

# Using ISO 14001 certification to signal sustainability equivalence: an examination of the critical success factors

Udechukwu Ojiako<sup>a,b,c,d</sup>, Hamdi Bashir<sup>b</sup>, Houria Hassan Buhindi Almansoori<sup>b</sup>, Eman Jasim Hussain AlRaeesi<sup>b</sup> and Hassan Ahmed Al Zarooni<sup>b</sup>

<sup>a</sup>Department of Design, Manufacturing & Engineering Management, University of Strathclyde, Glasgow, UK; <sup>b</sup>Department of Industrial Engineering & Engineering Management, University of Sharjah, Sharjah, UAE; <sup>c</sup>Centre for Systems Studies, Hull University Business School, University of Hull, Hull, UK; <sup>d</sup>Johannesburg Business School, University of Johannesburg, Johannesburg, South Africa

## ABSTRACT

Organisations employ third-party certification for various purposes including to signal commitment to sustainability compliance and equivalence with stakeholders. However, while successful certification implementation requires a focus on its 'Critical success factors' (CSFs), its proliferation in the literature impedes its usefulness. To, therefore, gain insights into how individual CSFs can be employed to signal relevant compliance and equivalence, we conduct an in-depth case study with a public sector organisation based in the United Arab Emirates (UAE). We employ a three-staged study consisting of (i) literature-based CSF identification, (ii) interpretive structural modelling (ISM) relationship modelling/visualisation, and (iii) fuzzy Cross-impact matrix multiplication analysis (MICMAC)/Social network analysis (SNA) metric relationship analysis. Five key CSFs ('Top management commitment and support', 'Environmental policies and objectives', 'Government policies and Environmental legislation', 'Employee involvement', and 'Teamwork') are identified as requiring maximum priority for successful ISO 14001 certification in public sector organisations. Building on the findings, the originality of the paper is two-fold. First, we explore the phenomenon of the public sector subjecting itself to certification undertaken by private sector institutions. While this phenomenon is not very unusual, its exploration in an operations context is largely unknown. Second, we explore and explain to what extent information exchange emanating from the intricate and iterative interrelationship between the various CSFs driving successful third-party certification can be employed to signal sustainability compliance and stakeholder equivalence in public sector organisations.

## ARTICLE HISTORY

Received 28 February 2023  
Accepted 14 May 2024

## KEYWORDS

ISO 14001; certification; sustainability; signals; critical success factors

## SUSTAINABLE

DEVELOPMENT GOALS  
SDG 9: Industry, innovation and infrastructure

## 1. Introduction


*Environmental management systems* (EMSs) are primarily, processes and practices designed to assist organisations manage and reduce the impact of their operations on the environment (Corbett and Cutler 2000; Sroufe 2003; Melnyk, Sroufe, and Calantone 2003; González, Sarkis, and Adenso-Díaz 2008; Ronnenberg, Graham, and Mahmoodi 2011; Prajogo, Tang, and Lai 2014; Mosgaard, Bundgaard, and Kristensen 2022). Thus, EMSs therefore, play a major role in facilitating the compliance of organisations with environmental regulations and standards (Prajogo, Tang, and Lai 2014). There are different forms of EMS; for example, they can come in standardised forms or can be designed to specific organisational requirements (Galante et al. 2017).

Several organisations implement EMSs as part of their broader strategy for sustainable operations (Prajogo, Tang, and Lai 2014; Phan and Baird 2015; Heras-Saizarbitoria, Arana, and Boiral 2016; Galante et al. 2017; Wong, Wong, and Boon-Itt 2020). These include public sector organisations

(Lozano and Vallés 2007; Zutshi, Sohal, and Adams 2008; Mazzi et al. 2016) and, more specifically, public utilities (Homsy 2016; Kazagic et al. 2016; Rathore et al. 2018; Albastaki et al. 2021).

While an EMS can be employed by an organisation to demonstrate commitment to sustainability, it can also perform a certification role, signalling to shareholders (stakeholders) and the wider society the organisation's (i) adherence, commitment, and compliance to environmental sustainability principles and (ii) equivalence between its sustainable aspirations, intentions, and values and those of its stakeholders (Desai 2018). Thus, EMSs may serve as a tool that both public and private sector organisations may utilise to 'signal' trust, reliability, and legitimacy relating to sustainability. In our present study, we construe a 'Signal' to represent '...the deliberate communication of positive information in an effort to convey positive organizational attributes' (Connelly et al. 2011; p.44).

Signals are important because a major challenge facing numerous public sector organisations involves convincing

CONTACT Udechukwu Ojiako  [udi.ojiako@strath.ac.uk](mailto:udi.ojiako@strath.ac.uk)

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their stakeholders (i.e. the public) that their level of sustainability equivalence extends beyond mere superficiality/symbolism (Chowdhury, Prajogo, and Jayaram 2018; Iatridis and Kesidou 2018; Haack and Rasche 2021) and/or 'lip service' (see Klein 2021; ISG 2022). This challenge can be further exacerbated by limited access of these stakeholders to direct information about the sustainable activities of the organisation (due to information asymmetries). Third-party certifications such as EMS are, therefore, attractive as they represent one avenue by which public sector organisations can communicate their adherence to sustainable values, allowing stakeholders a means of assessing the nature of their sustainable activities. In our present study context, 'Certification' implies '...the process of assuring compliance with a standard by various instrumentalities' (Rosenberg 1976; p. 80). Over the last few years, the use of sustainability-related third-party certifications has increased exponentially among public sector organisations (see Chu and Wang 2001; Chu, Huang, and Wang 2001; Singh and Mansour-Nahra 2006; Rhodes 2007; Carey and Guttenstein 2008; Abdullah et al. 2013; Ćwiklicki, Pilch, and Żabiński 2020; Tawiah and Soobaroyen 2022).

The ISO 14001 standard is an example of an internationally recognised EMS standard. Thus, its use and implementation has continued to attract interest from a wide range of scholars (Hsu et al. 2013; Ivanova, Gray, and Sinha 2014; Prajogo, Tang, and Lai 2014; Simpson and Sroufe 2014; Hsu, Tan, and Mohamad Zailani 2016; Roehrich, Hojmoose, and Overland 2017). In recent years, given its popularity, there has been a rapid increase in studies focused on exploring factors likely to impede or enable ISO 14001 implementation. Existing studies are numerous (see Chin, Chiu, and Rao Tummala 1999; Babakri, Bennett, and Franchetti 2003; Sambasivan and Fei 2008; Chiarini 2019; Waxin, Knuteson, and Bartholomew 2019; Sorooshian and Yee 2019; Weerasinghe and Jayasooriya 2020; Ahmed and Mathrani 2023). These 'factors', which have generally been explored under the notion of 'Critical success factors', represent principle independent variables which are most likely to enhance the possibility of successfully implementing ISO 14001.

Despite previous studies in this area, there is still a need for further exploration into CSFs for ISO 14001 implementation in the context of public sector organisations due to a lack of detailed understanding of (i) the nature of interrelationship between individual CSFs relevant to public sector ISO 14001 implementation and (ii) how individual ISO 14001 implementation CSFs can be employed as signals by public sector organisations for sustainability compliance and stakeholder equivalence. We opine that, to give a clear signal of their environmental stewardship, it is of utmost importance that public sector organisations identify and leverage information on the specific CSFs likely to lead to the successful implementation of ISO 14001 standards. For these reasons, our study focuses on giving detailed answers to the following two questions.

RQ1: What are the CSFs driving successful ISO 14001 certification in public sector organizations and the nature of their interrelationship?

RQ2: How can individual CSFs driving successful ISO 14001 certification be employed by public sector organizations as signals for sustainability compliance and stakeholder equivalence?

To address these research questions, we structure the remainder of this paper as follows. In the next section (section 2), we articulate the key theoretical framing of our study which is *Signalling* theory. We also explore the intersection between signalling and third-party certification. In section 3, the key concepts to this study which include 'Public sector use of third-party certification', 'ISO 14001' and 'Critical success factors' are reviewed. We also review prior relevant studies. In Section 4, we present the research methodology. Specifically, we report on a three-staged study consisting of (i) literature-based CSF identification, (ii) interpretive structural modelling (ISM) relationship modelling/visualisation, and (iii) fuzzy Cross-impact matrix multiplication analysis (MICMAC)/Social network analysis (SNA) metric relationship analysis. We discuss our findings in section 5. The article concludes in Section 6.

## 2. Theory

### 2.1. Signals

While a variety of theories have been proposed to explain third-party certification (e.g. Rao 1994; Dranove and Jin 2010; Darnall, Ji, and Vázquez-Brust 2018; Lins et al. 2023), its theoretical foundations are widely acknowledged to be found within signalling theory (Kirmani and Rao 2000; Connelly et al. 2011; Karasek and Bryant 2012; Bergh et al. 2014; Taj 2016; Drover, Wood, and Corbett 2018; Yasar, Martin, and Kiessling 2020; Bafera and Kleinert 2023).

Essentially, with its origins in economics (see Spence 1973), signalling theory is the leading theory that explains how external parties (i.e. client/customer/the public) may seek to overcome a focal issue in their interactions with vendors (i.e. public sector organisation/s), and this focal issue is the existence of information asymmetries. The situation is that, if information on the sustainability activities of the vendor organisation was efficient, external parties would be perfectly informed and understand all the relevant issues, motives, internal processes of the vendor (Dineen and Allen 2016; Jean and Kim 2021), and so on, relating to the extent of vendors' equivalence with its (i.e. the external parties) sustainable aspirations, intentions, and values. Information asymmetry can have a major impact on (i) whether the client/customer (i.e. the public) does engage with the vendor (i.e. public sector organisation) and, if they do, (ii) the nature of their relationship. Information is rarely perfect, particularly in the context of sustainability activities of public sector organisations. The existence of information asymmetries is *the* underlying notion of signalling theory (Connelly et al. 2011).

To overcome these information asymmetries, there are two approaches that the external party may adopt (Desai 2018). They may seek to directly obtain such relevant information on the performance of the vendor. This can be done, for example, through an examination of financial reports published by the vendor or examining reports by organisations responsible for auditing central government departments such

as the National Audit Office (NAO) in the United Kingdom or the Supreme Audit Institution (SAI) in the United Arab Emirates. However, doing so may not be an attractive option (Desai 2018). For example, this information may not provide the necessary information or the granularity of detail which the external party needs/requires. Information sourced from other avenues may also be incomplete and unable to provide the level of assurance on the nature of the vendor's internal sustainable processes. Alternatively, the external party may seek to obtain such relevant information indirectly. In this case, they may seek to assess commentary, statements, and evaluations of the vendor's activities from reputable third parties with a history of previous interaction with the vendor.

They may also seek to rely on voluntary third-party certification and accreditation provided by well-established certifying institutions/accreditation bodies (see Dineen and Allen 2016; Desai 2018; Jean and Kim 2021). These certifications serve to convey a level of vendor competency and, thereby, signal likely expectations in terms of the vendor's sustainability compliance and equivalence. Under such circumstances, credible signals sent by the vendors can be employed by the external party to reduce information asymmetries. On this basis, certification obtained from recognised and well-respected bodies not only assists in reducing the effect of information asymmetry but also helps mitigate against moral hazard by substantiating the credibility of the certified organisation (Jean and Kim 2021). Busenitz, Fiet, and Moesel (2005) observe that signals are important because, when embedded into actions, they are generally construed as more reliable than verbal promises and words.

There are several core assumptions associated with signalling theory. One is that it is assumed that the signal being observed is trustworthy and credible (Vanacker et al. 2020). In effect, there is an assumption that signals should provide the external party (i.e. client/customer/the public) with a true and comprehensive picture of the vendor's daily decisions or the capabilities that the vendor employs as part of their daily routines (see Robson, Ojiako, and Maguire 2022). This effectively suggests that verification of signals may be important (Stahl and Strausz 2017). The adoption of specific practices is a general part of internal processes that the vendor does not need to fully disclose/make public. This means that signals may sometimes only reflect cues that an organisation wishes to convey. Another assumption of signalling theory is that a vendor will honour the implied promises that its signals convey to external parties (i.e. client/customer/the public). This assumption, however, resides on two points. One is the expectation that, in the vendor's assessment, not doing so will expend relational capital to the extent that not honouring its implied commitments becomes uneconomical. The expectation in this case is that when signals conveyed to clients/customers are not honoured, there is a potential that clients/customers will lose confidence in the organisation, ultimately ceasing continuation of business relationships (Kirmani and Rao 2000). It is expected that vendors are likely to lose out financially if their signals convey information which is misleading. Second is the expectation that the implied promises conveyed to clients/customers reflect the

expectations of the vendor (Saxton et al. 2019; Kharouf et al. 2020). Flowing from an acknowledgement that how third-party certification is employed as a signalling tool is context specific, the manner of the client/customer/public's interpretation of signals is dependent on the context (Cambier and Poncin 2020).

While different types of signals have been discussed in the extant literature (e.g. '*Nondissipative signalling*' in Bhattacharya (1980); '*Reliable signalling*' in Bliege Bird and Smith (2005); and '*Reputation signalling*' and '*Status signalling*' in Havakhor and Sabherwal (2018), more relevant marketing literature classifies signals into two main categories: '*Default-independent*' signals and '*Default-contingent*' signals (Kirmani and Rao 2000). Here, '*Default-independent*' signals are those where monetary/financial losses will occur independently (i.e. irrespective) of whether the cues conveyed to clients/customers are honoured or not. Conversely, '*Default-contingent*' signals are those where monetary/financial losses will occur when cues conveyed to clients/customers are not honoured. Kirmani and Rao (2000) further delimitate '*Default-independent*' and '*Default-contingent*' signals into sub-categories. However, for brevity, these are outside our current scope of interest.

## 2.2. Signals and third-party certification

Both public and private organisations have at their disposal numerous signalling channels that they can employ. These can include (i) reporting/marketing communication (Moratis 2016); (ii) development of a reputation for high-quality products and services; (iii) offering 'money-back' guarantees/warranties on products and services; (iv) fuller disclosure of product/service information of not only financial statements, but also product and service specifications; (v) use; and (iv) the use of third-party certification offered by professional licencing bodies and testing organisations (such as the ISO), and so on (Dewally and Ederington 2006). Although all these different channels have individually received considerable attention in the literature, third-party certification sends the strongest signal (Dewally and Ederington 2006). There are other reasons apart from its strong signalling potential which may drive the use of third-party certification by both public and private sector organisations, one being that because these certifications are primarily voluntary, private certifying institutions and accreditation bodies are very likely to offer 'complete' certification systems encompassing standards setting, compliance monitoring, and enforcement without external intervention (e.g. from the courts).

Third-party certifications, according to Rao (1994), '*... provide[s] extrinsic criteria of fitness and reduce the ambiguity caused by the lack of standards and the absence of complete knowledge*' (p. 32). Thus, as a form of endorsement (Desai 2018), organisations can, through certification, 'rent' the reputation of an external entity such as a trade association to assure its stakeholders of its adherence to sustainability values (Chu and Chu 1994). In the process, they become more able to '*... score favorably in relation to their rivals, induc[ing] them to devote resources to visible criteria of*

performance, stratify organizations, and generate status orderings of organizations that determine their access to resources' (Rao 1994; p. 32). Certification is usually based on adherence to guidelines, practices (including inspections), and standards that represent approximations of minimum acceptable business practice as relates to the environment (Lansing et al. 2019; Fanasch and Frick 2020). Signals emanating from being in possession of relevant sustainability certification may encourage stakeholders, who may be otherwise hesitant (due to a lack of information), to engage with the organisations in possession of the certification (Desai 2018; Jean and Kim 2021). In the process, certification signals to stakeholders a reduced level of uncertainty in transacting with the certified organisation. Signals through third-party certification bring several benefits to both client and vendor organisations (Desai 2018). These include (i) risk reduction, (ii) increased due diligence, (iii) increased confidence of compliance, and (iv) reduced insurance costs (Tanner 2000).

Understanding of the interface between signalling and certification has continued to develop. Some recent relevant studies include Stahl and Strausz (2017), Desai (2018), Heras-Saizarbitoria et al. (2020), and Lamin and Livanis (2020). The study by Stahl and Strausz (2017) provides an interesting economic perspective of how certification interfaces with market transparency. In acknowledging that the use of certification by external party (i.e. client/customer/the public) and vendor (i.e. public sector) organisations differs, they make several observations. For example, they observe that while clients primarily rely on certification for assurance purposes, vendors primarily use certification for signalling. They also highlight that when compared, vendor-driven certification is more likely to enhance transparency than certification which is driven by clients/customers. The reason for this is that, even when 'Default-independent', vendor-driven certification will be more information intensive. On the other hand, client/customer driven certification is likely to motivate certifying institutions/accreditation bodies to seek to limit transparency as it is only likely to increase the demand among clients for further inspections.

The study by Desai (2018) presents some insight which, while not of direct relevance to our present study, is worth briefly highlighting. For example, in acknowledging the benefits of voluntary third-party certification, Desai (2018) highlighted that its value will change over time. Notably, he developed theory suggesting the existence of three mechanisms that potentially could limit the efficacy of third-party certification. Specifically, Desai (2018) observes that the efficacy of third-party certification is likely to be negatively impacted when (i) an organisation seeks such certification within a short time after the occurrence of problems (which will suggest superficial/symbolic certification); (ii) when the third-party certifying institution/accreditation body certifies an increasing number of entities (leading to a dilution of legitimacy); and (iii) when an organisation that has recently obtained certification becomes subject to quality problems emanating from other entities certified/accredited by the third-party certifying institution (i.e. a phenomenon that he refers to as 'stigma transfer').

