • environmental awareness and social aspects (image and stakeholder relationships, employee involvement, employee training and knowledge, managers’ involvement, other).
Adoption of ISO 14001	<ul style="list-style-type: none"> • costs and lack of resources, superficial implementation, bureaucracy and excessive documentation, resistance to change, lack of capabilities, time constraints, expertise of registrars and consultants, other; • contingent factors (support and commitment of managers, employee involvement, integration with existing practices, motivation for certification, internalization, other); • contextual factors (maturity of certification, company size, early adoption, other).

First, a categorization grid was developed by the research team and tested on a sample of a dozen papers. As suggested by Tranfield *et al.* (2003), the categorization grid was based on two levels:

the characteristics of the studies and their results in relation to the objective of the systematic review (impact of ISO 14001). The variables related to the characteristics of the studies covered 12 main issues: design and methods, region where the study was conducted, status and number of respondents, sector of activity, sampling method, biases, specific objectives of the study, data collection, method of analysis, validation method and reflexivity, statistical tests (for quantitative studies only), appraising research³. The variables related to results of the studies used in this systematic review⁴ covered two main themes and some 30 subthemes describing the main outcomes of ISO 14001 (please, see Table 2).

Second, the relevant information was extracted from the 94 papers analysed in the systematic review. To limit bias, particularly related to the subjective interpretation of some results, the selection of papers, extraction and data analysis were performed independently by two coders. The points of disagreement were resolved by frequent discussions between the two coders and the lead researcher of the study. Those discussions focused on the adding of new codes in the categorization grid depending on the variables covered by the various papers analysed. The diversity of papers and heterogeneity of ISO 14001 outcomes required the adaptation of the categorization grid used by the two coders on numerous occasions. Each code was carefully defined and explained in the categorization grid. The codes related to the impact of ISO 14001 were codified in an Excel spreadsheet according to the following variables: non-applicable (0), strong positive impact (1), strong negative impact (2), no positive or negative impact demonstrated (3), low positive impact (4), low negative impact (5). At the end of the data extraction, the level of inter-rater agreement was calculated using the Kappa-Cohen coefficient. This coefficient was calculated using SPSS v20 software on a sample of 14% of categorized papers, which is more than the 10% sample recommended by Brennan and Prediger (1981). The Kappa coefficient obtained was 0.894, which reflects excellent inter-rater agreement.

Third, the results of the categorization process were analysed by the two coders. The codes were first analysed in the Excel file and in SPSS to calculate the proportion of studies related to each code. For example, the analysis of the codes related to the countries made it possible to evaluate the geographic distribution of the studies and regions poorly covered by research on the impact of ISO 14001. The analysis of codes related to the results of the studies provided information on the various outcomes of ISO 14001, including the pitfalls of this standard and contingency factors explaining its success or failure. In addition, to facilitate the interpretation of results, a synthesis of the main conclusions of each paper and relevant passages illustrating those conclusions was also made. Finally, a synthesis of the main results of the systematic review for the main variables and codes of the categorization grid was produced in a separate Word file by each of the two coders.

³ Appraising research was based on some twenty criteria essentially related to methodological issues such as, for quantitative studies, the specification of the response rate, hypothesis or objective, and relevance of outcome variables.

⁴ Other variables related in particular to the economic impact and motivation were also analyzed. To limit the length of this paper, these variables have not been reported.

This synthesis was structured around three main themes which are developed in the following sections of the paper: the mapping of the literature on the outcomes of ISO 14001; the outcomes of ISO 14001; the adoption of ISO 14001.

Mapping of the literature on the outcomes of ISO 14001

The analysis of the characteristics of the studies of the outcomes of ISO 14001 show tendencies generally ignored in the literature. Table 3 summarises the salient findings concerning the distribution of the sample (geographical distribution of studies, type of respondent, sector of activity) and the characteristics of publications (methods, tendency, journals).

Table 3: mapping of the literature on the outcomes of ISO 14001 (n = 94)

Samples distribution and data collection	Research designs and publications
<p>Geographical distribution (% of publications⁵ - % of certifications per country⁶)</p> <ul style="list-style-type: none"> • USA (25.5% - 2%) • Spain (12.8% - 5.3%) • Japan (8.5% - 7.9%) • Canada (9.6% - 0.5%) • Germany (9.6% - 2.6%) • United Kingdom (6.4% - 5.6%) • China (10.6% - 34.8%) • Malaysia (5.3% - 0.7%) • Sweden (6.4% - 1%) • France (5.3% - 2.6%) <p>Status of respondents⁷</p> <ul style="list-style-type: none"> • Environment managers and specialists (74.5%)⁸ • CEOs and senior managers (52.7%) • Operation and production managers (27.3%) 	<p>Research designs and method</p> <ul style="list-style-type: none"> • Quantitative: 74% • Qualitative: 15% • Mixed: 12% • Longitudinal : 7%⁹ <p>Number of publications</p> <p>1990s: 1996 (0), 1997 (0), 1998(1), 1999(0)</p> <p>2000s: 2000 (5), 2001 (3), 2002 (3), 2003 (6), 2004 (3), 2005 (8), 2006 (6), 2007 (5), 2008 (6), 2009 (6)</p> <p>2010s: 2010 (3), 2011 (10), 2012 (12), 2013 (4), 2014 (8), 2015 (5)</p> <p>Journals (type and number of publication)</p> <ul style="list-style-type: none"> • Environmental issues (55.3%): Journal of Cleaner Production (23); Business Strategy and the Environment (4); Journal of Environmental; Management (5);

⁵ Only most represented countries are listed. Certain studies covered several countries.

⁶ Certifications per country were obtained from the ISO Survey 2013 (ISO, 2014). The % of certifications per country represents the geographical distribution of ISO 9001 certificate.

⁷ Given the high proportion of studies in which the status of respondents is unclear (41.5%), the data on the proportion for respondent status are based on the 58.5% of studies that clearly specify this aspect.

⁸ Including managers in charge of the ISO 14001 system.