### 3. Literature

#### 3.1. Public sector use of third-party certification

Traditionally, a key characteristic of the modern state has been the existence of separate but co-existing markets, private institutions, and government/public sector organisations which are self-regulated (which is analogous to self-certifying) (Steurer 2013). Generally, part of the functions of government includes providing the monetary, fiscal, and legal framework needed for economic activities to operate effectively. Guiding and regulating private economic activity through for example, monetary and fiscal policy. Amongst others, these frameworks will be expected to set the necessary economic conditions for the maintaining of competition, resource allocation, income redistributing and stability. An interesting phenomenon emerges within the above dispensation when the public sector subjects itself to third-party certification undertaken by private sector actors (i.e. private/non-state certifying institutions and accreditation bodies). This phenomenon is not unusual (Scott 2002; Carey and Guttentstein 2008; Logue 2015; Rappaport 2017).

There is longstanding evidence of private regulation of the public sector in diverse areas such as economic policy (Schwarcz 2002) and crime prevention (Kempa et al. 1999; Van Steden and Sarre 2020). Public sector organisations (including public utilities—see Slacik and Greiling 2020) have also regularly sought certification offered by private certifying institutions such as the American National Standards Institute (ANSI), the European Union's Eco-management and Audit Scheme (EMAS), and the International Organisation for Standardisation (ISO). These certifications include (i) *ISO 14001* (Prajogo, Tang, and Lai 2014; Liu et al. 2020; Mosgaard and Kristensen 2020; Mosgaard, Bundgaard, and Kristensen 2022); (ii) the *Eco-Management and Audit Scheme (EMAS)* (Marrucci and Daddi 2022; García-Álvarez and de Junguitu 2023); (iii) *Green Globe* (Remizov et al. 2021); (iv) *Leadership in Energy and Environmental Design (LEED)* (Santa et al. 2020; Remizov et al. 2021); and (v) *Carbon Trust Standard* (Kern 2012).

Irrespective of widescale use, public sector use of third-party certification raises questions. For example, it raises questions as to whether and the extent to which private/non-state-certifying institutions and accreditation bodies should set standards on matters that have public policy implications (Scott 2002). This question is important because the motivations driving private certifying institutions, more often than not, are not perfectly aligned with that of the public interest (Logue 2015). The public sector's use of third-party certification also raises questions on possible undue influence of private institutions on public policy (Scott 2002). The extended period of the certification process provides private certifying institutions with a high level of access/proximity to some of the confidential work undertaken by the public sector. This can potentially mean that the public sector becomes less insulated from influence or potential attempts by private institutions to either directly or indirectly influence the setting, monitoring, and enforcement of public policy. This is important because the general opinion of

most literatures exploring potential regulation of the public sector by private institutions is that, more often than not, private sector institutions become entangled in critical public policy debates following access (see Scott 2002; Logue 2015; Rappaport 2017). These considerations are important when dealing with private certifying institutions whose legitimacy is not derived from any legal mandate (e.g. national legislation or treaties).

### 3.2. ISO 14001

Originally developed by the International Organisation for Standardisation (ISO) in 1996 (to date it has been subject to four major revisions in 2014, 2015, 2016, and 2019), ISO 14001 is one of the most popular EMS frameworks (Mosgaard, Bundgaard, and Kristensen 2022). It is also the most popular of the ISO 14000 family of standards which includes ISO 14004, ISO 14006, ISO 14015, and ISO 14064. One reason for its popularity is that it is not sector specific. It can be employed by any type of organisation (e.g. public, private, voluntary/non-governmental organisation) and, therefore, is extremely flexible (Prajogo, Tang, and Lai 2014; Mosgaard and Kristensen 2020). The ISO14001 can be used either in part or in whole as an EMS standard and assurance mechanism. It, however, generally does not provide warranties of optimum sustainable performance; instead, its focus is on articulating standard processes likely to enable an organisation to meet its objectives. The ISO 14001 standard also does not stipulate which sustainable objectives an organisation must meet (Sambasivan and Fei 2008). Instead, it focuses on the reduction of the environmental impact of an organisation's operations by focusing on five key areas; (i) *policy*—which deals with the organisations commitment to sustainable objectives and targets; (ii) *planning*—which deals with the preliminary schedule of tasks needed to achieve targets articulated in its performance policy; (iii) *implementation*—which focuses on the process of transformation that the organisation engages with in order to meet its sustainable targets; (iv) *monitoring/corrective action*—which focuses on the process for assessing what has been achieved against set out targets; and (v) *review*—which focuses on potential corrective action/intervention in light of changing needs and priorities.

While we acknowledge an unparalleled increase in the number of public and private organisations seeking ISO 14001 certification, we also draw attention to its burgeoning literature. Some scholars have discussed drivers for successful ISO 14001 certification implementation (Camilleri 2022). Other have discussed drivers for decertification/abandonment (Mosgaard and Kristensen 2020; Ferreira and Cândido 2021; Podrecca et al. 2021).

Some literatures have reported positive outcomes from ISO 14001 certification (Ikram et al. 2019; Arocena, Orcos, and Zouaghi 2021). Others have not found any evidence of positive performance outcomes (Blackman 2012). Some report that performance outcomes associated with ISO 14001 certification implementation are mixed, suggesting that the relationship between ISO 14001 certification implementation

and environmental performance is complex (e.g. Prajogo, Tang, and Lai 2014; Treacy et al. 2019). For example, Treacy et al. (2019) found that implementation of ISO 14001 practices will enhance performance in areas such as employee productivity and return on assets (ROA), with performance gains becoming stronger in several areas (such as productivity). However, they also found that, in certain areas such as fixed assets efficiency, ISO 14001 certification implementation will result in diminished gains over the long term (probably caused by maintenance challenges). On this basis, they concluded that benefits from ISO 14001 were likely to be intangible stemming mainly from changes in the organisation's philosophy rather than from tangible fixed assets.

The popularity of third-party certification such as ISO 14001 does not mean that it has not attracted criticism. Some scholars have cited the bureaucratic nature of the certification process as potentially outweighing any benefit to be obtained from its implementation (Bravi et al. 2020; Tayo Tene, Boiral, and Heras-Saizarbitoria 2021). Others opine that the use of third-party certification is, in effect, a political process that seeks to benefit several actors while simultaneously disenfranchising others (Brown and Getz 2008). Konefal and Hatanaka (2011) argue that the power and position of certain organisations with the expertise/resources to secure such certification, while other stakeholders—those without such expertise/resources—more often than not, are unable to secure such certification. As observed by Ponte (2008), it is necessary that certification is understood from the reality that it is undertaken '*...in the context of global and local competition, special interest battles, and local politics*' (p.171).

### 3.3. Critical success factors (CSFs)

Defined as the '*... factors that, to a great extent, determine whether the implementation will be successful*' (Umble, Haft, and Umble 2003; p. 244), the notion of '*Critical success factors*' (CSFs) was first introduced into academic literature by Rockart (see Rockart 1979, 1982; Bullen and Rockart 1981). The essence of his work is that firm executives being subjected to overwhelming amounts of information were likely to experience information overload. Such information overload will seriously impair their ability to determine what business areas needed the greatest management attention and focus (see Sumecki, Chipulu, and Ojiako 2011). Thus, by focusing on the '*Critical success factors*' (CSFs), executives will maintain clarity on the relatively few important activities within the business where 'things must go right' (Rockart 1979; Bullen and Rockart 1981).

The popularity of CSFs as a concept has led to its widespread appeal across a range of disciplines including operations management (Hastig and Sodhi 2020; Kumar et al. 2023; Ojiako et al. 2023). Its appeal has also extended to sustainable operations (Chiappetta Jabbour, Mauricio, and Jabbour 2017; Kumar et al. 2023) and, more precisely, to sustainability certification (Chin, Chiu, and Rao Tummala 1999; Babakri, Bennett, and Franchetti 2003; Sambasivan and Fei 2008; Cassells, Lewis, and Findlater 2011, 2012; Ivanova, Gray, and Sinha 2014; Luthra, Garg, and Haleem 2015a, 2015b,

Luthra et al. 2018; Chiarini 2019; Waxin, Knuteson, and Bartholomew 2019). Despite its popularity and widespread use, though, CSF-related research has attracted some criticism. This criticism touches on three areas. First is observed proliferation of success factors in the literature (Wateridge 1995). Second, they are limited in terms of real use due to their variation in scope and purpose (Ojiako et al. 2023), despite being mostly characterised by specificity (see Belassi and Tukul 1996). Third, is their un-usefulness because they are generally described to such a high level that practitioners are unable to use them (Netland and Aspelund 2014). These observations appear to also extend to CSFs for ISO certification where a vast amount of literature is gradually developing.

Within the context of third-party certification, identification of CSFs is important as it allows managers to explicitly ascertain what relatively few important activities within their certification program require focused and comprehensive management attention. Furthermore, its understanding will help to ensure that certification does not lead to superficial adoption but will ensure the embedding of new managerial practice within an organisation's routines and processes. In essence, therefore, the identification of CSFs will contribute to the development of organisations which are more sustainable in their production operations.

### 3.4. Prior studies

There are three strands of studies of relevance which we now briefly outline. The first deals with signalling. The second deals with the use of third-party certification as a signalling tool by public sector organisations. The third deals with CSFs relevant to ISO 14001 adoption/implementation.

As relates to overall signalling studies, our understanding of this literature is fragmented across three knowledge areas: (i) Studies focused on exploring how signals can be successfully and effectively transmitted of which motives of target audience is a necessity. This literature suggests that how individual signals are interpreted vary among the target audience. (ii) Studies focused on mode of signalling. (iii) Studies focused on exploring the extent to which signalling effectiveness can be impacted by an organisation's maturity/experience (Kirmani and Rao 2000; Connelly et al. 2011; Karasek and Bryant 2012; Bergh et al. 2014; Bafera and Kleinert 2023).

Evidence of the use of third-party certification as a signalling tool in the public sector has been reported in the literature (Chu and Wang 2001; Chu, Huang, and Wang 2001; Singh and Mansour-Nahra 2006; Rhodes 2007; Carey and Guttenstein 2008; Abdullah et al. 2013; Ćwiklicki, Pilch, and Żabiński 2020; Tawiah and Soobaroyen 2022). These literatures suggest that the public sector is motivated to use, encourage, and enable the development and implementation of voluntary third-party certification standards as a public signal for a diverse range of reasons. These motivations will generally be dependent on the circumstances of individual public sector entities as relates to their routines, capabilities (including awareness), and operational practices. For

example, Chu, Huang, and Wang (2001) note that ISO certification is generally employed to signal '*... credible... process quality control*' (p. 396). The same assertion is made by Chu and Wang (2001) who observed the use of ISO certification by public sector organisations to signal its focus on addressing environmental, financial, and social concerns of citizens. Similar views are expressed by Singh and Mansour-Nahra (2006), Carey and Guttenstein (2008), Abdullah et al. (2013), Ćwiklicki, Pilch, and Żabiński (2020), and Tawiah and Soobaroyen (2022).

Carey and Guttenstein (2008), for example, observe that the motivation to engage in third-party certification by a public sector organisation may be to signal '*Governance*' compliance and equivalence in areas of sustainability such as best practice, international credibility and recognition, reputation, resource sharing, and change promotion, among others. It may also be driven to signal '*Policy*' compliance and equivalence, an example being to signal value added to products and services delivered by the public sector organisation. Abdullah et al. (2013), on the other hand, observe the implementation of ISO standards within the Malaysian government to signal to citizens that its various agencies are operating not only effectively, but at a '*world-class*' level. Although not focused on ISO certification, there are two studies which we deem of relevance to our current research. The first, Hayward and Vertinsky (1999), examined managers' perceptions of third-party certification, and found that businesses utilised certification for different signalling purposes (e.g. commitment to stewardship, intrinsic needs/e.g. external validation, and extrinsic needs/e.g. the maintenance of a perceive '*public license*' to operate. The second, Tawiah and Soobaroyen (2022), examined how adoption of third-party accounting standards serve to signal improved accountability and information transparency by national governments seeking to secure financial assistance from international institutions such as the International Monetary Fund (IMF) and the World Bank. In sum, while these literatures have identified the various signals driving successful ISO certification, none has explicitly examined how individual CSFs driving successful ISO 14001 certification are employed to signal sustainability compliance and equivalence (the study by Carey and Guttenstein provides a brief outline as shown in Table 1).

As relates to the second strand of studies, above, we highlighted that several prior studies have examined CSFs in the context of ISO 14001 adoption/implementation. These studies include Chin, Chiu, and Rao Tummala (1999) who focused on manufacturing firms in Hong Kong, identifying four key CSFs as (i) '*management attitude*', (ii) '*organisational change*', (iii) '*external and social aspects*', and (iv) '*technical aspects*'. Babakri, Bennett, and Franchetti (2003) focus was on industrial firms in the United States. Framing CSFs as elements of ISO 14001 requiring the most effort to implement, they identified 17 such elements, of which eight were determined as the most critical. Sambasivan and Fei (2008) focused on electrical/electronics firms in Malaysia, identifying four CSFs for ISO 14001 adoption/implementation as (i) '*management approach*', (ii) '*organisational change*', (iii) '*technical aspects*', and (iv) '*external and social aspects*'.

**Table 1.** Example of third-party certification signals used by public sector organisations.

Governance signals	Policy signals
Independent verification signals adherence to best practice	Signals key attributes of fair and ethical trading (e.g. development and cooperation)
Signals credibility and international recognition	Signals improved labour practices, working conditions, and the support for social accountability.
Will facilitate resource sharing	Adds value to products and services designated for foreign export
Key to the management of reputational risk	
Key to the promotion of transformation without the need for regulatory constraints	

Cassells, Lewis, and Findlater (2011, 2012) focused on Small and Medium Enterprises (SMEs) in New Zealand. Six CSFs were identified in both their studies; namely, (i) 'management commitment and involvement', (ii) 'employee involvement', (iii) 'developing internal capabilities and competencies', (iv) 'clear implementation strategy', (v) 'internal resource availability' and allocation' and (vi) 'employee training'. This study was extended in Cassells, Lewis, and Findlater (2012) where all but one of the previous CSFs (in this case, 'employee training') was not identified as a CSF for of ISO 14001 adoption/implementation. Cassells, Lewis, and Findlater (2011) differs from Cassells, Lewis, and Findlater (2012) in that the second study was not focused solely on SMEs. In Ivanova, Gray, and Sinha (2014), eight CSFs were identified spread across three phases of ISO 9001/ISO 14001 implementation.

Other studies on of ISO 14001 adoption/implementation CSFs reported in the literature include Chiarini (2019) which focused on Italian construction firms, Luthra, Garg, and Haleem (2015a, 2015b, Luthra et al. 2018) situated in an Indian context, and Waxin, Knuteson, and Bartholomew (2019). Our study differs from their studies in three ways. First, we acknowledge the classical view of CSFs advanced by Rockart (see Rockart 1979, 1982; Bullen and Rockart 1981) which lays emphasis on the need to tailor CSFs to either managers, organisations, or industry sector. The Waxin, Knuteson, and Bartholomew (2019) study does not appear to acknowledge the need for such emphasis, focusing on either 'private' or 'public' organisations which we construe as too broad for application. Second, while their studies employ qualitative research approaches, we employ quantitative means and, more precisely, interpretive structural modelling (ISM) to identify the relevant CSFs. Third, they do not examine the interrelationships between these CSFs which we do so using *fuzzy* cross-impact matrix multiplication applied to classification analysis metrics (MICMAC) and a social network analysis (SNA) metric.

Our present study is, therefore, timely because, despite the prodigious nature of literature on the use of third-party certification as a signalling tool by public sector organisations and literature on CSFs relevant to ISO 14001 certification, both streams of literature have progressed relatively independent of each other. The implication is that we are still unclear as to (i) the specific CSFs driving successful ISO 14001 certification in public utilities and the nature of their interrelationship and (ii) how individual CSFs driving successful ISO 14001 certification can be employed as signals for sustainability compliance and stakeholder equivalence.

## 4. Methods

### 4.1. The UAE context

Our study is set within the context of the United Arab Emirates (UAE). The UAE is a sovereign state located along the south-east of the Arabian gulf. Driven by economic and population growth, the UAE is a major intensive energy economy (Enerdata 2022; United States Energy Information Administration 2022). Total energy consumption per capita in the UAE is 11<sup>th</sup> highest in the world in 2021 while per capita electricity consumption is the 8<sup>th</sup> highest in the world in 2021. The country also generates approximately 98% of its electricity (in 2018) utilising natural gas-fired power (BP 2019). The International Energy Agency (IEA 2022) observes that natural gas-fired power has contributed to an increase in CO<sub>2</sub> emissions by approximately 3% which must be reduced to achieve global net zero emission targets.