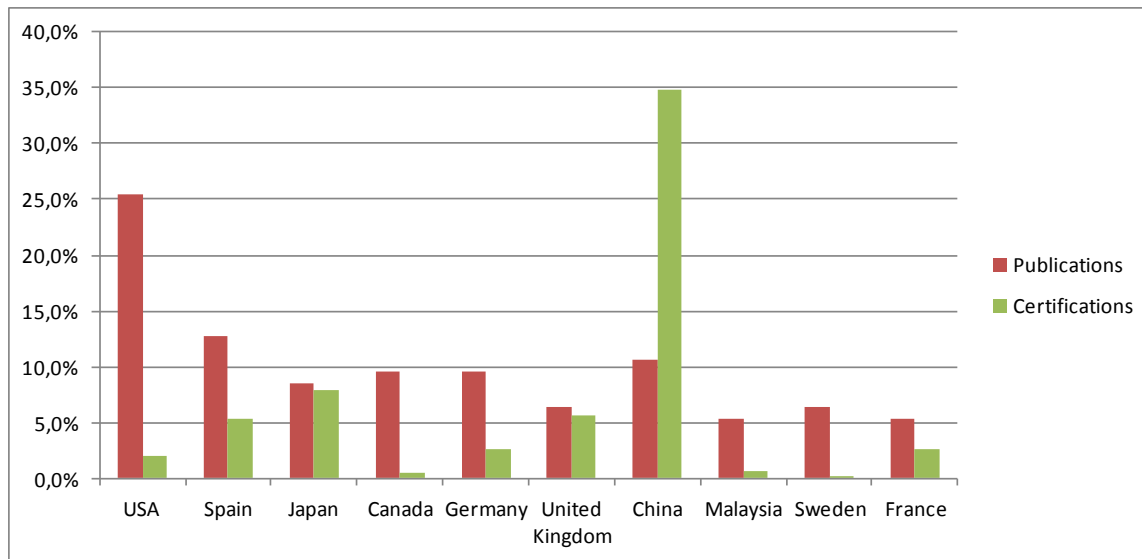
⁹ All longitudinal studies were based on quantitative approaches.

<ul style="list-style-type: none"> • Employees (20%) • Representatives of public administration (2 %) • Consultant (2%) • Auditors (0%) • Not clearly mentioned (38%) <p>Measurement of environmental impacts</p> <ul style="list-style-type: none"> • Perceptual measures (80,9%) • Databases on environmental impacts (13.8%) • Social desirability bias addressed: 17% 	<p>Corporate Social Responsibility and Environmental Management (2); other (18)</p> <ul style="list-style-type: none"> • General Management (27.7%): Long Range Planning (3); European Management Journal (2); other (20), China Economic Review (1). • Production and operation (11.7%): International Journal of Operations and Production Management (6); International Journal of Production Economics (1); other (4) • Other (5.3%)
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Sample distribution and data collection

The composition of the sample of studies on the outcomes of ISO 14001 shows important discrepancies in terms of geographic distribution, status of respondents and sectors of activity (see Table 3 and Graph 1). First, the regions covered by those studies do not reflect the distribution of ISO 14001 certification across the world. Close to 50% of the studies on ISO 14001 have been conducted in three countries, namely USA, Spain, and Canada, which represent less than 8% of the total number of certifications worldwide. Conversely, China and Japan, which represent nearly 43% of certifications worldwide, have been covered by only 19% of studies. Moreover, the majority of these studies were carried out before 2007, when the number of certificates in China was much lower (Fryxell et al., 2004; Yeung et al., 2005; Zeng et al., 2005; Chan et al., 2006; Mohammed, 2000; Christmann and Taylor, 2006). The study of Yeung et al. (2005) and, above all, the research on the selection of ISO registrars conducted by Fryxell et al. (2004) have raised intriguing issues related to the quality of the certification process in China and the professionalism of certain Chinese registrars considered as unscrupulous and profit-oriented (Fryxell et al., 2004; Yeung et al., 2005). Although this type of issue may also be of concern on other countries, the very rapid growth of ISO 14001 certification in China, with more than 104,000 Chinese organizations achieving certification in 2013 (ISO, 2014), raises unanswered questions about the quality of certification and auditing practices in certain regions. Only five papers (Rivera-Camino, 2001; Bellesi et al., 2005; Wagner, 2008; Potoski and Prakash, 2013; Darnall and Kim, 2012) are based on international and comparative studies of ISO 14001. Among these studies, only Bellesi et al. (2005) delved deeper into the institutional and cultural specificities of the adoption of the standard in relation to its geographical distribution. Generally speaking, the literature remains essentially focused on a few countries which are no longer the main regions in terms of ISO certification development. The decline of certifications in certain countries such as Japan and Russia, and the interesting phenomena of decertification, or the decision not to renew certification by certain organisations, also remain largely unexplored in the literature.

Graph 1: Geographical distribution (% of publications - % of certifications per country)



Second, the status of the respondent who provided data for the studies on the outcomes of ISO 14001 is quite homogeneous and not representative of the variety stakeholders concerned with the standard. Environmental managers are, by far, the most represented and are covered in nearly three quarters of the studies in which the respondents' status is clearly specified (see Table 3). Although environmental specialists seem the best positioned to respond to questions on the outcomes of ISO 14001, they are generally directly involved in the promotion and adoption of the standard within their organization. As a result, they will probably tend to attach more importance to the success of the standard. Thus, their answers can be significantly influenced by social desirability bias (Arnold and Feldman, 1981). The same remark can apply to CEOs/seniors managers and operation/production managers who are covered in 52.7% and 27.3% of studies respectively. Although employees are considered the key actors in the successful adoption of ISO 14001 (Kitazawa and Sarkis, 2000; Zeng et al., 2005; Sambasivan and Fei, 2008), their opinions are taken into account in only 12% of studies. More importantly, only 5% of studies include the perceptions of external stakeholders, including representatives of public administration and consultants. The study of Heras-Saizarbitoria et al. (2011a), which is based on questionnaires and interviews with representatives of managers, consultants, auditors and public administrators, is the most inclusive in terms of the participation of external stakeholders. Most studies focus on one or two categories of respondents, generally environmental managers and/or senior managers. Although the focus on this type of respondent is understandable for practical reasons related to data collection, the complexity of the impact of ISO 14001, in particular with regard to environmental aspects, would seem to require the collection of information from a much wider spectrum of respondents, including representatives of NGOs, customers and shareholders.

Third, in 81% of papers the measurement the environmental impact of ISO 14001 is based on perceptions and in only 14% of papers is it based on databases such as the Toxics Releases Inventory of the American Environmental Protection Agency or the National Pollutant Release Inventory provided by the Canadian Government. The literature therefore largely relies on perceptions, in particular the opinions of environmental managers. These opinions can be very relevant, but they may clearly be influenced by social desirability bias or self-reporting bias, which are addressed in only 17% of all papers.

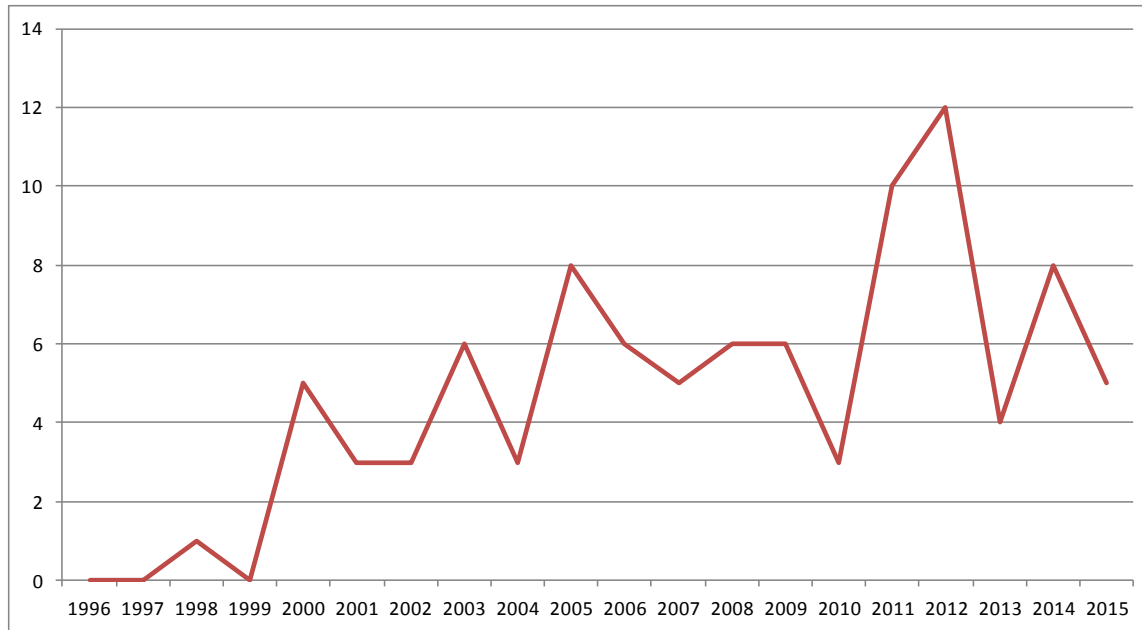
Research designs and publications

Systematic reviews are very well suited to analyze the characteristics of the literature in terms of research designs and publication tendencies. First, the analysis of research design and methods of the ISO 14001 literature shows the predominance of quantitative approaches, which represent more than 74% of studies (see Table 1). Qualitative approaches are therefore relatively infrequent, with only 15% of studies - all of them based on case studies - while 12% adopted a hybrid or mixed methodology. Moreover, the proportion of qualitative studies tends to decline and represents around 12% of papers published since 2005, compared with nearly 20% before 2005. This tendency has important implications since qualitative studies tend to focus on more diverse respondents (including employees and other stakeholders) and to adopt a more critical and in-depth approach to standard internalization. As a result, the mainstream literature on the impact of ISO 14001 increasingly focuses on uncritical studies based on quite homogeneous samples composed of environmental and general managers. With the exception of Heras-Saizarbitoria et al. (2011a), the few hybrid methodologies have been based on small samples and remain essentially focused on qualitative aspects (Ghisellini and Thurston, 2005). Although longitudinal approaches are very relevant to explore the impact of the standard over time, they have been adopted by only nine studies (Szymanski and Tiwari, 2004; Ghisellini and Thurston, 2005; Heras-Saizarbitoria et al., 2011b; Nishitani et al., 2012; Potoski and Prakash, 2013; Zobel, 2013; Zhang et al., 2014, Barla, 2007; Russo, 2009). The small proportion of longitudinal and qualitative approaches may be explained by the difficulty of collecting and analysing information in comparison with standardized quantitative methods.

Second, although the number of ISO 14001 certifications worldwide multiplied tenfold between 2001 and 2013 (ISO, 2014), the number of papers published on the impact of the standard has not significantly increased and represents on average four to five academic publications per year (see Graph 2). Moreover, many avenues of research, such as the development of the standard in emerging economies and new sectors of activities, or the perceptions of external stakeholders on the standard's effectiveness, remain underexplored. In this respect, the literature on the impact of the ISO 14001 seems relatively underdeveloped considering the growing importance of the standard worldwide.

Third, the publications on the subject can be divided into three main fields: journals on environmental issues, general management, and production and operation (see Table 1).

Graph 2: Number of publications per year (1996-2015)



Journals on environmental issues account for 55% of the sample of papers on the impact of ISO 14001. *The Journal of Cleaner Production* is, by far, the most common publication, with 23 papers, followed by *The Journal of Environmental Management* (5 papers) and *Business Strategy and the Environment* (4 papers). Most other specialized journals, notably those on the environment and the economy, have published one or two papers. Surprisingly, the journals on general management only account for 28% of publications. Moreover, only one journal on general management, namely *Long Range Planning*, has published more than two papers on the impact of ISO 14001. This finding was quite unexpected given the importance and nature of ISO 14001, which is essentially based on management practices rather than specific environmental issues. Finally, production and operation journals account for 12% of ISO 14001 papers, close to half of them published in *The International Journal of Operations and Production Management*.