The UAE government recognises the need to promote sustainable development and has set out several green/sustainability initiatives and policies. These include (i) a national climate change plan which sets out the country's ambitions to reduce its carbon footprint by 2030 (UAE Ministry of Climate Change & Environment 2022); (ii) a national green development strategy which sets out the country's ambitions for investment in not only clean energy but also in green infrastructure in order to drive sustainable economic growth (UAE Telecommunications Regulatory Authority 2019); and (iii) legislation, e.g. Federal Law No. 24 of 1999 (which sets out national regulations directed at environmental protection and development) and Federal Law No. 2 of 2015 (which regulates the use of genetically modified organisms in a manner that protects the environment). The UAE intends based on its Energy Strategy 2050, to diversify energy sources of energy generation to include 44% clean energy, 38% gas, 12% clean coal, and 6% nuclear (UAE (Ministry of Energy & Industry) 2022). To actualise this ambition, the country has sought to invest heavily in nuclear energy. For example, it recently commissioned (in 2020) the Barakah Nuclear Energy Plant which provides the country with the capacity to reduce greenhouse gas emissions by approximately 25% and provide a reliable source of low-carbon energy without the emissions associated with fossil fuels (UAE (Ministry of Energy & Industry) 2019; United States Energy Information Administration 2022).

The use of ISO 14001 has rapidly diffused across many countries including the UAE (ISO 2021, 2022). This diffusion extends to public and private organisations including public

utilities. Overall, ISO 14001 remains the most widely used EMS standard in the UAE (Waxin, Knuteson, and Bartholomew 2019; Bashir et al. 2022a). Furthermore, the overall adoption of ISO 14001 in the UAE remains the highest across the Cooperation Council for the Arab States of the Gulf/GCC (i.e. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE). For example, to date, the number of ISO 14001 certificates issued across the GCC region is 6400 (ISO 2022) of which 2733 have been issued to UAE organisations. In comparison for example, 199 certificates were issued to organisations in Bahrain, 387 in Kuwait, 441 in Oman, 952 in Qatar and 1688 in Saudi Arabia.

#### 4.2. The study

In Figure 1 (below), we show a representation of the overall study. Our approach, which is inspired by systems thinking, focuses on (i) identification of problem/setting of study objectives, (ii) quantification of the problem and then determining the solution, and (iii) solving the problem.

To identify the critical success factors (CSFs) for implementing the ISO 14001 certification standard, relying on Bullen and Rockart (1981) suggestion that their identification and evaluation were best undertaken '...through soft, subjective information not currently gathered in an explicit formal way' (p. 14), we chose to undertake our studies via a case study (Yin 2017; Volmar and Eisenhardt 2020). Case studies are a popular research approach employed in operations management for knowledge creation (Barratt, Choi, and M. Li 2011; Childe 2011, 2017; Ketokivi and Choi 2014). Case studies have been found particularly useful in terms of their ability to generate, test, and embellish theory (Ketokivi and Choi 2014). Furthermore, they can serve as an intensive source of real-life knowledge (Yin 2017).

The organisation in question (Organisation 'X') is a major public utility generating, transmitting, and distributing water and electricity in the UAE. We focus on public utilities because, globally, most utilities are organised as public entities (Palaniappan et al. 2004; Dominguez et al. 2009; Lieberherr and Truffer 2015). Public utilities are, therefore,

not only the primary producers of consumer energy but also a major polluter. In fact, the United States Environmental Protection Agency (2023) has found that, in 2021, energy production (specifically, electricity) represents approximately 25% of greenhouse gas emissions (following transportation at 28%). Furthermore, compared to those privately owned/operated, public utilities are poor innovators (Ojiako et al. 2024). There are various reasons why this is the case, including their public interest role (Negassi et al. 2019).

Driving the ISO 14001 certification program of Organisation 'X' were a combination of internal (cost savings and financial performance) and external factors (compliance with national legislation and brand reputation among customers). Netland and Aspelund (2014) observed that it cannot be assumed that CSFs that are of relevance to single operational facilities will be applicable across networks of factories. On this basis, to avoid superficial implementation of ISO 14001 certification, it is necessary to explore CSFs from a multi-facility perspective.

#### 4.3. Our approach

To address the research questions, we employ a three-staged study. The first stage of the study involved the identification of the CSFs. The second stage involved CSF relationship modelling. The third stage involved the analysis of the relationships among the CSFs. In Figure 2, we show the flow chart for implementing our three-stage method approach.

##### 4.3.1. First stage (identify the CSFs)

This stage concerned identifying a preliminary list CSFs and then examining its face validity using an expert panel drawn from Organisation X's senior management cadre (see Stage 1 of Figure 2). To identify the CSFs, we adopted an approach similar to Luthra, Garg, and Haleem (2015a, 2015b, Luthra et al. 2018). This involved extracting a list of CSFs from the relevant studies on CSFs for ISO 14001 certification standard implementation. These studies were described earlier in our literature section.

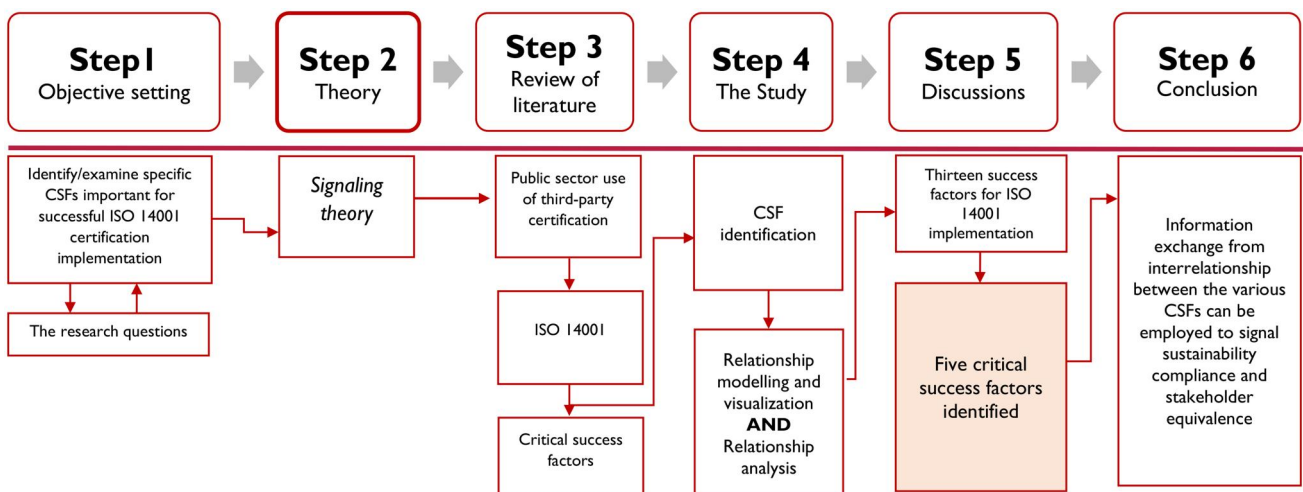


Figure 1. The overall research.



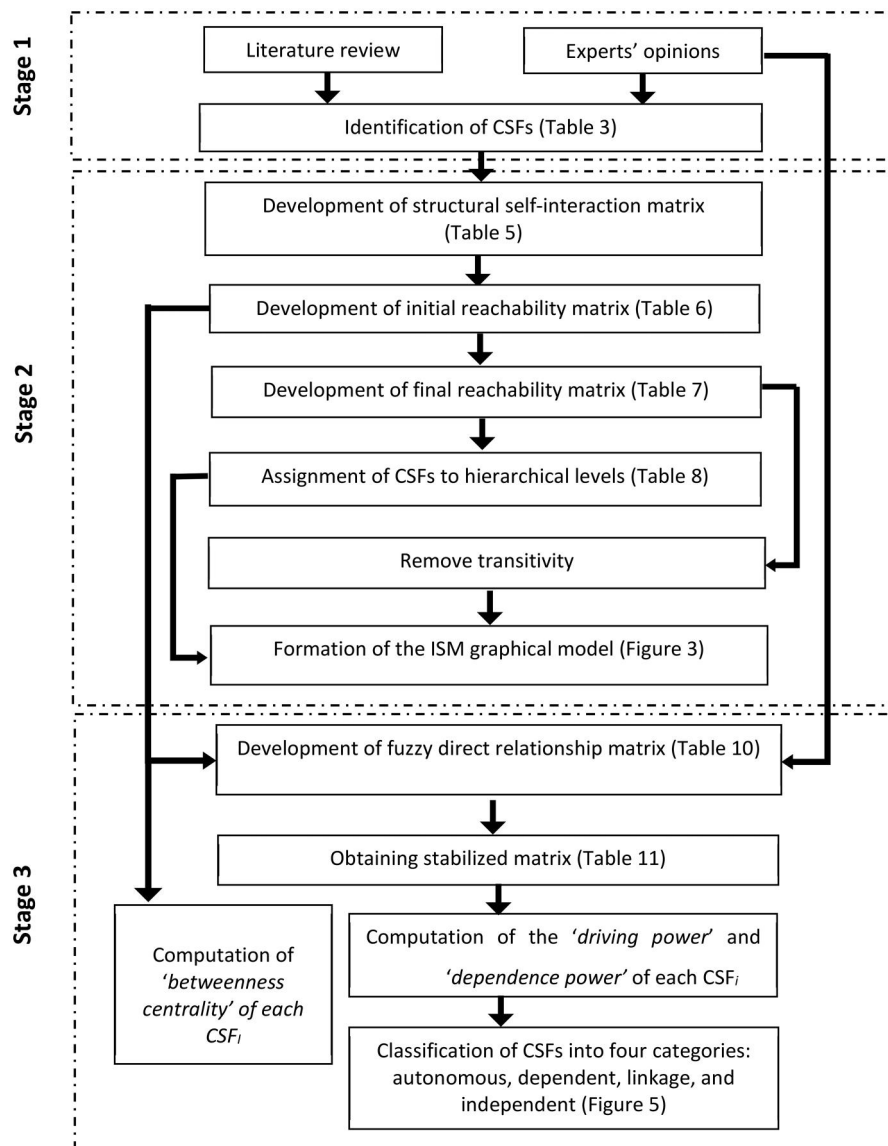


Figure 2. Flow chart for three-stage method.

The process of identification was undertaken based on a process earlier described by Chipulu et al. (2016) and Al-Mazrouie et al. (2021). It involved the first and second authors first independently reviewing the 10 papers in question (i.e. Chin, Chiu, and Rao Tummala 1999; Babakri, Bennett, and Franchetti 2003; Sambasivan and Fei 2008; Cassells, Lewis, and Findlater 2011, 2012; Ivanova, Gray, and Sinha 2014; Luthra, Garg, and Haleem 2015a, 2015b, Luthra et al. 2018; Waxin, Knuteson, and Bartholomew 2019). All CSFs identified in each of the papers were independently collated and cross-checked to ensure similarity (shown in Table 2).

The first and second authors then undertook CSF matching/consolidation and value assigning using a scale of '0' for 'not related', '1' as 'maybe related' and '2' as 'very closely related'. Earlier, Hallowell and Gambatese (2010) outlined that several desirable competencies should determine expertise (i.e. qualification and experience) among researchers utilising subjective study techniques. These competencies include first or second author of a minimum of three peer-reviewed

journal papers; a minimum of five years of professional experience in industry; and an advanced degree in the discipline. The expectation was that rigour in research was more likely to be achieved with the researcher meeting, at the least, four of the requirements. Both authors engaged in this process not only satisfied Hallowell and Gambatese (2010) desirable competencies but were also conversant with utilising the assessment scales based on prior experience and involvement in research projects employing similar evaluation/judgement scales (i.e. Chipulu et al. 2019; Al-Mazrouie et al. 2021). In addition, both had previously published on the subject area (Bashir et al. 2022a).

As in Chipulu et al. (2019) and Al-Mazrouie et al. (2021), for every CSF identified in these 11 papers, the scores of the first and second authors were summed up. The MS Excel spreadsheets with the summed scores were then exchanged, followed by a discussion on the outcome of the exercise. This process was repeated with the intention that the first and second authors will either retain or change their previous scores considering visibility of the others scoring from



Table 2. Continued.

Author(s) and Year	Key Findings/Contributions
Chin, Chiu, and Rao Tummala (1999)	Environmental specialist assistance
Babakri, Bennett, and Franchetti (2003)	Uncertainty about the benefit implementing the 14001 standards Additional training requirements Lack of top management commitment Lack of environmental performance improvement Employee resistance Lack of concern about environmental issues
Sambasivan and Fet (2008)	Production process enhancement Monitoring and measuring equipment Environmental specialist assistance
Cassells, Lewis, and Findlater (2011)	
Cassells, Lewis, and Findlater (2012)	Management commitment and involvement
Ivanova, Gray, and Sinha (2014)	
Luthra, Garg, and Haleem (2015a)	
Luthra, Garg, and Haleem (2015b)	
Luthra et al. (2018)	Ethical and safe Practices Community welfare and development considerations Competitiveness and brand image considerations
Waxin, Knutesson, and Bartholomew (2019)	

the first round. A finally agreed spreadsheet produced by the first and second authors was then compared. Following discussions and the renaming of some of the CSFs and the reaching of consensus, an initial list of 22 CSFs for ISO 14001 certification standard implementation was identified. Once completed, over a period of approximately 12 weeks (between 6 June 2022 and 2 September 2022), ‘expert’ judgement within the case organisation via a Delphi process was undertaken. The Delphi process has been widely employed in operations management and related studies focused on ISO 14001 implementation (Horry, Booth, and Mahamadu 2022; Kafel and Nowicki 2022).

Cognisant of previous UAE-specific studies (see Al-Mazrouie et al. 2021; Ojiako et al. 2024), the approach adopted is now briefly explained. First, an expert panel was constituted. To the best of our knowledge, the Delphi process does not stipulate an appropriate number of participants. Rowe and Wright (1999), for example, suggest that between three and eighty participants could be part of a Delphi cohort. Panel members consisted of six senior managers from Organisation X. The emphasis was on managers because they exert considerable and direct influence on not only sustainability practices within organisations (Arora et al. 2020; Fritz and Cordova 2023) but also on their certification efforts (Geerts 2014). The same applies to public sector organisations (Huang and Villadsen 2023). Baines and Shi (2015) point out that the most essential factor for panel members in a Delphi study is their expertise; however, there is limited unanimity on the definition of an ‘expert’ in the literature. Meyer and Booker (2001) had defined an expert as ‘... a person who has background in the subject area and is recognized by his or her peers or those conducting the study as qualified to answer questions’ (p. 3). Soanes and Stevenson (2004), on the other hand, define an expert as a ‘... a person who is very knowledgeable about or skillful in a particular area’. Ericsson, Prietula, and Cokely (2007) suggest that, for an individual to be determined an expert, they must meet three criteria: (i) their performance must without fail exceed that of their contemporaries; (ii) they must be able to deliver results that are verifiable; and (iii) they must be able to replicate and measure their performance.

In Delphi studies, there are no established guidelines for determining who is an ‘expert’ (Baker, Lovell, and Harris 2006). Thus, determination of expertise focused on panel members in possession of the knowledge competency to grasp, evaluate, and discuss the key issues relating to public utilities seeking third-party sustainability certification undertaken, and the likely CSFs that may drive the success of such an endeavour (see Fosso Wamba and Ngai 2015).

To ensure operational experience, all panel members had significant responsibility (and, therefore, relevant insight) for driving Organisation X’s ISO 14001 certification program. Previous studies (e.g. Durugbo et al. 2021; AlMalki and Durugbo 2023) had construed that panel members in a Delphi study who are in possession of a bachelor’s degree and who also have at least two years of relevant working experience in the subject matter of interest/issue being

investigated are able to satisfy objective inclusion conditions to be regarded as experts.

To summate, panel members (i.e. the six managers) were selected on the following bases: (i) have significant individual experience of at least five years in the organisation's energy production operations regarded as comparable to the status of a Chartered Engineer ([www.engc.org.uk/ceng](http://www.engc.org.uk/ceng)) as expected for registration by the United Arab Emirates Society of Engineers ([www.soeuae.ae](http://www.soeuae.ae)); (ii) had a long association with Organisation X's sustainability program; (iii) had prior involvement delivering other certification programs within Organisation X; (iii) had experience and knowledge of Organisation X's operations (Baines and Shi 2015); and (iv) expressed confidence that they had acquired relevant high-level and practical knowledge, and consistently demonstrated superior performance developed through a substantial amount and quality of practical experience (Ericsson, Prietula, and Cokely 2007; Hassan et al. 2015). This level of expertise was extremely important to ensure that we could draw on their critical insight of the CSFs which had been derived initially from literature. Each member of the panel was asked to indicate to what extent the 22 individual CSFs best aligned with Organisation X's program for implementing ISO 14001 certification. The SOE is the professional engineering body (promulgated under UAE Ministerial Decree No. 331 1979) responsible for regulating the engineering profession in the UAE.

The study then proceeded as follows. In a tick box, the panel members were requested to indicate which of the 22 CSFs they deemed irrelevant and to comment on the identified list. On completion, each panel member was then requested to rank the individual CSFs in terms of relevance (using a simple three-point scale of '0' as 'not relevant', '1' as 'may be relevant', and '2' as 'very relevant'). A three-point scale and not a five-point scale was employed based on the literature (see Jacoby and Matell 1971; Lange et al. 2020) which suggests that three-point scales—when compared to the use of five-point, seven-point, or even nine-point scales—generally provide more straightforward and realistic choices to respondents. More specifically, Jacoby and Matell (1971) note that '*... both reliability and validity are independent of the number of scale points used for Likert-type items*' (p. 498). The forum was then opened up for discussion, allowing panel members to discuss their individual choices and reasons for ascribing specific scales of relevance to the individual CSFs.