The impact of ISO 14001

Although the ISO 14001 standard has been designed to improve environmental practices and performance in this area, about 17% of the papers analyzed focus on its socioeconomic rather than environmental outcomes: improved manufacturing efficiency, cost saving, customer satisfaction, market position, financial performance, investors' returns and share price, and so on. Moreover, the environmental aspects covered by the studies are very heterogeneous. In the absence of clear and shared indicators of performance, the comparison of results from one study to another is difficult, if not impossible. Nevertheless, the categorization process of the systematic review made it possible to organize the results around a few categories that are representative of the main environmental variables used in the literature. Table 2 summarizes the findings of the systematic review with regard to the three main environmental issues covered in the ISO 14001 literature: environmental management practices, environmental indicators, and social aspects.

Table 4: The impact of ISO 14001

Impacts of ISO 14001 ¹⁰	Number of papers ¹¹	Positive impacts ¹² (%)
Environmental management <ul style="list-style-type: none"> • Rigour and effectiveness of practices • Regulatory compliance • Greener supply chain • Documentation control 	20 14 9 5	95% 100% 100% 40%
Environmental indicators <ul style="list-style-type: none"> • Waste minimization and management • Air pollution • Environmental performance in general • Energy and resources consumption • Environmental risks and safety issues • Water contamination 	19 16 14 13 8 6	84% 63% 71% 92% 88% 33%
Environmental awareness and social aspects <ul style="list-style-type: none"> • Image and stakeholders relationships • Employees involvement • Employees training and knowledge • Managers involvement 	22 13 6 5	91% 69% 83% 80%

Environmental management

The impact of ISO 14001 on environmental management practices is covered by around 51% of the papers analysed. One of the main issues, covered in 20 papers, is the improvement of the rigour and effectiveness of environmental practices (see Table 2). The higher rigour is generally related to the adoption of alleged best environmental practices, better commitment of employees and improved follow-up of the management system through regular audits (e.g. Perez et al., 2009; González Benito and González-Benito, 2008; López-Fernández and Serrano-Bedia, 2007; Turk, 2009; Morrow and Rondinelli, 2002; Zeng et al., 2005). Interestingly, certain critical papers —i.e. works that include a critical research perspective that somehow questions established practices, ideologies or discourses (Alvesson and Deetz, 2000)— have also observed some improvements of the environmental management system (Jiang and Bansal, 2003; Boiral, 2007; Boiral and Henri, 2012). Nevertheless, those studies also found that, in most cases, the ISO 14001 system did not provide significant internal improvements or substantial added value over in-house management systems. The impact of the standard on the management of regulatory compliance was covered in 14 studies. Studies on this issue have all found positive impacts such as improvement of compliance with environmental regulation and avoidance of fines due to lack of compliance (e.g. Nguyen and Hens, 2015; McGuire, 2014; Zhang et al., 2014; Kwon et al.,

¹⁰ Only most significant impacts covered by at least 3 studies are included in the table.

¹¹ Number of papers covering the aspect.

¹² % of papers that found a positive and significant impact of ISO 14001 on the aspect.

2002; Holt, 1998; Alemagi et al., 2006; Stratchan et al., 2003), or reduction of time to be compliant and better anticipation of legal risks (Morrow and Rondinelli, 2002; Potoski and Prakash, 2005). Improvements in the greening of supply chain management was also observed in studies that measured this aspect (e.g. Prajogo et al., 2014; Bellesi et al., 2005; Arimura et al., 2011; Nawrocka et al., 2009; Bansal and Bogner, 2002; Zeng et al., 2005; Curkovic and Sroufe, 2011). Other studies have highlighted the positive impact of ISO 14001 on the documentation of environmental practices, notably in terms of control of environmental aspects (López-Fernández and Serrano-Bedia, 2007; Morrow and Rondinelli, 2002). Nevertheless, certain studies found that these improvements were questionable or that the *raison d'être* of the ISO documentation was often misunderstood inside organizations (Psomas et al., 2011; Curkovic and Sroufe, 2011; Boiral, 2011).

Environmental indicators

Environmental indicators are covered by around 81% of papers on the impact of ISO 14001. Waste minimization and air emissions are the indicators most frequently measured in the literature. The adoption of ISO 14001 has been found to have a positive impact on waste reduction and waste management in general in 16 studies (e.g. Djekic et al., 2014; Hasan and Chan, 2014; Martín-Peña et al., 2014; Schylander and Martinuzzi, 2007; Curkovic and Sroufe, 2011; Rondinelli and Vastag, 2000). Conversely, three studies found that the standard has no significant impact on this issue (Zobel, 2015 2013; Ghisellini and Thurston, 2005). According to ten studies (e.g. Testa et al., 2014; Martín-Peña et al., 2014; Nishitani et al., 2012; Alemagi, 2006; Mohammed, 2010; Potoski and Prakash, 2013), the adoption of ISO 14001 tends to reduce air pollution and atmospheric emissions. Nevertheless, six studies found this relationship was not significant (Zobel, 2013; Gomez and Rodriguez, 2011; Ghisellini and Thurston, 2005; Aravind and Christmann, 2011; Russo, 2009; Mohammed, 2000). Some studies remained quite general on environmental performance and did not focus on specific indicators. This is the case for most of the qualitative studies and those using aggregate indicators to measure performance.

The findings show a somewhat mixed picture: 9 studies found that ISO 14001 has a positive influence on environmental performance in general (e.g. Zhang et al., 2014; Prajogo et al., 2014; Morrow and Rondinelli, 2002; Poksinska et al., 2003; Link and Naveh, 2006; Turk, 2009; Gonzalez-Benito and Gonzalez-Benito, 2005) while 5 others found no significant improvement related to the standard (Zobel, 2013; Prajogo et al., 2012; King et al., 2005; Boiral, 2007; Boiral and Henri, 2012). With regard to energy and resources consumption, 12 studies found that the standard improved effectiveness (e.g. Djekic et al., 2014; Hasan and Chan, 2014; Martín-Peña et al., 2014; Alemagi et al., 2006; Radonjic and Tominc, 2006; Castka and Prajogo, 2013) while one paper (Zobel, 2013) found that non-certified firms performed better in this area. The reduction of environmental risk and safety issues were covered in 8 studies (e.g. Djekic et al., 2014; Alemagi et al., 2006; Zeng et al., 2005; Curkovic and Sroufe, 2011; Radonjic and Tominc, 2006; Tan, 2005). With the exception of Mohammed (2000), they all found improvements related to the standard. With the exception of Mohammed (2000) and Darnall and Kim (2012), studies that have investigated the impact of the standard on water contamination (Potoski and Prakash, 2013; Zobel, 2013; Gomez and Rodriguez, 2011; Barla, 2007) have found no significant improvements related to ISO 14001 implementation.

Environmental awareness and social aspects

The social impact of ISO 14001, in particular the development of environmental awareness, was covered by 49% of papers. The most frequent social benefit of the standard is, by far, its impacts on image, stakeholder relationships, and reputational benefits which are mentioned in 22 studies. With few exceptions (Schylander and Martinuzzi, 2007; Morrow and Rondinelli, 2002), all papers found a positive impact on this issue (e.g. Turk, 2009; Martín-Peña et al., 2014; Djekic et al., 2014; Hasan and Chan, 2014; Jiang and Bansal, 2003; Boiral, 2007; Zeng et al., 2005; Psomas et al., 2011; Castka and Prajogo, 2013). Some papers stressed that image and reputation improvements were the most important benefits observed (Poksinska et al., 2003; Holt, 1998; Strachan et al., 2003; Tan, 2005; Sambasivan and Fei, 2008).

The impact of the standard on employee environmental awareness and commitment were mentioned in 13 papers. Those studies observed improvements in employees' environmental involvement (Perez et al., 2009; Rondinelli and Vastag, 2000; Link and Naveh, 2006; Zeng et al., 2005). Certain studies also measured some improvements in environmental awareness, communication and work culture (Schylander and Martinuzzi, 2007; Kitazawa and Sarkis, 2000; Morrow and Rondinelli, 2000; Curkovic and Sroufe, 2011). Nevertheless, four papers did not observe substantial changes in employee awareness and commitment following the implementation of the standard (Boiral, 2007; Balzarova et al., 2006; Tan, 2005; Rivera-Camino, 2001). With regard to employee training and competences related to the environment, 6 papers (Morrow and Rondinelli, 2002; Kitazawa and Sarkis, 2000; Boiral, 2007; Poksinska et al., 2003; Strachan et al., 2003) found a positive impact of ISO 14001 or observed significant actions. Nevertheless, López-Fernández and Serrano-Bedia (2007) found no substantial change in this area. Finally, four papers concluded that ISO 14001 improves managers' support and involvement (Nguyen and Hens, 2015; Schylander and Martinuzzi, 2007; Kitazawa and Sarkis, 2000; Rondinelli and Vastag, 2000). Conversely, one study questioned these improvements and observed a lack of manager commitment in certain certified organizations (Boiral, 2007).

Adoption of ISO 14001

Around 76% of the papers on the impact of ISO 14001 focus on criteria of effectiveness and positive aspects. Such a focus tends to obscure the possible perverse effects of the adoption of the standard. The analysis of these undesirable effects and drawbacks related to the standard sheds more light on issues that tend to be overlooked or ignored in the mainstream literature and provides a more comprehensive vision of the possible outcomes of ISO 14001. Whatever the positive or negative impacts observed, those outcomes are not necessarily predictable and automatic. They rather depend on contingent and contextual factors that influence the success or failure of implementation. These factors are covered by around half of the literature analyzed. Table 5 presents the results of the systematic review with regard to the pitfalls and contingent factors of ISO 14001 implementation.

Table 5: The adoption of ISO 14001

Adoption of ISO 14001	Number of papers ¹³
Drawbacks	
• Costs and lack of resources	18
• Bureaucracy and excessive documentation	12
• Superficial adoption	11
• Time constraints	9
• Resistance to change	8
• Lack of internal capabilities	7
• Expertise of registrars and consultants	5
Contingent factors	
• Managers' support and commitment	17
• Employee involvement and empowerment	12
• Integration with existing practices	11
• Internalization	10
• Motivation for certification	10
Contextual factors	
• Company size	10
• Maturity of certification	8
• Early adoption	7

Drawbacks and obstacles

The most frequent drawback, observed in 18 studies (see Table 5), is related to the cost of implementing the standard and the certification process (e.g. Martín-Peña et al., 2014; Ofori et al., 2000; Rivera-Camino, 2001; Turk, 2009; Bansal and Bogner, 2002; Jiang and Bansal, 2003; Strachan et al., 2003; Massoud et al., 2010). Although many papers highlight the economic benefits of the standard (e.g. Darnall et al., 2008; Holt, 1998; Tan, 2005; Sambasivan and Fei, 2007), implementation and certification costs are often considered to be the main obstacle, due to the lack of resources in many organizations or insufficient commitment from managers (Rodríguez et al., 2011; Babakri et al., 2004; Alemagi et al., 2006; Boiral, 2011). Such costs may also divert scarce resources from more profitable initiatives and be perceived as excessive (Montabon et al., 2000; Yeung and Mok, 2005, Curkovic and Sroufe, 2011). Although two studies found benefits related to documentation control (see Table 2), 12 others observed organizational resistance and difficulties with the ISO paperwork (e.g. Turk, 2009; Yeung and Mok, 2005; Babakri et al., 2003; Ghisellini and Thurston, 2005; Ivanova et al., 2014). Excessive documentation is often associated with the certification process which is essentially based on the verification of ISO documentation (Curkovic and Sroufe, 2011; Strachan et al., 2003; Boiral, 2007, 2011). Paperwork and implementation costs may explain the tendency of certain organizations to adopt the ISO 14001 certificate symbolically, mostly for commercial and image