The discussion also touched upon differences in assigned scales of relevance. Finally, the panel members were asked to consider revising their choices of relevance (if need be) and providing further comments/feedback on the CSFs. A Relative Importance Index to be able to change the outcome from this exercise into decimals was developed (see Kometa, Olomolaiye, and Harris 1994). Slight adjustments were made where necessary to the title of the CSFs. Noting that the study was undertaken in the UAE where the official business language is Arabic (العربية), based on prior studies (see Al-Hanshi, Ojiako, and Williams 2022; Ojiako et al. 2024), attention was particularly paid to ensure that challenges associated with syntactical, idiomatic, and/or grammatical equivalence did not arise when seeking to translate the CSFs

from English to Arabic (and vice versa). To this extent, while the discussions during the Delphi were primarily conducted in Arabic (since all panel members were native Arabic speakers), as all were also fluent English speakers, the recordings of the rankings were all in English. The result of this exercise was the identification of 13 CSFs deemed of relevance to ISO 14001 certification implementation. As the authors were particularly mindful of potential misreading and mis-conceptualization of emerging CSFs, emphasis was laid throughout the process described above to encourage the participants to express their views and then, if/when needed, seek necessary clarification to dispel potential misinterpretations. Furthermore, participants could modify and amend their responses. Table 3 shows these CSFs and their descriptions.

#### 4.3.2. Second stage (CSF relationship modelling)

Relationship modelling/visualisation of the CSFs were undertaken utilising Interpretive Structural Modelling (ISM). The ISM was introduced by Warfield (1974) as a technique for identifying the relationships between system elements. It has three main characteristics in that its interpretive nature allows specialists and analysts to judge the relationships among and between elements. Also, its structural nature allows for variables to be obtained based on association. Furthermore, as a modelling technique, it allows for hierarchical models with nodes and directed arcs to be represented, with nodes representing variables (elements) of the system and arcs indicating the directions of their association.

Having identified 13 CSFs of relevance to ISO 14001 certification implementation, the expert panel next proceeded to examine the association among the identified CSFs. A five stepped process was employed (see Stage 2 of Figure 2). *Step 1*: develop a structural self-interaction matrix (SSIM); *Step 2*: develop an initial reachability matrix from the SSIM; *Step 3*: obtain a final reachability matrix; *Step 4*: partition the final reachability matrix obtained into levels; and *Step 5*: construct an ISM hierarchical graphical model. Our focus was to ensure that the panel established the strength of the relationships between the different CSFs. This stage allowed for an SSIM to be developed (via the panel members conducting a pairwise comparison of the relationships among the identified CSFs). The following symbols were used to signify the direction of the association among CSFs:

1.  $V$  reflects that  $CSF_i$  influences  $CSF_j$ .
2.  $A$  reflects that  $CSF_j$  influences  $CSF_i$ .
3.  $X$  reflects that  $CSF_i$  and  $CSF_j$  influence each other.
4.  $O$  reflects that  $CSF_i$  and  $CSF_j$  are independent.

The substitution rules that we employed are shown in Table 4 while we show the SSIM that emerged from the pairwise comparison undertaken by the expert panel in Table 5. We then sought to transform the SSIM into an  $n \times n$  initial reachability matrix (IRM), in which  $n$  represents the number of CSFs, by replacing the four symbols ( $V$ ,  $A$ ,  $X$ , and  $O$ ) with ones and zeros.

**Table 3.** Brief descriptions of the identified CSFs.

CSFs	Description
1 'Top management commitment and support'	Top management facilitates ISO 14001 certification implementation by encouraging employee commitment and competencies. Top management will also champion the development of a change culture within the organisation.
2 'Environmental policies and objectives'	Policies form the basis upon which public sector organisations set their ISO 14001 certification objectives and targets (including monitoring/corrective action); Public sector organisations also play a critical role in influencing and driving environmental policies and objectives/sustainability agenda.
3 'Management reviews'	Top management must continuously assess the organisation's sustainability programs and ISO 14001 certification regime to ensure alignment, suitability, adequacy, and efficiency with government policy.
4 'Employee involvement'	Employees are the first to directly improve sustainable performance. Employee engagement is key to public sector organisations meeting their certification initiatives.
5 'Training and awareness'	Training and awareness of relevant objectives, targets, and obligations is critical to ensuring successful embedding of new ISO 14001 practices into pre-existing organisational routines. Awareness is critical, especially as relates to the consequences of non-compliance.
6 'Internal motivation for EMS certification'	An organisation is more likely to benefit from ISO 14001 if it is internally motivated to seek certification. Motivation is important noting that certification takes considerable time and that its benefits may also take time to accrue.
7 'Documentation and control'	As part of overall compliance and management, organisations generally have to establish document control systems for the storing and management of documents related to their environmental sustainability programs.
8 'Effective communication'	Good manager–employee communication and collaborative management are essential for internal commitment to ISO 14001 certification implementation.
9 'Government policies and Environmental legislation'	Global environmental concerns emerge along with government involvement via financial instruments and green legislation. Government regulation and legislation are major drivers for any organisation's interest in seeking ISO 14001 certification implementation.
10 'Teamwork'	Working as a team creates opportunities for brainstorming, mutual relationships, involvement, and cooperation.
11 'Green business practices'	Green business practices are environmentally friendly practices that an organisation implements to become more sustainable.
12 'Environmental specialist assistance'	This assistance helps understand and assess an organisation's technical and operational issues that could significantly impact successful ISO 14001 certification implementation.
13 'Auditing'	Auditing is a systematic, independent, objective, and documented fact-gathering process to identify areas for improvement and ensure that an organisation uses best practices.

**Table 4.** Substitution rules for SSIM transformation.

Entry in SSIM ( $i, j$ )	Entry in IRM	
	( $i, j$ )	( $j, i$ )
V	1	0
A	0	1
X	1	1
O	0	0

Table 6 shows IRM produced by making the substitutions. On its completion, the transitivity principle constructed the last reachability matrix (FRM). The transitivity denotes that, when  $i$  influences  $j$  and  $j$  influences  $k$ , then  $i$  necessarily impacts  $k$ . Table 7 shows the FRM obtained by multiplying the IRM repeatedly until it stabilised by applying Boolean matrix multiplication. In the FRM, we used '1' to denote the presence of a direct relationship and '1\*' to indicate indirect relationship'. For instance, Table 7 illustrates that 'Top management commitment and support' (CSF1) exhibits a direct connection with 'Environmental policies and objectives' (CSF2) and an indirect connection with 'Management reviews' (CSF3), 'Training and awareness' (CSF5), 'Documentation and control' (CSF7), 'Effective communication' (CSF8), 'Green business practices' (CSF11), and 'Auditing' (CSF13).

We then proceeded to assign every  $CSF_i$  to one of the levels of in the ISM hierarchical graphical model by ascertaining the intersection of the reachability and antecedent sets. For every  $CSF_i$ , the reachability set  $R(CSF_i)$  is the set of CSFs reachable from  $CSF_i$ . Likewise, for each  $CSF_i$ , the antecedent set  $A(CSF_i)$  is the set of CSFs that reach  $CSF_i$ . The  $CSF_i$  with

similar  $R(CSF_i)$  and  $A(CSF_i)$  was considered the lowest level  $CSF_i$  in the ISM hierarchical graphical model. To determine the next CSFs level that employed the same process, all the lowest-level CSFs were then excluded from all the reachability and antecedent sets. This iterative process was repeated until all CSFs were apportioned to six levels as shown in Table 8.

The last step in this *second stage*—i.e. *modelling of the relationships among CSFs*—involved developing a model to visualise the associations among the CSFs. This process involved taking away transitivity to build the simple hierarchical graphical model shown in Figure 3.

#### 4.3.3. Third stage (analyze the relationships among CSFs)

To analyse the relationships among CSFs, we employed a hybrid fuzzy cross-impact matrix multiplication analysis (MICMAC)/Social network analysis (SNA) metric (see Stage 3 of Figure 2). MICMAC is an acronym for *matrice d'impacts croisés et multiplication appliquées à un classement* (i.e. *Cross-impact matrix multiplication analysis*). MICMAC was developed by Duperrin and Godet (1973) to analyse the relationships among the variables for the categorisation and, thus, determine a system's most critical variables based on their driving and dependence powers. These were shown using *Social network analysis* (SNA). There are two variants of MICMAC analysis: the classical version and the *fuzzy* version. In the classical version, binary relations represent the association between every two variables. On the other hand, the

Table 5. Structural self-interaction matrix.

	13	12	11	10	9	8	7	6	5	4	3	2
1	0	0	0	0	0	0	0	0	0	0	0	V
2	0	0	0	0	A	V	0	0	V	0	0	
3	0	0	0	0	0	0	A	0	0	0		
4	0	0	0	V	0	0	0	0	V	0		
5	0	0	V	0	0	0	0	0	0			
6	0	0	V	0	0	0	0					
7	0	0	0	0	0	0						
8	0	0	V	0	0							
9	0	0	0	0								
10	0	0	V									
11	X	0										
12	V											

Table 6. Initial reachability matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	0	0	0	0	0	0	0	0	0	0	0
2	0	1	0	0	1	0	0	1	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	0	0	0
4	0	0	0	1	0	1	0	0	0	1	0	0	0
5	0	0	0	0	1	0	0	0	0	0	1	0	0
6	0	0	0	0	0	1	0	0	0	0	1	0	0
7	0	0	1	0	0	0	1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	0	1	0	0
9	0	1	0	0	0	0	0	0	1	0	0	0	0
10	0	0	0	0	0	0	0	0	0	1	1	0	0
11	0	0	0	0	0	0	1	0	0	0	1	0	1
12	0	0	0	0	0	0	0	0	0	0	0	1	1
13	0	0	0	0	0	0	0	0	0	0	1	0	1

Table 7. Final reachability matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	1*	0	1*	0	1*	1*	0	0	1*	0	1*
2	0	1	1*	0	1	0	1	1	0	0	1*	0	1*
3	0	0	1	0	0	0	0	0	0	0	0	0	0
4	0	0	1*	1	0	1	1*	0	0	1	1*	0	1*
5	0	0	1*	0	1	0	1*	0	0	0	1	0	1*
6	0	0	1*	0	0	1	1*	0	0	0	1	0	1*
7	0	0	1	0	0	0	1	0	0	0	0	0	0
8	0	0	1*	0	0	0	1*	1	0	0	1	0	1*
9	0	1	1*	0	1*	0	1*	1*	1	0	1*	0	1*
10	0	0	1*	0	0	0	1*	0	0	1	1	0	1*
11	0	0	1*	0	0	0	1	0	0	0	1	0	1
12	0	0	1*	0	0	0	1*	0	0	0	1*	1	1
13	0	0	1*	0	0	0	1*	0	0	0	1	0	1

1 = Direct relationship; 1\* = Indirect relationship.

fuzzy version allows for the strength between variables to be defined vaguely using fuzzy sets (see Zadeh 1965).

Social network analysis (SNA) utilises computational and statistical methods, including graph theory aspects, to study the associations between social entities, referred to as ‘actors’ (Carrington, Scott, and Wasserman 2005). While early SNA applications considered either binary or weighted associations among actors, fuzzy SNA approaches cater to imprecise and vague associations. In addition to enabling users to visualise the associations among the actors (the objects being investigated), SNA analyzes a network’s structure utilising a group of metrics at both network and node levels.

Three metrics—that is, (i) ‘Driving power’, (ii) ‘Dependence power’, and (iii) ‘Betweenness centrality’—were employed to analyse the association among the 13 identified CSFs (see also Bashir et al. 2022b). Computing the values for ‘Driving power’ and ‘Dependence power’ requires conducting fuzzy-MICMAC analysis, whereas computing the ‘Betweenness centrality’ requires utilising the following formula:

Table 8. Level assignment.

CSFs	Reachability Set	Antecedent Set	Level
1	1, 2, 3, 5, 7, 8, 11,13	1	Level 1
2	2, 3, 5, 7, 8, 11,13	1, 2, 9	Level 2
3	3	1, 2, 3, 4, 5, 6, 7, 8, 9,10, 11, 12, 13	Level 6
4	3, 4, 6, 7, 10, 11,13	4	Level 1
5	3, 5, 7, 11,13	1, 2, 5, 9	Level 3
6	3, 6, 7, 11, 13	4, 6	Level 2
7	3, 7	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	Level 5
8	3, 7, 8, 11, 13	1, 2, 8, 9	Level 3
9	2, 3, 5, 7, 8, 9, 11,13	9	Level 1
10	3, 7, 10, 11, 13	4,10	Level 2
11	3,7,11,13	1, 2, 4, 5, 6, 8, 9,11, 12,13	Level 4
12	3, 7, 12,13	12	Level 1
13	3, 7, 11, 13	1, 2, 4, 5, 6, 8, 9, 10,11,12,13	Level 4

$$BC_i = \sum_{j < k} \frac{S_{jk}}{T_{jk}}$$

where  $S_{jk}$  = the number of shortest paths connecting CSFs  $j$  and  $k$  passing through CSF $_i$  and

$T_{jk}$  = the total number of shortest paths connecting CSFs  $j$  and  $k$ .

In social network analysis (SNA), ‘Betweenness centrality’ helps to identify a node’s importance in a network based on shortest paths, measured by the extent to which a node rests between all other pairs of nodes on their geodesic paths. Thus, the more often a node appears in the paths, the higher its centrality. In the context of this study, CSFs with high ‘Betweenness centrality’ values can be considered main CSFs for the successful implementation of the ISO 14001 standard. Figure 4 shows the rank of the CSFs in terms of their computed ‘Betweenness centrality’ values which were obtained by changing the diagonal elements of the IRM from ones to zeros; then, the formula was applied to this matrix using the NetMiner Software Package.

To conduct fuzzy MICMAC analysis, elements with values of ‘1’ in the IRM were replaced using weights representing the strength of relationships using a triangular membership function, among the most widely accepted and used fuzzy membership functions. Assessment of the association strengths among the CSFs was undertaken by employing linguistic variables as shown in Table 9. Corresponding triangular fuzzy numbers then replaced the assigned variables. The fuzzy triangular numbers were then defuzzified into the best non-fuzzy performance values to generate the fuzzy direct relationship matrix (FDRM), shown in Table 10.

Besides direct associations, indirect associations are present between CSFs. A repeated self-multiplication of the FDRM utilising fuzzy matrix multiplication was performed until a stabilised matrix was provided to create the fuzzy final relationship matrix (FFRM) shown in Table 11, which accounts for these two types of relationships. All the values in column  $j$  of the stabilised matrix were added to determine the ‘Dependence power’ of CSF $_j$ , and all the values in row  $i$  of the stabilised matrix were added to determine the ‘Driving power’ of CSF $_i$ . These values were then used to create a ‘Driving-dependence power’ diagram shown in Figure 5. The CSFs were subsequently classified by splitting the diagram into four quadrants. The first quadrant contains ‘autonomous’ CSFs that have weak ‘Dependence power’ and weak ‘Driving power’. The second quadrant contains ‘dependent’ CSFs that have strong ‘Dependence power’ and

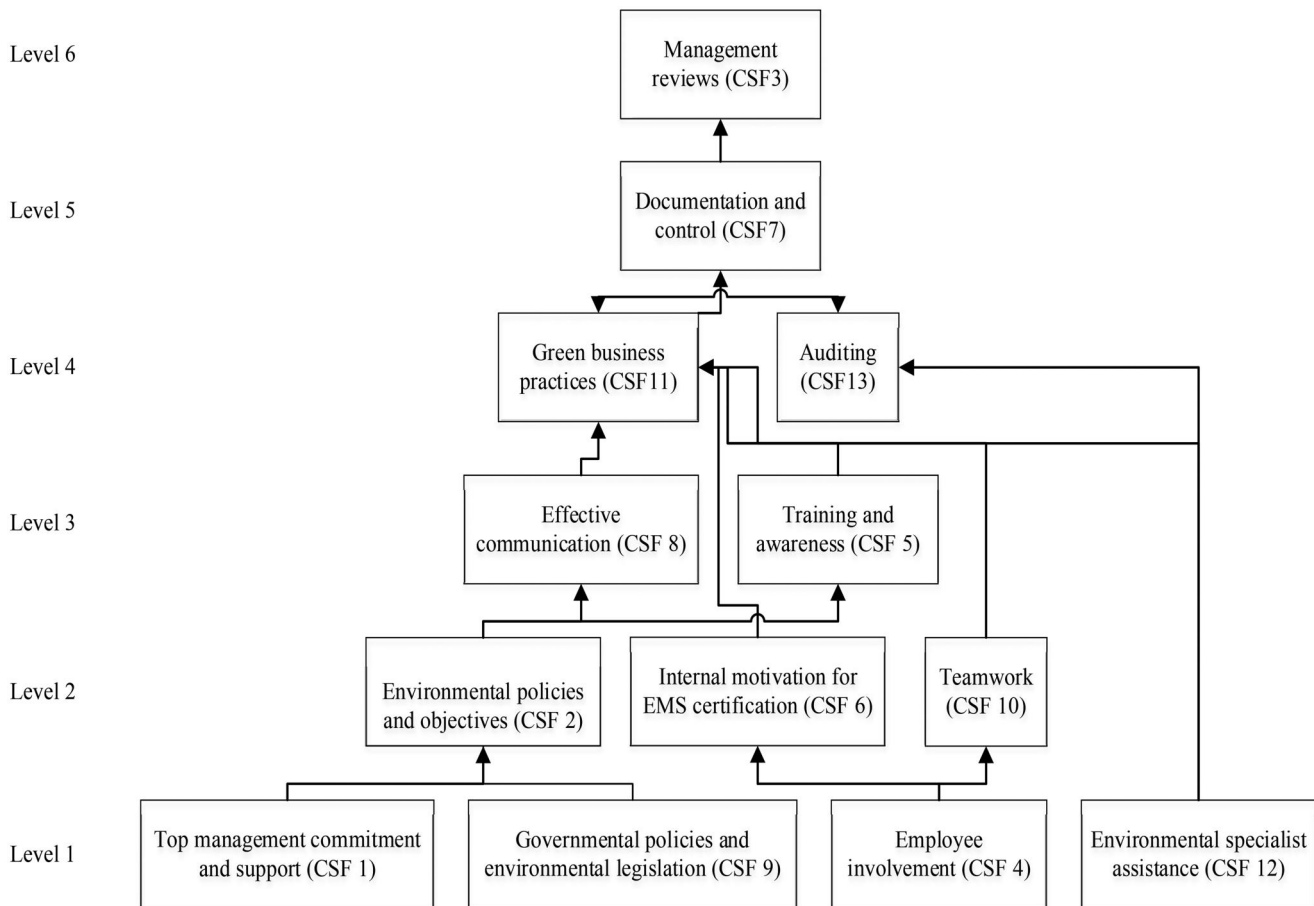


Figure 3. ISM-based model of CSFs.