¹³ Number of papers covering the aspect.

reasons rather than for substantially changing internal practices. Overall, the tendency of organizations to adopt the standard in a symbolic, superficial, or ritualistic manner was observed in 11 studies (e.g. Christmann and Taylor, 2006; Yin and Schmeidler, 2009; Yeung and Mok, 2005; Guoyou et al., 2011; Jiang and Bansal, 2003; Boiral and Henri, 2012). This tendency is often associated with the search for external legitimacy and tends to translate into a procedural or symbolic view of the standard (Aravind and Christmann, 2011; Boiral, 2007, 2011; Heras-Saizarbitoria et al., 2011a). Time constraints, efforts needed to implement the standard and time delay to obtain certification were also mentioned in 9 studies (e.g. Hasan and Chan, 2014; Alemagi et al., 2006; Psomas et al., 2011; Babakri et al., 2003; Turk, 2009; Massoud et al., 2010; Ghisellini and Thurston, 2005). According to 8 papers, the requirements of the standard, in particular regarding documentation, cause significant resistance to change among employees and middle-managers (e.g. Boiral, 2007; Morrow and Rondinelli, 2002; Yeung and Mok, 2005; Turk, 2009; Babakri et al., 2003; Psomas et al., 2011). These difficulties are fuelled by the lack of internal capabilities to implement the standard and insufficient knowledge of its requirements. This issue was highlighted in 7 studies (e.g. Rodriguez et al., 2011; Alemagi et al., 2006; Massoud et al., 2010; Turk, 2009; Boiral, 2007) and seems more intense in developing countries where, according to Tan (2005), the shortage of environmental expertise can represent a serious obstacle. Finally, 5 studies mentioned the lack of professionalization of registrars in certain regions such as China or dependence on consultants with insufficient knowledge of organizational practices (Yeung and Mok, 2005; Fryxell et al., 2004; Bansal and Bogner, 2002; Massoud et al., 2010; Boiral, 2011).

Contingent factors

The prevention of ISO 14001 pitfalls and, more generally, the successful adoption of the standard depend on various factors which are rarely addressed thoroughly in the literature. Most contingent factors observed are related to the way the standard is implemented. 17 studies highlight the critical role of managers' support and commitment in the adoption of the standard (e.g. Balzarova et al., 2006; Boiral, 2011, 2007; Zeng et al., 2005; Chan and Wong, 2006; Kitazawa and Sarkis, 2000; Curkovic and Sroufe, 2011; Kaur, 2011; Yin and Schmeidler, 2009). Managerial commitment is necessary to address several drawbacks, including the lack of internal resources, resistance to change and superficial adoption of ISO 14001. According to 12 studies, employee empowerment, training and involvement in the adoption of the standard also play a critical role (e.g. Djekic et al., 2014; Ivanova et al., 2014; Poksinska et al., 2003; Yin and Schmeidler, 2009; Boiral, 2011, 2007; Kaur, 2011).

The integration of the standard with existing practices seems essential if excessive documentation is to be avoided and to generate internal commitment. Such integration is mentioned in 11 studies (e.g. Psomas et al., 2011; Balzarova et al., 2006; Boiral, 2011, 2007) and also concerns the ISO 9001 standard, the adoption of which can encourage the development of capabilities facilitating the successful adoption of ISO 14001 (e.g. Montabon et al., 2000; López-Fernández and Serrano-Bedia, 2007; King et al., 2005; Yin and Schmeidler, 2009; Schylander and Martinuzzi, 2007). Integration with existing practices is closely related to the concept of internalization, which requires the integration of environmental practices and ISO requirements into daily activities (e.g. Guoyou et al., 2012; Heras-Saizarbitoria et al., 2011a; Castka and Prajogo, 2013; Boiral, 2011; Yin and Schmeidler, 2009; Christmann and Taylor, 2006; Aravind and Christmann, 2011). As highlighted in 10 studies, the intensity and nature of motivation for certification can also have a

major impact. Although certain studies conclude that the intensity of external pressures increases the internalization of ISO 14001 (e.g. Prajogo et al., 2012; Hanim Mohamad Zailani et al., 2012; Christmann and Taylor, 2006), others found that those pressures, notably from secondary stakeholders, tend to encourage a superficial adoption of the standard (Castka and Prajogo, 2013; Boiral, 2007). Overall, internal motivations appear to play a more important role in the internalization and successful adoption of ISO 14001 (e.g. Guoyou et al., 2012; Boiral, 2011; Heras-Saizarbitoria et al., 2011a; Prajogo et al., 2012; González-Benito and González-Benito, 2005; Gavronski et al., 2008).

Others contingent factors related to the context of ISO 14001 adoption, in particular the company size and maturity of the environmental certification, are also covered in the literature. Organizational size was studied in 10 papers (e.g. ; Ivanova et al., 2014; Martín-Peña et al., 2014; Testa et al., 2014; González-Benito and González-Benito, 2005; Massoud et al., 2010), most of them concluding that larger businesses have more resources, capabilities or incentives for successfully implementing the standard. The maturity of certification has also been studied in 8 papers. Most of the studies concluded that the internalization and effectiveness of the standard is greater where the company has been certified longer (e.g. Prajogo et al., 2014; Russo, 2009; López-Fernández and Serrano-Bedia, 2007; Testa et al., 2014; Yin and Schmeidler, 2009; Babakri et al., 2004). Finally, 6 studies analyzed the outcomes of the early adoption of ISO 14001. According to four of the studies (Babakri et al., 2003; Heras-Saizarbitoria et al., 2011a; Prajogo et al., 2012; Russo, 2009), early adopters are characterized by a more proactive and substantial adoption of the standard than late adopters. Nevertheless, three studies (Bansal and Hunter, 2003; Barla, 2007; Ivanova et al., 2014) found that early adoption of ISO 14001 did not improve environmental performance or corporate commitment in this area.

Discussion

The objective of this paper was to analyze the adoption and outcomes of the ISO 14001 standard. Such analysis contributes to both a better understanding of the outcomes of the standard and a more comprehensive view of the literature itself, including its limitations and avenues for future research. Table 6 summarizes the main findings of the systematic review and research gaps observed.

This systematic review sheds light on the main findings and features of the literature, which remains essentially focused on quantitative studies based on the perceptions of managers from North American and European countries representing a relatively small fraction of ISO 14001 certifications worldwide. Surprisingly, the reliability and unbiased nature of the information collected from managers in charge of the ISO 14001 system tend to be taken for granted¹⁴. Although the outcomes observed are generally positive, essential issues such as the role of consultants, auditors and other stakeholders and employees' perceptions are clearly overlooked. Moreover, the drawbacks of the standard are most often ignored or toned down by the exclusive

¹⁴ Interestingly, there seems to be a current trend toward questioning the reliability of information collected from managers (see, for example, Heras-Saizarbitoria and Boiral, 2013; Zobel, 2015).

focus on effectiveness criteria. Conversely, studies that analyze the drawbacks of the standard have found significant obstacles and pitfalls related to the lack of internal commitment and the administrative burden of the standard. From this perspective, the main question is not whether or not the standard is effective, but rather what criteria are taken into account to measure its impacts and what are the conditions for its successful adoption. The literature has identified several success factors and contextual aspects, such as the internalization of the standard, its early adoption and its maturity inside the organization. Nevertheless, this contingency perspective remains underexplored and many aspects that could explain the effectiveness of ISO 14001 are not covered in the literature (see Table 4).

Table 6: Main findings of the systematic review and research limitations reported in the literature

		Main findings	Main research gaps
Mapping of the literature	Sample distribution	Concentration of studies on very few countries that do not represent the international development of ISO 14001, notably in developing countries.	The rapid expansion of certification in China, India and other emerging countries is under-researched; comparative and international studies are also needed.
	Respondents' status	Focus on environmental managers and, to a lesser extent, on other managers.	The perceptions of employees and external stakeholders are overlooked.
	Measurements and bias	Essentially based on perceptions of ISO/environmental managers.	More research should rely on official databases and address social desirability bias.
	Method	Essentially quantitative surveys based on questionnaires.	More qualitative and longitudinal studies are needed.
	Publications	Focused on a few specialized journals and descriptive studies.	Theoretical and critical approaches in the managerial literature are under-represented.
Outcomes of ISO 14001	Environmental management	Positive impacts on rigour of practices, regulatory compliance, and green supply chain; mixed results on documentation control and performance indicators.	Important aspects are overlooked such as auditing practices, development of indicators and identification of salient aspects; the role of consultants and others stakeholders in the improvement of practices is almost ignored.
	Environmental impact	Improvements in air pollution, waste management, environmental risk, energy and resource consumption; mixed results regarding environmental performance in general and specific issues such as water contamination.	Important issues such as biodiversity, greenhouse gas emissions, and transportation are overlooked; the causes of performance improvements other than ISO certification and the questionable reliability of the indicators analyzed are rarely addressed.
	Environmental awareness, social aspects	Mostly focused on image and stakeholder relationships; improvements in employee	Employee commitment is generally measured from managers' perceptions rather than direct observations; the

		awareness, commitment and training.	elasticity of managers' commitment needs to be further investigated.
Adoption of ISO 14001	Drawbacks	Drawbacks and pitfalls tend to be highlighted only when they are measured; the main obstacles are related to costs, superficial adoption, paperwork, time constraints, resistance to change, and lack of capabilities.	Most studies ignore the criteria of ineffectiveness of the standard; relationships between ISO 14001 pitfalls and the way it is implemented are overlooked; the cultural and institutional causes of certain issues such as the lack of capabilities are almost ignored.
	Success factors	Critical role of managers' support, employee commitment, integration with existing practices, internal motivations for certification and internalization; mixed results on the impacts of external pressures.	The roles of consultants and auditing process (preparation and outcomes of certification) in the successful adoption of the standard are overlooked; the dependence of certain success factors on contextual aspects (e.g. culture, sector) is ignored.
	Contextual factors	Large companies seem more successful with the standard; the maturity of implementation tends to be correlated with improvements.	Various contextual aspects (e.g. culture, region, sector of activity, polluting nature of the activity; visibility of impacts) are overlooked.

Contributions and managerial implications

This paper makes a number of relevant contributions to the literature.

First, the paper offers a comprehensive mapping of the literature on the outcomes of ISO 14001 and shows its main features, findings and research gaps. The publications that were analyzed largely depend on specific studies that are limited in terms of their sample, scope, variables used and contextual aspects. The systematic analysis of 94 papers provides a more comprehensive picture of the outcomes of the standard from various methodological and empirical perspectives. Although the mainstream literature is optimistic and focuses on the benefits of the standard, the systematic review shows that this literature is essentially based on managerial perceptions, which may be influenced by social desirability bias. Moreover, most critical studies are based on qualitative approaches, which represent only 12% of the papers published after 2005. This systematic review therefore contributes to contextualizing the findings of the literature and shows its limitations.

Second, the paper contributes to the development of systematic reviews in the area of management. To our knowledge, no systematic review has been undertaken on ISO 14001 or environmental management systems in general. Although systematic reviews are very common or even dominant in many fields, it remains marginal in the area of management where most literature reviews are narrative and conventional (Tranfield et al., 2003; Tari, 2011; Boiral, 2012). The development of systematic reviews in the field of organization studies and environmental

management, where many research studies address similar questions, could help to clarify the state of existing research and refocus future studies on questions that are really new. In the case of ISO 14001, as has also been the case for the general field of meta-standards (Heras-Saizarbitoria and Boiral, 2013), too many studies have analyzed the impact of the standard from conventional perspectives, where the conclusions seem predictable and interesting avenues of research remain unexplored. Moreover, many of the studies are based on narrative and traditional literature reviews, so that they tend to ignore the vast majority of past publications on the same subject. As a result, many studies on the impact of ISO 14001 are redundant and their contributions are unclear. This systematic review helps to identify and prevent these redundancies by identifying topics previously covered by the literature and those that still need to be addressed (see Table 4).