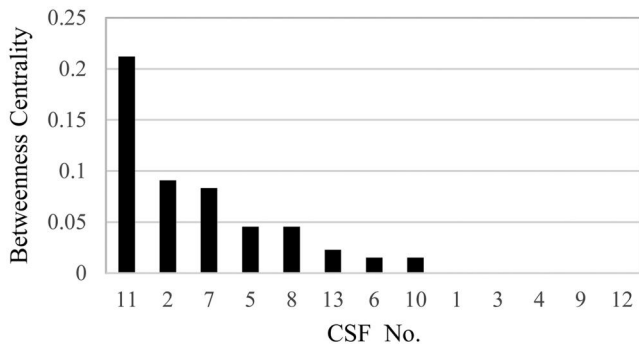


Figure 4. CSF ranking in terms of 'betweenness centrality' values.

weak 'Driving power'. The third quadrant contains 'independent' CSFs that have weak 'Dependence power' and strong 'Driving power'. The last quadrant contains 'linkage' CSFs that have strong 'Dependence power' and strong 'Driving power'.

## 5. Discussion

We identified 13 CSFs deemed relevant to ISO 14001 certification implementation within public sector organisations. Employing a six-level hierarchical graphical model (Figure 3), we modelled their interrelationships. Visualisation of these interrelations allowed us to determine that the CSFs maintained several intricate interrelationships. These interrelationships reiterate the iterative nature of the CSFs that need to

Table 9. Fuzzy linguistic scale.

Linguistic variable	Triangular fuzzy number
Very low influence (VL)	(0, 0.1, 0.3)
Low influence (L)	(0.1, 0.3, 0.5)
Medium influence (M)	(0.3, 0.5, 0.7)
High influence (H)	(0.5, 0.7, 0.9)
Very high influence (VH)	(0.7, 0.9, 1)

be considered during ISO 14001 certificate implementation (see Bashir et al. 2022b). The interrelations also suggest that there may be substantial information exchange emanating from these different CSFs that require detailed management attention.

Our findings shows that four of these CSFs—namely, 'Top management commitment and support' (CSF1), 'Employee involvement' (CSF4), 'Government policies and Environmental legislation' (CSF9), and 'Environmental specialist assistance' (CSF12)—appeared in the lowest level (level 1) of the ISM hierarchical model. We then proceeded to analyse the original 13 CSFs employing fuzzy MICMAC analysis measured against (i) 'Driving power' and (ii) 'Dependence power' to classify the CSFs based on the strength of their direct and indirect relationships among each other measured against (i) 'autonomous', (ii) 'dependent', (iii) 'independent', and (iv) 'linkage'. When we examine the 'Driving-dependence power' diagram (Figure 5), we find that five CSFs can be deemed 'independent'. They are 'Top management commitment and support', 'Environmental policies and objectives', 'Government

policies and Environmental legislation', 'Employee involvement', and 'Teamwork'. Based on prior studies (see Bashir, Ojiako, and Mota 2019, Bashir et al. 2022b, Bashir et al. 2023; Bashir and Ojiako 2020), 'independent' and/or 'linkage' CSFs are the key CSFs driving successful ISO 14001 certificate implementation in public sector organisations/utilities. For this reason, these five CSFs should be accorded maximum priority due to their direct influence on other CSFs. Regarding evaluating the CSFs in terms of 'Betweenness centrality', we found that 'Green business practices' (CSF11) had the highest value (as shown in Figure 4), which means that this CSF acts as a hub connecting a large number of CSF pairs; therefore, it can be

Table 10. Fuzzy direct relationship matrix.

CSF	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	0.7	0	0	0	0	0	0	0	0	0	0	0.7
2	0	1	0	0	0.3	0	0	0.7	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	0	0	0
4	0	0	0	1	0	0.7	0	0	0	0.5	0	0	0
5	0	0	0	0	1	0	0	0	0	0	0.5	0	0
6	0	0	0	0	0	1	0	0	0	0	0.3	0	0
7	0	0	0.5	0	0	0	1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	0	0.7	0	0
9	0	0.7	0	0	0	0	0	0	1	0	0	0	0
10	0	0	0	0	0	0	0	0.7	0	1	0.7	0	0
11	0	0	0	0	0	0	0.3	0	0	0	1	0	0.5
12	0	0	0	0	0	0	0	0	0	0	0	1	0.3
13	0	0	0	0	0	0	0	0	0	0	0.5	0	1

Table 11. Stabilised fuzzy matrix.

CSF	1	2	3	4	5	6	7	8	9	10	11	12	13	Driving Power
1	0	0.7	0.3	0	0.3	0	0.3	0.7	0	0	0.7	0	0.7	3.7
2	0	0	0.3	0	0.3	0	0.3	0.7	0	0	0.7	0	0.5	2.8
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0.3	0	0	0.7	0.3	0.5	0	0.5	0.5	0	0.5	3.3
5	0	0	0.3	0	0	0	0.3	0	0	0	0.5	0	0.5	1.6
6	0	0	0.3	0	0	0	0.3	0	0	0	0.3	0	0.3	1.2
7	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0.5
8	0	0	0.3	0	0	0	0.3	0	0	0	0.7	0	0.5	1.8
9	0	0.7	0.3	0	0.3	0	0.3	0.7	0	0	0.7	0	0.5	3.5
10	0	0	0.3	0	0	0	0.3	0.7	0	0	0.7	0	0.5	2.5
11	0	0	0.3	0	0	0	0.3	0	0	0	0	0	0.5	1.1
12	0	0	0.3	0	0	0	0.3	0	0	0	0.3	0	0.3	1.2
13	0	0	0.3	0	0	0	0.3	0	0	0	0.5	0	0	1.1
Dependence Power	0	1.4	3.8	0	0.9	0.7	3.3	3.3	0	0.5	5.6	0	4.8	

considered as one of the most significant CSFs in addition to CSFs identified as 'independent'. Before we discuss the implications of these findings considering the extant literature, we have one observation to make.

This observation is that we were surprised that 'Environmental specialist assistance' did not emerge as a significant CSF. This is because of the role that consultants play as boundary-spanning brokers of knowledge. Consultants also serve as subject matter experts and the translators of shared experiences (Chipulu, Ojiako, and Thomas 2024). We, therefore, would have naturally expected consultants (including those providing 'Environmental specialist assistance') to play a significant role in third-party certification efforts of the public sector; bringing with them superior knowledge and expertise which rarely exists within the public sector. Thus, we would have expected to find their role to represent a key CSF impacting on certification implementation efforts. We also would have thought that there are strong signals associated with consultants ('Environmental specialist') entering, remaining, and exiting from certification implementation programs within organisations. For example, their entry may signal to stakeholders that the organisation is seeking to robustly implement such certification. On the other hand, exit may signal successful completion. Alternatively, it may also signal failure, especially if the exit is construed as premature. As such, a more nuanced understanding of the role of consultants requires further investigation and will be of benefit to increased advancements in the field. In fact, there are opportunities to explore how consultants may also influence how external parties (i.e. client/customer/the public) interpret the phenomenon of the public sector subjecting itself to certification undertaken by private sector institutions. Insights from cognitive science and psychology may be useful in surfacing the mechanisms of signal processing which may be of relevance to such studies. Also noting the different roles that internal and external consultants play in organisations, it may also be of interest to examine how different consultancy roles may impact upon certification implementation success.

### 5.1. Top management commitment and support

We would expect managers at all levels, including top managers and executives, to play an extremely important role in

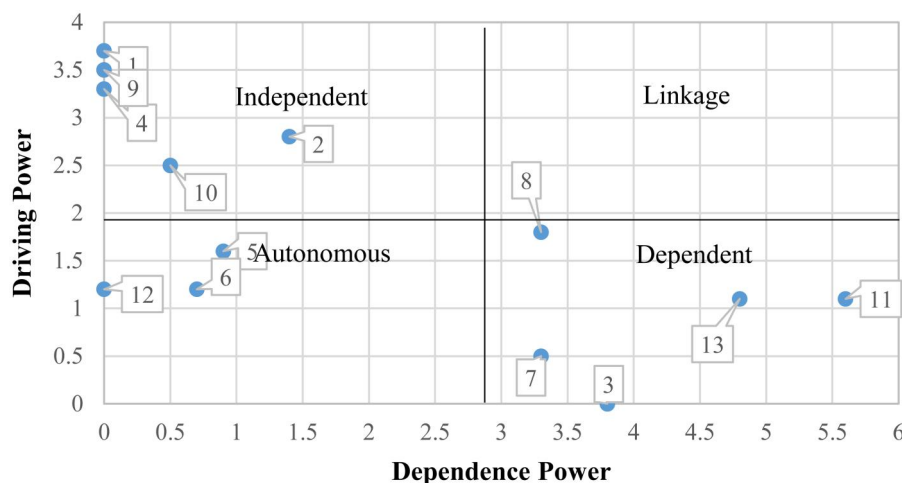


Figure 5. CSF 'driving-dependence power'.



ISO 14001 certificate implementation within the public sector. However, it unfortunately appears that top managers and executives are not all open-minded about change (Chiu et al. 2022). As observed by Huang and Villadsen (2023), despite a role primarily focused on executing and implementing decisions made by politicians, top managers and executives in the public sector perform extremely crucial roles requiring autonomy and discretion. This will include the implementation of certification programs (Ma et al. 2021). Evidence shows that the commitment and support of top managers and executives is of importance in certification because such commitment and support will suggest a willingness of management to engage in extra-role activities (e.g. creativity or innovation) which are extremely critical to certification success (Camilleri and Van Der Heijden 2007). More specifically, 'Top management commitment and support' plays a major role in certification implementation based on (i) the extensive information available to top managers (Cohen and Dean 2005), (ii) the scope of their cognitive base, and (iii) the scale of discretion that they wield in strategic decision making related to sustainability-related certification practices (Ma et al. 2021). The efficacy of 'Top management commitment and support' is widely acknowledged in literature and has been consistently cited as one of the key CSFs driving successful ISO 14001 certification implementation. In our earlier reviewed literature, all but two of the prior studies (i.e. Luthra, Garg, and Haleem 2015b; Luthra et al. 2018) had cited 'Top management commitment and support' (or a variant) as a key CSF for ISO 14001 certification implementation. Top managers are generally part of the senior management of an organisation with direct responsibility for implementing environmental sustainability policies (Ma et al. 2021).

While information required to effect sustainability-related decisions is expected to be broadly distributed across the entire hierarchy of the organisation, the literature recognises that agency and information costs do sometimes prevent the full use (and exploitation) of such information, resulting in intra-organisational information asymmetry (Bergh et al. 2019). Commitment, support, and participation of top managers and executives will send strong signals to stakeholders of the equivalence between its sustainable aspirations, intentions, and values and those of its stakeholders. It also serves to signal the legitimacy of the certification initiative (Sine, David, and Mitsuhashi 2007). To employees, commitment, support, and participation of top managers and executives sends a powerful signal that the certification efforts are a priority to the organisation and that top managers and executives are in support of more staff expending considerable efforts towards the initiative. This is based on the assumption that top managers are unlikely (because of potential damage to their individual reputation) to associate themselves with certification implementation initiatives that are not viable or legitimate.

### 5.2. Environmental policies and objectives

One means by which sustainability concerns can be captured and incorporated into public policy is by using policy

indicators which form part of '*Environmental policies and objectives*'. In this context, indicators serve as means by which vendors (i.e. public sector) provide critical sustainability information to external parties (i.e. client/customer/the public) (Ramos et al. 2007). Most organisations set out their '*Environmental policies and objectives*' in explicit and express terms in documents, therefore suggesting that they represent concrete knowledge. However, these policies and objectives can also exist in abstract terms (see Marshall et al. 2019). When set out in abstract terms, it is likely that the organisation will face considerable difficulty being able to clearly articulate key attributes of its environmental policies and objectives and associated/relevant management practices. Efficient '*Environmental policies and objectives*' should provide unbiased, objective, and transparent information. Ensuring that environmental policies and objective and unbiased is, however, difficult because of the need to incorporate various economic, technical, and considerations into it. However, these considerations are generally contested areas of policy and, therefore, because they can be subject to immediate change (to reflect changing policy objectives), they need to be responsive and flexible.

The strong governance mechanism that should exist within any viable environmental policy objectives and the effort needed to ensure that the ethos is fully embedded in daily operational practice means that there are three significant organisational factors of relevance. The first is *cost*. Since ISO 14001 certification implementation takes considerable time and effort (Babakri, Bennett, and Franchetti 2003), we expect organisations of high quality to spend lower costs implementing ISO 14001 certification. Conversely, those of poor/lower quality are more likely to expend higher costs implementing ISO 14001 certification. This will mean that the relative cost of certification may serve to filter poor from good performers. The second is *proactiveness*. Organisations operating more proactively are more likely to exhibit/develop competencies required for successful certification implementation (González-Benito and González-Benito 2008; González, Sarkis, and Adenso-Díaz 2008). The third is *institutional* factors. There is literature to suggest that (i) international trade interests (Heras-Saizarbitoria, Arana, and Boiral 2016; Liu et al. 2020) and (ii) firm exposure within a country to significant influence by foreign multinationals are among the factors driving coercive isomorphism in terms of EMS-related certification (Asiri, Khan, and Kend 2020). In fact, the literature opines that implementing ISO 14001 certification is a key environmental sustainability signal for the international trade market (Liu et al. 2020). This is of relevance to the UAE where international trade represents a significant element of its national economy (Dadakas, Ghazvini Kor, and Fargher 2020).

### 5.3. Government policies and environmental legislation

'*Government policies and environmental legislation*' represents a key CSF for successful ISO 14001 certificate implementation. Government policy and legislation can have a significant impact on not only the sustainability agenda of the public sector but also on certification efforts. For example, public sector organisations seeking to invest in or launch

new sustainable services may face financial, regulatory, and legal constraints which may significantly alter the need for and value of the proposed/new services. The main policy reason driving third-party certification within the public sector is to enhance consumer rights protection by increasing the quality of information made available to the public (as clients/customers/consumers). The use of third-party certification is not new and has been reported in classical marketing literature (see Phelps 1949; Taylor 1958). While available studies suggest that certification marks may be well received by the public, there is still debate on the extent to which customers/consumers understand the information they contain (Schiavetti 2021; Mogyoros 2023). There is also a debate in the literature as to whether private certification by privatising regulation, in effect, seeks to encroach on what should be the role of the public sector in consumer protection (Zoller, Strohlic, and Getz 2020). Thus, it is more likely that, in environments where trust in the public sector is not very high, customers/consumers may not regard possession of such certification by the public sector as signalling any form of credibility (Devine, McCollum, and Orlova 2022).

'Government policies and environmental legislation' can serve to encourage private third-party certifiers to adhere to common certification guidelines. Government can also draw upon its legitimacy to ensure that private institutions providing third-party certification do so in a manner that does not raise concerns within the public as to the potential for undue influence of private institutions on public policy. Internal government policy and, where necessary, legislation, needs to be in place to ensure that private institutions do not seek direct or indirect means to influence the setting, monitoring, and enforcement of public policy.

'Government policies and environmental legislation' serves as a major signal in two ways. First, it serves as a major signal of the intention of the government to protect the public interest. Second, its technical capability serves as a signal for legitimacy. A key consideration for public sector organisations is whether to implement third-party certification under voluntary or mandatory regimes. Studies by Chen and Deng (2008) suggest that mandatory certification generally encourages quality improvements to a lesser extent than voluntary certification.