Third, this paper shows the complexity and paradoxes of the impact of environmental management systems. Although the positive outcomes and drawbacks of ISO 14001 may seem conflicting, they are not necessarily mutually exclusive. For example, the adoption of ISO 14001 can have positive impacts on internal practices, image and environmental awareness, while generating bureaucracy, paperwork, resistance to change and other pitfalls. The variety of these outcomes shows the heterogeneity of certified organizations that have not necessarily implemented the standard in the same way or for the same reasons. This paper also shows the ambiguities of environmental performance whose measure and monitoring by organizations is often, at best, uncertain and ambiguous. With the exception of Ghisellini and Thurston (2005), the literature seems to ignore this essential issue of measurability which clearly raises questions about the reliability of data collected, in particular through questionnaires. As highlighted by Ghisellini and Thurston, “Most companies identify their environmental impacts in a generic way, and the methodology used to assess their significance may hide serious biases” (p. 773).

Fourth, this paper can help managers and ISO practitioners to analyze the possible and perceived impact of implementing the standard. Reading the many studies on the subject is almost impossible for most managers, who can be influenced by one or a few papers that do not represent the whole literature. This systematic review therefore constitutes a saving of time and offers a more comprehensive picture on the subject than a single empirical study.

Limitations and avenues for future research

The limitations of this paper suggest avenues for future research¹⁵.

First, this systematic review depends on the methods used to measure the outcomes of ISO 14001 in the empirical literature studied. Its results tend, therefore, to reflect, not only the findings of empirical studies, but also their possible bias. Moreover, the salience, relevance and reliability of the indicators chosen to measure the effectiveness of ISO 14001 are rarely well established. As a result, the real impact of the standard is uncertain and specific issues such as greenhouse gas

¹⁵ See also Table 4 for more information on research gaps and avenues for future research.

emissions and biodiversity remain almost unexplored. Although this systematic review sheds more light on the existence of this type of unexplored issue, it does not directly address the gaps identified in literature. Future studies could delve deeper into understudied impacts and more rigorously demonstrate the reliability of performance indicators. Different sources of information, including governmental databases, should be used as much as possible rather than self-declared and perceptual measures that, as emphasized by Nawrocka and Parker (2009) in their review, are prone to be biased. Moreover, longitudinal studies, allowing further analysis of the long term impact of the standard, the role of early adoption and maturity of implementation, should be encouraged.

Second, this systematic review depends on the context of the existing literature, especially in terms of sample distribution and the status of respondents. Future studies should focus on the outcomes of ISO 14001 in emerging countries, notably China. The discrepancy between the importance of certification in China – which represent nearly 35% of all ISO 14001 certificates worldwide - and the small proportion of studies covering this region – about 11% - calls for more studies on the adoption of this standard in Chinese organizations. Moreover, the few studies on this region have highlighted internalization issues and the lack of professionalization of registrars (Yeung et al., 2005; Fryxell et al., 2004; Christmann and Taylor, 2006). Further research is needed on the possible relationships between these issues and the exponential growth of ISO certification in certain countries such as China. Moreover, the perceptions of stakeholders, including employees, on the implementation of ISO 14001 have largely been overlooked in the literature, as stressed by Heras-Saizarbitoria and Boiral (2013). Interviews with employees, consultants, registrars and former expatriate workers who have worked in certified organizations in China or others emerging countries would shed more light on the adoption and real internalization of ISO 14001.

Third, because of the selection criteria used in this systematic review – in particular the exclusion of papers not published in peer reviewed journals or where the methodology and data analysis are not clearly explained – some potentially interesting studies may have been ignored. Although this type of selection criterion is quite widely accepted in the systematic review approach (Transfield et al., 2003. Needleman, 2002; Pettigrew and Roberts, 2008), it can direct the analysis of the literature to a restricted set of studies.

Fourth, because systematic reviews focus on recurring themes, they mostly reflect the findings of the mainstream literature. As a result, certain interesting findings mentioned by one or a few studies may be obscured. For example, according to Bansal (Bansal and Bogner, 2002; Jiang and Bansal, 2003), the opacity of environmental impacts and visibility of certain activities have an impact on the adoption of the standard. The study by Potoski and Prakash (2013) also indicates that the visibility of environmental impact tends to increase institutional pressures and to improve the effectiveness of ISO 14001. This interesting avenue of research on the influence of environmental visibility on the adoption and outcomes of ISO 14001 should be further explored. In the same vein, the effectiveness of ISO 14001 certification in highly polluting industries could be compared with that in less polluting industries.

The in-depth analysis of the reviewed articles enabled us to detect a set of limitations or deficiencies that could suggest directions for future research. As stressed by Heras-Saizarbitoria and Boiral (2013) for the general case of the meta-standards, and Nawrocka and Parker (2009)

for the EMSs, a much wider spectrum of respondents should be involved in the field-work of the research studies, especially among NGOs and customers. Regarding the former, environmental activist groups have frequently criticized ISO 14001 for its lack of transparency (Aragon-Correa and Rubio-Lopez, 2007) but this issue has not been analyzed in depth in the literature. Similarly, the analysis of the signalling value of ISO 14001 in the eyes of different types of consumers has largely been overlooked. If companies are encouraged to adopt ISO 14001 in order to gain differentiation in the marketplace, the real perceptions of different types of customers, such as industrial customers and end consumers, should be analyzed rigorously. Furthermore, as underlined by Aragon-Correa and Rubio-Lopez (2007) the number of environmental standards has grown enormously in recent years and this is also the case for the eco-labels (Darnall and Aragón-Correa, 2014). Although ISO 14001 is probably the best-known certification scheme, there is a surprising absence of empirical work that examines the knowledge and perceptions that different types of customers have of this standard. And although it is frequently used as a product label, there has not been enough research into its real influence on consumers' purchasing choices. Most of the literature avoids analysis of these and other essential issues that are crucial for understanding the process of adoption of ISO 14001 and its real outcomes.

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