#### 5.4. Employee involvement

Despite the noted benefits, there is a corpus of scholarship that has regularly criticised third-party certification for a range of reasons. These include concerns that certification most likely best serves the interest of institutional providers as against those seeking certification (Scott 2002). In fact, some scholars have pointed out that, while certification efforts do start with clear social justice objectives, on occasions, these objectives have given way to privilege and control (Auld, Renckens, and Cashore 2015). As newer organisational forms emerge and changes from centrally coordinated structures to self-managing networks are increasingly adopted, employee involvement in the form of

participation will take a more centre stage in most corporate practices (Zoller, Strohlic, and Getz 2020).

Earlier seminal work by Boyne (2002) highlights that public and private organisations differ in key three areas, one being the weaker level of commitment in the public sector. This lack of commitment—arguably, a feature of poor/lack of employee involvement—is likely to lead to poor outcomes from ISO 14001 certificate implementation. Stohl and Cheney (2001) provide explanations of employee participation in the workplace that are of relevance to our present study. They point out, for example, that involvement is a substitute for customarily established hierarchical configurations that may exist in organisations. However, the need for involvement is increasingly representing a social expectation of employees. More specifically, employee involvement entails several attributes which includes (i) inclusion in decision making at the frontline (with employees empowered to problem-solve (see also Doyle et al. 2021); (ii) involving employees in decisions traditionally construed as being under the management purview (e.g. at the point of initial engagement with private certification institutions); and (iii) ensuring that employees play a meaningful role in corporate-level decisions.

Our finding on '*Employee involvement*' is in line with the extant literature where it has explicitly featured as a key CSF for successful ISO 14001 certification implementation in the majority of the reviewed literature (see Chin, Chiu, and Rao Tummala 1999; Sambasivan and Fei 2008; Cassells, Lewis, and Findlater 2011; Cassells, Lewis, and Findlater 2012; Ivanova, Gray, and Sinha 2014; Luthra, Garg, and Haleem 2015a; Waxin, Knuteson, and Bartholomew 2019). For example, Ikram et al. (2019) point out that employees derive major benefits (such as personal development) from ISO 14001 certification implementation. '*Employee involvement*' is key to successful ISO 14001 certification implementation because successfully embedding changes in organisational routines will require the employees to fully embrace and incorporate the essence/'spirit' of such certification in their daily routines (Prajogo, Tang, and Lai 2014). We expect that public sector organisation that fully embraces '*Employee involvement*' will be more successful in bringing about the desired changes in their environmental management practices through ISO 14001 certificate implementation.

The extent to which employees will fully embrace changes in their routines emanating from ISO 14001 certificate implementation will be largely determined not by actual organisational practices, but predominantly by their perception of such practices (Gelens et al. 2015). In the absence of full information (despite an expectation that such information will be widely distributed across the entire hierarchy of the organisation), employees will seek signals from top management to interpret their intentions. '*Employee involvement*' serves as one such signal, thus ensuring commitment to the ideals of certification (Suazo, Martínez, and Sandoval 2009). Our finding on '*Employee involvement*' should also serve as a signal to top managers and executives that successful sustainability-related decisions require involvement to be broadly distributed across the entire hierarchy of the

organisation. Based on our findings we opine that, when public sector employees are involved in sustainability-related decision making, they are more likely to proactively seek improvements and innovation. They are also more likely to adhere and commit to, and comply with, environmental sustainability principles being promoted by top managers and executives. They are also more likely to work towards ensuring equivalence between the aspirations, intentions, and values of their stakeholders—i.e. the public.

### 5.5. Teamwork

Although ‘*Top management commitment and support*’ and ‘*Employee involvement*’ are both important to the public sector’s certification efforts, the complexity of ISO 14001 implementation in public sector organisations (driven by, for example, the dynamic nature of public policy) requires ‘*Teamwork*’ (Daily and Huang 2001). In the context of this present study, we draw on Rasmussen and Jeppesen (2006; p. 105) to frame ‘teamwork’ as a term that explains how work may be organised based on autonomy and task interdependence. Espousing teamwork will provide the platform for an organisation to draw on the resources and competencies of different individuals and access complementary skillsets. These skillsets will usually include very detailed and intimate knowledge needed to (i) build solutions which are comprehensive, (ii) avert replication, and (iii) simultaneously undertake different tasks. It will also provide for the effective allocation and monitoring of tasks. The existence of teamwork will help to ensure that teams spend less time managing potential interpersonal conflict and more time in knowledge streamlining. In fact, highlighting the importance of teamwork relevant to sustainability certification, Daily and Huang (2001) observed that ‘... *teamwork is a necessity of a successful environmental management system*’ (p.1547). Simply put, teamwork is part and parcel of the public sector (Van der Hoek, Groeneveld, and Kuipers 2018).

The decision of external parties to engage with the public sector organisations or buy into the sustainability initiatives that it is implementing may take into consideration, in addition to a range of criteria, the composition of the certification implementation team (see Busenitz, Fiet, and Moesel 2005). Given information asymmetries surrounding these initiatives, the wider organisation and external parties will rely on various signals to ascertain the likely prospect of the initiative (i.e. whether it will be successful) and the ability of the certification team to make that success possible. Drawing from the literature (Busenitz, Fiet, and Moesel 2005; Havakhor and Sabherwal 2018), we opine that the formation of dedicated certification teams can signal to external parties (i.e. client/customer/the public) not only that the public sector entity in question is committed to the success of its implementation; it also signals sustainability compliance and stakeholder equivalence in public sector organisations. Thus, on the assumption that the commitment of the vendor reflects their personal belief in the importance of the initiative, putting together a well-resourced and experienced certification team may serve as a ‘knowledge signal’. In other words, it shows that the initiative is being

implemented by staff with the required level of knowledge to ensure successful implementation. Using high-caliber professionals for such initiatives may also serve as a ‘commitment signal’ (Havakhor and Sabherwal 2018); in effect, a means of demonstrating ‘Top management commitment and support’ and ‘Employee involvement’. The assumption is that an organisation will only go through the ‘trouble’ of establishing a staff with high-caliber professionals if it is confident and sees value in the implementation of the certification program.

Teamwork ensures that the organisation can galvanise the range of expertise and knowledge held by its employees, which may be multifaceted and multidimensional. This is despite the likelihood that, during the implementation of certification initiatives in organisations, work is undertaken on an ad hoc basis. Team members may not always be formally appointed into a dedicated implementation ‘team’; thus, there may be a need for the organisation to move away from seeking to set out individual expertise/knowledge in various areas of the implementation. Instead, the focus may need to be on finding a way to convey right across the organisation (and to its external stakeholders) the precise expertise of individual team members/employees. This approach recognises that knowledge may reside in areas where an individual is not necessarily an ‘expert’. Furthermore, when team members/employees are conversant with the expertise/knowledge of others, they are more able to make informed decisions relating to task allocation (Kankanhalli, Tan, and Wei 2005).

## 6. Conclusion

An organisation will utilise third-party certification to demonstrate commitment to sustainability, signalling to shareholders (stakeholders) and the wider society their adherence and commitment to, and compliance with, environmental sustainability principles and equivalence between its sustainable aspirations, intentions, and values and those of its stakeholders. However, successful certification efforts demands that organisations focus on a range of critical success factors’ (CSFs). In this paper, to gain insights into how individual CSFs can be employed to signal relevant sustainability compliance and equivalence, we conducted an in-depth case study with a major public sector organisation operating in the UAE.

We presented two research questions as part of our study. As relates to the first research question (RQ1: *What are the CSFs driving successful ISO 14001 certification in public utilities and the nature of their interrelationship?*), we identified 13 CSFs of which ‘*Top management commitment and support*’, ‘*Environmental policies and objectives*’, ‘*Government policies and Environmental legislation*’, ‘*Employee involvement*’, and ‘*Teamwork*’ were key to successful ISO certification implementation and should be accorded maximum priority. In terms of the second research question (RQ2: *How can individual CSFs driving successful ISO 14001 certification be employed as signals for sustainability compliance and stakeholder equivalence?*), we relied on signalling theory to explain the largely unknown phenomenon within operations of public sector organisations subjecting themselves to certification

undertaken by private sector institutions. While it is largely acknowledged that the public sector maintains the authority to regulate, amongst others, economic activities (and perhaps by implication, the activities of the private sector), the reverse remains debateable. Our study makes important contributions to both theory and practice.

### 6.1. Theoretical contributions

In terms of *theoretical contributions*, our study contributes to ISO 14001 certification implementation CSF/ISO 14001 certification and signalling literatures. As relates to CSF literature, we do so by identifying the specific CSFs driving successful ISO 14001 certification in public utilities and the nature of their intricate and iterative interrelationship, we respond to calls by Ika and Pinto (2022) for a recalibration of notions of success (and by extension CSFs) that incorporates notions of sustainability. Our study contributes to further understanding of ISO 14001 certification implementation specifically as contextualised within public sector implementation.

Our study also complements signalling research. By empirically bringing together third-party certification and ISO 14001 implementation CSF ideas, our study offers rigorous and provocative new insights into a domain of operations (i.e. public sector certification by private sector institutions). We also offered insights for organisations seeking to implement ISO 14001 certification while simultaneously being able to signal the efficacy of their sustainability claims. A vendor (i.e. public sector organisation) will always be concerned about whether the signal it is transmitting is effectively conveying the intended message to its clients/customers (i.e. the public). Clients/customers (i.e. the public) in receipt of signals may interpret them in a different manner depending on contextual factors. Accordingly, it is important for organisations to examine the extent to which there is a fit between the intended message being conveyed by adopting any approach to demonstrate sustainability equivalence.

There are three potential challenges associated with the use of ISO 14000 as a signal for sustainability compliance and equivalence. The first is that the identified CSFs are likely to serve as a template for driving the positive promotion of brand reputation. Thus, not explicitly focusing on the identified CSFs may lead the organisation to settle for superficial/symbolic adoption (to boost presumed legitimacy). A concern in signalling is that superficial/symbolic adoption may allow an organisation to emit signals about supposed environmental sustainability compliance and equivalence which, in fact, does not exist. Such misleading signals when deliberate serve as forms of 'greenwashing'; in effect, the engagement in information manipulation (and associated symbolic action), for the purpose of creating a favourable image of sustainability equivalence among stakeholders as relates to the organisation's environmental practices. The second is that clients/customers need to be aware that successful ISO 14001 implementation may signal that an organisation (i.e. vendor) possesses specific sustainability competencies without necessarily conveying any relevant information on the extent to which such principles are embedded into the

organisation's daily routines and practices. Customer/client organisations need to put in place other mechanisms to verify the efficacy of signals transmitted to them. Third, our study is set within the context whereby signals via third-party certification intend to convey information which is positive about the public sector. However, it is important to reflect on the potential unintended consequences of what may appear to be a purposeful evading of potential negative signals being transmitted by the public entity by what will appear to be biased signalling. Specifically, for public sector organisations, it may be more beneficial that signals truly reflect realist messages (whether positive or negative). Being that the actions of a single public sector organisation may have much wider implications, signal credibility is important.

### 6.2. Practical contributions

In terms of *practical contributions*, our study offers numerous implications for public sector organisations looking to enhance their ability to adopt and implement third-party certification initiatives. Considering, for example, the rapid evolution of social media platforms such as 'X' (formerly Twitter), public sector organisations face greater challenges when seeking to employ signals to communicate sustainability equivalence. The ubiquitous nature and wide and dynamic coverage of these platforms also means that the audience for these signals is unrestricted. It also means that, in an instant, signals can potentially be repurposed and reinvented in a manner that may engage or enrage stakeholders. Thus, while these platforms provide enormous signalling potential, they also simultaneously serve as critical risk factors.

We highlight that responsibility for driving successful ISO 14001 certificate implementation will reside primarily with top managers. Thus, the findings represent points that management must prioritise. Managers must, however, be mindful that, as all the CSFs are individually associated with distinct signals, there is a potential for multiple and potentially conflicting signals being emitted. (This raises an interesting point of future research focused on examining how CSF interrelationships correlate with the organisation's choice to prioritise one signal over another, and also examining the extent to which other components for its sustainable efforts—for example, *policy planning*, *monitoring/corrective action*, and *review*—may impact upon signal choice.) To mitigate against this (and the likely consequences of a misunderstanding of the interrelationship between the signals themselves), it may be necessary for the organisation to send signals at the corporate level that are more observable to its stakeholders. A more observable signal may be developed by maximising the intensity of the signal by ensuring that signals from all the CSFs are appropriately captured. Another approach may be to increase the frequency of such corporate level signalling. The challenge for public utilities is that they operate in a relatively dynamic certification and regulatory environment which implies constant change in their operational environment. Constant dissemination of the same signal using different channels may help in the reduction of the effect of information asymmetry.

### 6.3. Limitations and further studies

Our study does have limitations which provides the impetus for future research. The first relates to our focus on the UAE where we employed a single organisation as the case study. We also did not discuss in much detail, the 'Green business practices' (e.g. sustainable supply chains, recycling, and circular economy), of the case organisation (see e.g. Tanveer et al. 2022; Khan et al. 2023). Neither did we discuss UAE specific cultural/contextual factors likely to impact upon ISO 14001 certification or in fact, the signalling of sustainability equivalence. Considering these limitations, to broaden explorations of the research questions and in the process, produce much richer empirical evidence, future studies should focus on the broadening of the applicability of our findings. Specifically, while focusing the study on the UAE offers in-depth insights, there is the potential applicability of our findings to other geographic contexts, especially the gulf region (i.e. Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia). This is because of a shared outlook in these countries towards sustainability and the energy transition (see Sweidan 2021; Bourhous and Khafagi 2023). In the same vein, although our study focused on one public utility, to increase the appeal of our study to a broader readership and underscore the global relevance of our study, couching future studies in other organisations with a strategic interest in green and sustainable business practices will allow for the elaboration of how the individual CSFs can be employed to signal more widely applied sustainability compliance and equivalence.

The second limitation relates to our methodological and analytical approach. Here, there is an acknowledgment that there may be an appearance that the sample size in the Delphi study was limited. Furthermore, although the subsequent ISM and SNA analysis provides additional validation of the identified CSFs, only one round of ranking, discussion and feedback was undertaken during the Delphi process. There is also the potential that the three-point scale may be too simplistic. Hence, future studies which engages a larger panel of experts, uses multiple ranking rounds, incorporates statistical measures of consensus, and describes how disagreement are reconciled will not only strengthen the Delphi approach, but the validity of any future study. In the same vein, a statistical validation of our model would be very beneficial. The use of more granular five- or seven-point scales will also provide a greater differentiation of importance which will improve the rigour associated with CSF identification. During analysis, we took into consideration only one SNA metric, '*Betweenness centrality*'. However, while it represents a valuable metric for understanding the structure and dynamics of social networks, there are several other useful metrics such as '*Degree centrality*', '*Closeness centrality*', '*Eigenvector centrality*', '*Clustering coefficient*', and '*Network diameter*' that could also be employed to identify important CSFs and patterns of their interaction. Future studies focused on utilising any of these metrics will be of value if we are to develop a

more comprehensive understanding of the driving factors for successful certification implementation.

The third limitation relates to the alignment of the CSFs for ISO 14001. Specifically, the mere inclusion of model references may not be adequate for the robust validation of the aspired qualities of the ISM model. Future studies should incorporate additional well-established methods to ensure that the alignment of the CSFs is reinforced. An approach may include undertaking more detailed analysis of each CSF in the context of ISO 14001, using empirical data to demonstrate the impact of individual CSFs, or applying more rigorous statistical analysis to validate the effectiveness of the individual CSFs in achieving the ISO 14001 objectives.

The fourth limitation is that, although we employed a hybrid *fuzzy* MICMAC/SNA metric for interrelationships analysis in recognition of the imprecise nature of the interrelationships between the CSFs, our study did not acknowledge the reality that there were likely to be significant variations in the CSFs over the lifecycle of the ISO certificate implementation. This idea is rooted in lifecycle theories and prior studies predominantly within the operations/project management discipline which observe that CSFs are generally not static. While CSFs may be specific to a particular time, they are expected to vary as the certification implementation progresses. Further noting that CSFs are also expected to occur across different levels of an organisation's hierarchy, it will be of interest to explore not only how these CSFs (and their interdependencies) may differ at specific points in time during certification implementation but also how a multi-hierarchical view of these CSFs may also vary.

Finally, we did not examine the mediating effect of the CSFs on the implementation initiative itself (i.e. the ISO 14001 implementation). Nonetheless, we posit that CSFs may play a role as an intermediate element that elucidates why certain firms attain superior environmental outcomes via ISO 14001 compared to others. Verification of this hypothesis will require further investigation in future studies.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

### Notes on contributors



**Udechukwu Ojiako** is Professor of Engineering Systems Management at the University of Strathclyde. Previously, he was Professor of Engineering Management at the University of Sharjah. Udi holds a PhD (in Project Management) from Northumbria University, a second PhD (in Business) from the University of Hull and a third PhD (in Law) from Aberystwyth University. Having obtained law degrees from the University of London (LLB) and Aberystwyth University (MPhil in Law), he was called to the Bar of England & Wales as a Barrister (Honourable Society of the Middle

Temple). Udi's research interest is broad, spanning comparative decision-making and cross-disciplinary research situated in project-centric operational and business environments.



**Hamdi Bashir** is a Professor of Industrial Engineering and Engineering Management at the University of Sharjah, United Arab Emirates. He holds a PhD degree from McGill University, Canada. Prior to joining the University of Sharjah, he held faculty positions at Sultan Qaboos University, University of Alberta, and Concordia University. Bashir's research interest focuses on modelling and analysing complexity in engineering management using data mining and graph theory related techniques. He is a senior member of the Institute of Industrial and Systems Engineers.

ing and graph theory related techniques. He is a senior member of the Institute of Industrial and Systems Engineers.



**Houria Hassan Buhindi Almansoori** is a researcher with the University of Sharjah, United Arab Emirates. She completed her master's degree in engineering management with honours from the University of Sharjah in 2021. Houria possesses more than eight years of industrial experience in project management. Her current research interests are centred on project and risk management. Specifically, she is interested in the application of graph theory techniques in various areas of engineering management monitoring, analysis, and control.

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**Eman Jasim Hussain AlRaeesi** is the Engineering Affairs Director at the Government of Sharjah Office, Sharjah, United Arab Emirates. She is also a part time Lecturer in Engineering Management at the University of Sharjah. She has 15 years' experience working on service delivery, public policy and innovation and knowledge management projects across various facets of the Government of Sharjah. Most recently, she was solely responsible for the successful automating and unifying the processes of applying and delivering of the municipal services for the Engineering and Buildings Sector within the Emirate of Sharjah. Eman holds a PhD in Engineering Management from the University of Sharjah.

ful automating and unifying the processes of applying and delivering of the municipal services for the Engineering and Buildings Sector within the Emirate of Sharjah. Eman holds a PhD in Engineering Management from the University of Sharjah.



**Hassan Ahmed Al Zarooni** is an electrical power distribution manager with Sharjah Electricity, Water and Gas Authority (SEWA). He is also a part time Lecturer in Engineering Management at the University of Sharjah. He obtained his PhD in Engineering Management from the University of Sharjah. Hassan has over 20 years of experience in the electrical power industry. He has been involved in the management of many landmark projects in the emirate of Sharjah. He has also been involved in numerous events related to power systems. Among his various professional qualifications include Occupational Health and Safety Management System Auditor/Lead Auditor Training Course, Power Factor Correction, Power System Analysis, Project Management Professional (PMP) and Renewable Energy Technologies and Applications (Natural Power).

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## References

Abdullah, S., A. Abdul Razak, M. Hanizun Hanafi, and M. Jaafar. 2013. "Implementation Barriers of ISO 9000 within the Malaysian Local

- Government." *International Journal of Quality & Reliability Management* 30 (8): 853–876. <https://doi.org/10.1108/IJQRM-Dec-2011-0160>.
- Ahmed, A., and S. Mathrani. 2023. "Critical Success Factors for a Combined Lean and ISO 14001 Implementation in the Manufacturing Industry: A Systematic Literature Review." *The TQM Journal*. Advance online publication. <https://doi.org/10.1108/TQM-12-2022-0347>.
- Albastaki, F., H. Bashir, U. Ojiako, M. Shamsuzzaman, and S. Haridy. 2021. "Modeling and Analyzing Critical Success Factors for Implementing Environmentally Sustainable Practices in a Public Utilities Organization: A Case Study." *Management of Environmental Quality* 32 (4): 768–786.
- Al-Hanshi, M. A. M. O., U. Ojiako, and T. Williams. 2022. "Managing Strategic Resources in Petroleum Industry Projects." *Production Planning & Control* 33 (11): 1043–1060. <https://doi.org/10.1080/09537287.2020.1843081>.
- AlMalki, H., and C. Durugbo. 2023. "Institutionalising Industry 4.0: A Delphi Study of Institutional Change Readiness for the Fourth Industrial Revolution in an Emerging Economy." *Production Planning & Control* <https://doi.org/10.1080/09537287.2023.2217414>.
- Al-Mazrouie, J., U. Ojiako, T. Williams, M. Chipulu, and A. Marshall. 2021. "An Operations Readiness Typology for Mitigating against Transitional 'Disastrous Openings' of Airport Infrastructure Projects." *Production Planning & Control* 32 (4): 283–302. <https://doi.org/10.1080/09537287.2020.1730997>.
- Arocena, P., R. Orcos, and F. Zouaghi. 2021. "The Impact of ISO 14001 on Firm Environmental and Economic Performance: The Moderating Role of Size and Environmental Awareness." *Business Strategy and the Environment* 30 (2): 955–967. <https://doi.org/10.1002/bse.2663>.
- Arora, P., M. Hora, V. Singhal, and R. Subramanian. 2020. "When Do Appointments of Corporate Sustainability Executives Affect Shareholder Value?" *Journal of Operations Management* 66 (4): 464–487. <https://doi.org/10.1002/joom.1074>.
- Asiri, N., T. Khan, and M. Kend. 2020. "Environmental Management Accounting in the Middle East and North Africa Region: Significance of Resource Slack and Coercive Isomorphism." *Journal of Cleaner Production* 267: 121870. <https://doi.org/10.1016/j.jclepro.2020.121870>.
- Auld, G., S. Renckens, and B. Cashore. 2015. "Transnational Private Governance between the Logics of Empowerment and Control." *Regulation & Governance* 9 (2): 108–124. <https://doi.org/10.1111/rego.12075>.
- Babakri, K., R. Bennett, and M. Franchetti. 2003. "Critical Factors for Implementing ISO 14001 Standard in United States Industrial Companies." *Journal of Cleaner Production* 11 (7): 749–752. [https://doi.org/10.1016/S0959-6526\(02\)00146-4](https://doi.org/10.1016/S0959-6526(02)00146-4).
- Bafera, J., and S. Kleinert. 2023. "Signaling Theory in Entrepreneurship Research: A Systematic Review and Research Agenda." *Entrepreneurship Theory and Practice* 47 (6): 2419–2464. In Press. <https://doi.org/10.1177/10422587221138489>.
- Baines, T., and V. Shi. 2015. "A Delphi Study to Explore the Adoption of Servitization in UK Companies." *Production Planning & Control* 26 (14–15): 1171–1187. <https://doi.org/10.1080/09537287.2015.1033490>.
- Baker, J., K. Lovell, and N. Harris. 2006. "How Expert Are the Experts? An Exploration of the Concept of 'Expert' within Delphi Panel Techniques." *Nurse Researcher* 14 (1): 59–70. <https://doi.org/10.7748/nr2006.10.14.1.59.c6010>.
- Barratt, M., T. Choi, and M. M. Li. 2011. "Qualitative Case Studies in Operations Management: Trends, Research Outcomes, and Future Research Implications." *Journal of Operations Management* 29 (4): 329–342. <https://doi.org/10.1016/j.jom.2010.06.002>.
- Bashir, H., and U. Ojiako. 2020. "An Integrated ISM-MICMAC Approach for Modelling and Analysing Dependencies among Engineering Parameters in the Early Design Phase." *Journal of Engineering Design* 31 (8–9): 461–483. <https://doi.org/10.1080/09544828.2020.1817347>.
- Bashir, H., S. Hamdan, U. Ojiako, S. Haridy, M. Shamsuzzaman, and H. Al Zarooni. 2023. "A Weighted Fuzzy Social Network Analysis-Based Approach for Modeling and Analyzing Relationships among Risk Factors Affecting Project Delays." *Engineering Management Journal* 36 (1): 1–11. <https://doi.org/10.1080/10429247.2022.2162305>.

- Bashir, H., U. Ojiako, and C. Mota. 2019. "Modeling and Analyzing Factors Affecting Project Delays Using an Integrated Social Network-Fuzzy MICMAC Approach." *Engineering Management Journal* 32 (1): 26–36.
- Bashir, H., U. Ojiako, S. Haridy, M. Shamsuzzaman, and R. Musa. 2022a. "Implementation of Environmentally Sustainable Practices and Their Association with ISO 14001 Certification in the Construction Industry of the United Arab Emirates." *Sustainability: Science, Practice and Policy* 18 (1): 55–69. <https://doi.org/10.1080/15487733.2021.2022880>.
- Bashir, H., U. Ojiako, A. Marshall, M. Chipulu, and A. Yousif. 2022b. "The Analysis of Information Flow Interdependencies within Projects." *Production Planning & Control* 33 (1): 20–36. <https://doi.org/10.1080/09537287.2020.1821115>.
- Belassi, W., and O. Tukel. 1996. "A New Framework for Determining Critical Success/Failure Factors in Projects." *International Journal of Project Management* 14 (3): 141–151. [https://doi.org/10.1016/0263-7863\(95\)00064-X](https://doi.org/10.1016/0263-7863(95)00064-X).
- Bergh, D., B. Connelly, D. Ketchen, and L. Shannon. 2014. "Signalling Theory and Equilibrium in Strategic Management Research: An Assessment and a Research Agenda." *Journal of Management Studies* 51 (8): 1334–1360. <https://doi.org/10.1111/joms.12097>.
- Bergh, D., D. Ketchen, I. Orlandi, P. Heugens, and B. Boyd. 2019. "Information Asymmetry in Management Research: Past Accomplishments and Future Opportunities." *Journal of Management* 45 (1): 122–158. <https://doi.org/10.1177/0149206318798026>.
- Bhattacharya, S. 1980. "Nondissipative Signaling Structures and Dividend Policy." *The Quarterly Journal of Economics* 95 (1): 1–24. <https://doi.org/10.2307/1885346>.
- Blackman, A. 2012. "Does Eco-Certification Boost Regulatory Compliance in Developing Countries? ISO 14001 in Mexico." *Journal of Regulatory Economics* 42 (3): 242–263. <https://doi.org/10.1007/s11149-012-9199-y>.
- Bliege Bird, R., and E. Smith. 2005. "Signaling Theory, Strategic Interaction, and Symbolic Capital." *Current Anthropology* 46 (2): 221–248. <https://doi.org/10.1086/427115>.
- Bourhous, A., and E. Khafagi. 2023. *Environmental Politics in Gulf Cooperation Council States: Strengthening the Role of Civil Society*. Pub. Stockholm International Peace Research Institute (SIPRI), <https://www.sipri.org/publications/2023/sipri-policy-papers/environmental-politics-gulf-cooperation-council-states-strengthening-role-civil-society>.
- Boyne, G. 2002. "Public and Private Management: what's the Difference?" *Journal of Management Studies* 39 (1): 97–122. <https://doi.org/10.1111/1467-6486.00284>.
- BP. 2019. "Statistical Review of Energy." Accessed February 21, 2023. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf>
- Bravi, L., G. Santos, A. Pagano, and F. Murmura. 2020. "Environmental Management System according to ISO 14001: 2015 as a Driver to Sustainable Development." *Corporate Social Responsibility and Environmental Management* 27 (6): 2599–2614. <https://doi.org/10.1002/csr.1985>.
- Brown, S., and C. Getz. 2008. "Privatizing Farm Worker Justice: Regulating Labor through Voluntary Certification and Labeling." *Geoforum* 39 (3): 1184–1196. <https://doi.org/10.1016/j.geoforum.2007.01.002>.
- Bullen, C., and J. Rockart. 1981. "A Primer on Critical Success Factors. Center for Information Systems Research" (ISR No. 69): Sloan Working Paper No. 1220-81. <https://dspace.mit.edu/bitstream/handle/1721.1/1988/SWP-1220-08368993-CISR-069.pdf?sequen>
- Busenitz, L., J. Fiet, and D. Moesel. 2005. "Signaling in Venture Capitalist—New Venture Team Funding Decisions: Does It Indicate Long-Term Venture Outcomes?" *Entrepreneurship Theory and Practice* 29 (1): 1–12. <https://doi.org/10.1111/j.1540-6520.2005.00066.x>.
- Cambier, F., and I. Poncin. 2020. "Inferring Brand Integrity from Marketing Communications: The Effects of Brand Transparency Signals in a Consumer Empowerment Context." *Journal of Business Research* 109: 260–270. <https://doi.org/10.1016/j.jbusres.2019.11.060>.
- Camilleri, E., and B. Van Der Heijden. 2007. "Organizational Commitment, Public Service Motivation, and Performance within the Public Sector." *Public Performance & Management Review* 31 (2): 241–274. <https://doi.org/10.2753/PMR1530-9576310205>.
- Camilleri, M. 2022. "The Rationale for ISO 14001 Certification: A Systematic Review and a Cost–Benefit Analysis." *Corporate Social Responsibility and Environmental Management* 29 (4): 1067–1083. <https://doi.org/10.1002/csr.2254>.
- Carey, C., and E. Guttenstein. 2008. "Governmental Use of Voluntary Standards: innovation in Sustainability Governance." ISEAL Alliance, London.
- Carrington, P., J. Scott, and S. Wasserman. 2005. *Models and Methods in Social Network Analysis*. New York: Cambridge University Press.
- Cassells, Sue, Kate Lewis, and Alec Findlater. 2011. "Findlater. 2011. SMEs and ISO 14001 Adoption: A New Zealand Perspective." *Small Enterprise Research* 18 (1): 19–32. <https://doi.org/10.5172/ser.18.1.19>.
- Cassells, S., K. Lewis, and A. Findlater. 2012. "An Exploration of ISO 14001 Uptake by New Zealand Firms." *International Journal of Law and Management* 54 (5): 345–363. <https://doi.org/10.1108/17542431211264232>.
- Chen, Y.-J., and M. Deng. 2008. "Mandatory vs. Voluntary Certification: Investment, Quality, and Information Asymmetry." AAA 2009 Management Accounting Section (MAS) Meeting Paper. <https://ssrn.com/abstract=1177023>
- Chiappetta Jabbour, C., A. Mauricio, and A. Jabbour. 2017. "Critical Success Factors and Green Supply Chain Management Proactivity: shedding Light on the Human Aspects of This Relationship Based on Cases from the Brazilian Industry." *Production Planning & Control* 28 (6-8): 671–683. <https://doi.org/10.1080/09537287.2017.1309705>.
- Chiarini, A. 2019. "Factors for Succeeding in ISO 14001 Implementation in Italian Construction Industry." *Business Strategy and the Environment* 28 (5): 794–803. <https://doi.org/10.1002/bse.2281>.
- Childe, S. 2011. "Case Studies in Operations Management." *Production Planning & Control* 22 (2): 107–107. <https://doi.org/10.1080/09537287.2011.554736>.
- Childe, S. 2017. "Case Studies in the Management of Operations." *Production Planning & Control* 28 (1): 1.
- Chin, K., S. Chiu, and V. Rao Tummala. 1999. "An Evaluation of Success Factors Using the AHP to Implement ISO 14001-Based EMS." *International Journal of Quality & Reliability Management* 16 (4): 341–362. <https://doi.org/10.1108/02656719910248226>.
- Chipulu, M., U. Ojiako, and A. Thomas. 2024. "Salient Complexities of Engaging External Consultants in Information Systems Projects." *IEEE Transactions on Engineering Management* 71: 5212–5229. <https://doi.org/10.1109/TEM.2022.3220151>.
- Chipulu, M., U. Ojiako, A. Marshall, T. Williams, U. Bititci, C. Mota, Y. Shou, et al. 2019. "A Dimensional Analysis of Stakeholder Assessment of Project Outcomes." *Production Planning & Control* 30 (13): 1072–1090. <https://doi.org/10.1080/09537287.2019.1567859>.
- Chipulu, M., U. Ojiako, A. Marshall, T. Williams, J. Neoh, C. Mota, and Y. Shou. 2016. "Building Cultural Intelligence: insights from Project Management Job Advertisements." *Production Planning & Control* 27 (3): 133–147. <https://doi.org/10.1080/09537287.2015.1083623>.
- Chiu, S., S. Pathak, R. Hoskisson, and R. Johnson. 2022. "Managerial Commitment to the Status Quo and Corporate Divestiture: Can Power Motivate Openness to Change?" *The Leadership Quarterly* 33 (3): 101459. <https://doi.org/10.1016/j.leaqua.2020.101459>.
- Chowdhury, M., D. Prajogo, and J. Jayaram. 2018. "Comparing Symbolic and Substantive Implementation of International Standards—the Case of ISO 14001 Certification." *Australasian Journal of Environmental Management* 25 (3): 339–361. <https://doi.org/10.1080/14486563.2018.1451402>.
- Chu, P., and H. Wang. 2001. "Benefits, Critical Process Factors, and Optimum Strategies of Successful ISO 9000 Implementation in the Public Sector: An Empirical Examination of Public Sector Services in Taiwan." *Public Performance & Management Review* 25 (1): 105–121. <https://doi.org/10.1080/15309576.2001.11643648>.
- Chu, P., C. Huang, and H. Wang. 2001. "ISO 9000 and Public Organizations in Taiwan: organizational Differences in Implementation Practices with Organization Size, Unionization and Service Types." *Public Organization Review* 1 (4): 391–413. <https://doi.org/10.1023/A:1013725331164>.
- Chu, W., and W. Chu. 1994. "Signaling Quality by Selling through a Reputable Retailer: An Example of Renting the Reputation of Another

- Agent." *Marketing Science* 13 (2): 177–189. <https://doi.org/10.1287/mksc.13.2.177>.
- Cohen, B., and T. Dean. 2005. "Information Asymmetry and Investor Valuation of IPOs: Top Management Team Legitimacy as a Capital Market Signal." *Strategic Management Journal* 26 (7): 683–690. <https://doi.org/10.1002/smj.463>.
- Connelly, B., S. Certo, R. Ireland, and C. Reutzel. 2011. "Signaling Theory: A Review and Assessment." *Journal of Management* 37 (1): 39–67. <https://doi.org/10.1177/0149206310388419>.
- Corbett, L., and D. Cutler. 2000. "Environmental Management Systems in the New Zealand Plastics Industry." *International Journal of Operations & Production Management* 20 (2): 204–224. <https://doi.org/10.1108/01443570010304260>.
- Ćwiklicki, M., K. Pilch, and M. Żabiński. 2020. "ISO 9001 Quality Management Systems in Local Government Institutions in Poland: Past, Present and Future." *International Review of Administrative Sciences* 86 (4): 799–815. <https://doi.org/10.1177/0020852318815280>.
- Dadakas, D., S. Ghazvini Kor, and S. Fargher. 2020. "Examining the trade potential of the UAE using a gravity model and a Poisson pseudo maximum likelihood estimator." *The Journal of International Trade & Economic Development* 29 (5): 619–646.
- Daily, B., and S. Huang. 2001. "Achieving Sustainability through Attention to Human Resource Factors in Environmental Management." *International Journal of Operations & Production Management* 21 (12): 1539–1552. <https://doi.org/10.1108/01443570110410892>.
- Darnall, N., H. Ji, and D. Vázquez-Brust. 2018. "Third-Party Certification, Sponsorship, and Consumers' Ecolabel Use." *Journal of Business Ethics* 150 (4): 953–969. <https://doi.org/10.1007/s10551-016-3138-2>.
- Desai, V. 2018. "Third-Party Certifications as an Organizational Performance Liability." *Journal of Management* 44 (8): 3096–3123. <https://doi.org/10.1177/0149206316659112>.
- Devine, A., M. McCollum, and S. Orlova. 2022. "Cleaning up Corruption and the Climate: The Role of Green Building Certifications." *Finance Research Letters* 47: 102929. <https://doi.org/10.1016/j.frl.2022.102929>.
- Dewally, M., and L. Ederington. 2006. "Reputation, Certification, Warranties, and Information as Remedies for Seller-Buyer Information Asymmetries: Lessons from the Online Comic Book Market." *The Journal of Business* 79 (2): 693–729. <https://doi.org/10.1086/499169>.
- Dineen, B., and D. Allen. 2016. "Third Party Employment Branding: Human Capital Inflows and Outflows following 'Best Places to Work' Certifications." *Academy of Management Journal* 59 (1): 90–112. <https://doi.org/10.5465/amj.2013.1091>.
- Dominguez, D., H. Worch, J. Markard, B. Truffer, and W. Gujer. 2009. "Closing the Capability Gap: strategic Planning for the Infrastructure Sector." *California Management Review* 51 (2): 30–50. <https://doi.org/10.2307/41166479>.
- Doyle, J., U. Ojiako, A. Marshall, I. Dawson, and M. Brito. 2021. "The Anchoring Heuristic and Overconfidence Bias among Frontline Employees in Supply Chain Organizations." *Production Planning & Control* 32 (7): 549–566. <https://doi.org/10.1080/09537287.2020.1744042>.
- Dranove, D., and G. Jin. 2010. "Quality Disclosure and Certification: Theory and Practice." *Journal of Economic Literature* 48 (4): 935–963. <https://doi.org/10.1257/jel.48.4.935>.
- Drover, W., M. Wood, and A. Corbett. 2018. "Toward a Cognitive View of Signalling Theory: Individual Attention and Signal Set Interpretation." *Journal of Management Studies* 55 (2): 209–231. <https://doi.org/10.1111/joms.12282>.
- Duperrin, J., and M. Godet. 1973. "Methode de Organizationale Des Elements D'un Systeme." *Rapport Economique du CEA, R-45-51, Paris*.
- Durugbo, C., A. Anouze, O. Amoudi, and Z. Al-Balushi. 2021. "Competitive Priorities for Regional Operations: A Delphi Study." *Production Planning & Control* 32 (15): 1295–1312. <https://doi.org/10.1080/09537287.2020.1805809>.
- Enerdata. 2022. *United Arab Emirates*. <https://www.enerdata.net/estore/energy-market/ united-arab-emirates/>
- Ericsson, K., M. Prietula, and E. Kokely. 2007. "The Making of an Expert." *Harvard Business Review* 85 (7/8): 115–121.
- Fanasch, P., and B. Frick. 2020. "The Value of Signals: do Self-Declaration and Certification Generate Price Premiums for Organic and Biodynamic Wines?" *Journal of Cleaner Production* 249: 119415. <https://doi.org/10.1016/j.jclepro.2019.119415>.
- Ferreira, L., and C. Cândido. 2021. "Factors Influencing Firm Propensity for ISO 9001 Withdrawal: Evidence on Decertification Tendency and Antecedents." *International Journal of Production Economics* 233: 108024. <https://doi.org/10.1016/j.ijpe.2020.108024>.
- Fosso Wamba, S., and E. Ngai. 2015. "Importance of Issues Related to RFID-Enabled Healthcare Transformation Projects: results from a Delphi Study." *Production Planning & Control* 26 (1): 19–33. <https://doi.org/10.1080/09537287.2013.840015>.
- Fritz, M., and M. Cordova. 2023. "Developing Managers' Mindset to Lead More Sustainable Supply Chains." *Cleaner Logistics and Supply Chain* 7: 100108. <https://doi.org/10.1016/j.clscn.2023.100108>.
- Fu, W., and H. Su. 2020. "Take Actions or Outsource? An Empirical Examination of Strategic Environmental Options on Greenhouse Gas Emissions." *International Journal of Operations & Production Management* 40 (6): 753–776. <https://doi.org/10.1108/IJOPM-02-2020-0088>.
- Galante, E., T. Temple, M. Ladyman, and P. Gill. 2017. "The UK Ministry of Defence Project Orientated Environmental Management System (POEMS)." *Propellants, Explosives, Pyrotechnics* 42 (1): 36–43. <https://doi.org/10.1002/prep.201600193>.
- García-Álvarez, M., and A. de Junguitu. 2023. "Shedding Light on the Motivations and Performance of the Eco-Management and Audit Scheme (EMAS)." *Environmental Impact Assessment Review* 99: 107045. <https://doi.org/10.1016/j.eiar.2023.107045>.
- Geerts, W. 2014. "Environmental Certification Schemes: Hotel Managers' Views and Perceptions." *International Journal of Hospitality Management* 39: 87–96. <https://doi.org/10.1016/j.ijhm.2014.02.007>.
- Gelens, J., N. Dries, J. Hofmans, and R. R. Pepermans. 2015. "Affective Commitment of Employees Designated as Talent: Signalling Perceived Organizational Support." *European Journal of International Management* 9 (1): 9–27.
- González, P., J. Sarkis, and B. Adenso-Díaz. 2008. "Environmental Management System Certification and Its Influence on Corporate Practices: Evidence from the Automotive Industry." *International Journal of Operations & Production Management* 28 (11): 1021–1041. <https://doi.org/10.1108/01443570810910179>.
- González-Benito, J., and O. González-Benito. 2005. "An Analysis of the Relationship between Environmental Motivations and ISO14001 Certification." *British Journal of Management* 16 (2): 133–148. <https://doi.org/10.1111/j.1467-8551.2005.00436.x>.
- González-Benito, J., and O. González-Benito. 2008. "Operations Management Practices Linked to the Adoption of ISO 14001: An Empirical Analysis of Spanish Manufacturers." *International Journal of Production Economics* 113 (1): 60–73. <https://doi.org/10.1016/j.ijpe.2007.02.051>.
- Haack, P., and A. Rasche. 2021. "The Legitimacy of Sustainability Standards: A Paradox Perspective." *Organization Theory* 2 (4): 263178772110494. <https://doi.org/10.1177/26317877211049493>.
- Hallowell, M., and J. Gambatese. 2010. "Qualitative Research: Application of the Delphi Method to CEM Research." *Journal of Construction Engineering and Management* 136 (1): 99–107. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000137](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000137).
- Hassan, M., M. Ali, E. Aktas, and K. Alkayid. 2015. "Factors Affecting Selection Decision of Auto-Identification Technology in Warehouse Management: An International Delphi Study." *Production Planning & Control* 26 (12): 1025–1049. <https://doi.org/10.1080/09537287.2015.1011726>.
- Hastig, G., and M. Sodhi. 2020. "Blockchain for Supply Chain Traceability: Business Requirements and Critical Success Factors." *Production and Operations Management* 29 (4): 935–954. <https://doi.org/10.1111/poms.13147>.
- Havakhor, T., and R. Sabherwal. 2018. "Team Processes in Virtual Knowledge Teams: The Effects of Reputation Signals and Network Density." *Journal of Management Information Systems* 35 (1): 266–318. <https://doi.org/10.1080/07421222.2018.1440755>.
- Hayward, J., and I. Vertinsky. 1999. "High Expectations, Unexpected Benefits: what Managers and Owners Think of Certification." *Journal of Forestry* 97 (2): 13–17. <https://doi.org/10.1093/jof/97.2.13>.



- Heras-Saizarbitoria, I., G. Arana, and O. Boiral. 2016. "Outcomes of Environmental Management Systems: The Role of Motivations and Firms' Characteristics." *Business Strategy and the Environment* 25 (8): 545–559. <https://doi.org/10.1002/bse.1884>.
- Heras-Saizarbitoria, I., O. Boiral, E. Allur, and M. García. 2020. "Communicating Environmental Management Certification: Signaling without Signals?" *Business Strategy and the Environment* 29 (2): 422–431. <https://doi.org/10.1002/bse.2374>.
- Homsy, G. 2016. "Powering Sustainability: Municipal Utilities and Local Government Policymaking." *Environment and Planning C: Government and Policy* 34 (6): 1076–1094. <https://doi.org/10.1177/0263774X15596530>.
- Horry, R., C. Booth, and A. Mahamadu. 2022. "Towards a Consensus of Expert Opinions on Implementing ISO 14001 in the Architecture, Engineering and Construction Sectors of the UK." *WIT Transactions on Ecology and the Environment* 258 (2022): 329–341. <https://doi.org/10.2495/SDP220281>.
- Hsu, C., K. Choon Tan, S. Hanim Mohamad Zailani, and V. Jayaraman. 2013. "Supply Chain Drivers That Foster the Development of Green Initiatives in an Emerging Economy." *International Journal of Operations & Production Management* 33 (6): 656–688. <https://doi.org/10.1108/IJOPM-10-2011-0401>.
- Hsu, C., K. Tan, and S. Mohamad Zailani. 2016. "Strategic Orientations, Sustainable Supply Chain Initiatives, and Reverse Logistics: Empirical Evidence from an Emerging Market." *International Journal of Operations & Production Management* 36 (1): 86–110. <https://doi.org/10.1108/IJOPM-06-2014-0252>.
- Huang, T., and A. Villadsen. 2023. "Top Managers in Public Organizations: A Systematic Literature Review and Future Research Directions." *Public Administration Review* 83 (6): 1618–1634. In Press. <https://doi.org/10.1111/puar.13628>
- Iatridis, K., and E. Kesidou. 2018. "What Drives Substantive versus Symbolic Implementation of ISO 14001 in a Time of Economic Crisis? Insights from Greek Manufacturing Companies." *Journal of Business Ethics* 148 (4): 859–877. <https://doi.org/10.1007/s10551-016-3019-8>.
- Ika, L., and J. Pinto. 2022. "The "Re-Meaning" of Project Success: Updating and Recalibrating for a Modern Project Management." *International Journal of Project Management* 40 (7): 835–848. <https://doi.org/10.1016/j.ijproman.2022.08.001>.
- Ikram, M., P. Zhou, S. Shah, and G. Liu. 2019. "Do Environmental Management Systems Help Improve Corporate Sustainable Development? Evidence from Manufacturing Companies in Pakistan." *Journal of Cleaner Production* 226: 628–641. <https://doi.org/10.1016/j.jclepro.2019.03.265>.
- International Energy Agency (IEA) 2022. *Natural Gas-Fired Electricity*. Paris: IEA. <https://www.iea.org/reports/natural-gas-fired-electricity>
- International Organization for Standardization (ISO). 2021. "Survey of Certifications." Accessed February 17, 2023. <https://committee.iso.org/files/live/sites/jtc1sc40/files/ISO%20Survey%202020%20with%2020000-1%20analysis%20v2.pdf>
- International Organization for Standardization (ISO). 2022. "ISO Survey 2020 Results – Number of Certificates and Sites per Country and the Number of Sector Overall." Accessed February 17, 2023. <https://www.iso.org/home.isoDocumentsDownload.do?t=LROerLut5nbEh7h53H3ocguG1AzdH3LIFi-sYIPXlvw7mVd8y7BxapAJzFJfy3&CSRFToken=A69N-6VTB-WQ9T-Y12R-Q4TM-ER2H-WBYU-TIIG>
- ISG. 2022. "Sustainable Commitments Must go Beyond Lip Service." Accessed August 27, 2023. <https://www.isgltd.com/de/en/news/sbm-interview-iris-wolke-haupt>
- Ivanova, A., J. Gray, and K. Sinha. 2014. "Towards a Unifying Theory of Management Standard Implementation: The Case of ISO 9001/ISO 14001." *International Journal of Operations & Production Management* 34 (10): 1269–1306. <https://doi.org/10.1108/IJOPM-03-2013-0117>.
- Jacoby, J., and M. Matell. 1971. "Three-Point Likert Scales Are Good Enough." *Journal of Marketing Research* 8 (4): 495–500. <https://doi.org/10.2307/3150242>.
- Jean, R., and D. Kim. 2021. "Signalling Strategies of Exporters on Internet Business-to-Business Platforms." *Journal of Management Studies* 58 (7): 1869–1898. <https://doi.org/10.1111/joms.12761>.
- Kafel, P., and P. Nowicki. 2022. "Circular Economy Implementation Based on ISO 14001 within SME Organization: How to Do It Best?" *Sustainability* 15 (1): 496. <https://doi.org/10.3390/su15010496>.
- Kankanhalli, A., Tan, B., and K. Wei. 2005. "Contributing Knowledge to Electronic Knowledge Repositories: An Empirical Investigation." *MIS Quarterly*, 29 (1): 113–143. <https://doi.org/10.2307/25148670>.
- Karasek, R., and P. Bryant. 2012. "Signaling Theory: Past, Present, and Future." *Academy of Strategic Management Journal* 11 (1): 91–99.
- Kazagic, A., M. Music, I. Smajevic, A. Ademovic, and E. Redzic. 2016. "Possibilities and Sustainability of 'Biomass for Power' Solutions in the Case of a Coal-Based Power Utility." *Clean Technologies and Environmental Policy* 18 (6): 1675–1683. <https://doi.org/10.1007/s10098-016-1193-0>.
- Kempa, M., R. Carrier, J. Wood, and C. Shearing. 1999. "Reflections of the Evolving Concept of Private Policing." *European Journal on Criminal Policy and Research* 7 (2): 197–223. <https://doi.org/10.1023/A:1008705411061>.
- Kern, F. 2012. "Using the Multi-Level Perspective on Socio-Technical Transitions to Assess Innovation Policy." *Technological Forecasting and Social Change* 79 (2): 298–310. <https://doi.org/10.1016/j.techfore.2011.07.004>.
- Ketokivi, M., and T. Choi. 2014. "Renaissance of Case Research as a Scientific Method." *Journal of Operations Management* 32 (5): 232–240. <https://doi.org/10.1016/j.jom.2014.03.004>.
- Khan, S., M. Umar, Z. Yu, and M. Nawaz. 2023. "A Recent Digitalization in Recycling Industry Attaining Ecological Sustainability: A Comprehensive Outlook and Future Trend." *Environmental Science and Pollution Research International* 30 (47): 103760–103775. <https://doi.org/10.1007/s11356-023-29537-y>.
- Kharouf, H., D. Lund, A. Krallman, and C. Pullig. 2020. "A Signaling Theory Approach to Relationship Recovery." *European Journal of Marketing* 54 (9): 2139–2170. <https://doi.org/10.1108/EJM-10-2019-0751>.
- Kirmani, A., and A. Rao. 2000. "No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality." *Journal of Marketing* 64 (2): 66–79. <https://doi.org/10.1509/jmkg.64.2.66.18000>.
- Klein, T. 2021. "Founders must Show Investors that Sustainability is more than Lip Service." TechCrunch. Accessed August 27, 2023. <https://techcrunch.com/2021/06/08/founders-must-show-investors-that-sustainability-is-more-than-lip-service/>
- Kometa, S., P. Olomolaiye, and F. Harris. 1994. "Attributes of UK Construction Clients Influencing Project Consultants' Performance." *Construction Management and Economics* 12 (5): 433–443. <https://doi.org/10.1080/014461994000000053>.
- Konefal, J., and M. Hatanaka. 2011. "Enacting Third-Party Certification: A Case Study of Science and Politics in Organic Shrimp Certification." *Journal of Rural Studies* 27 (2): 125–133. <https://doi.org/10.1016/j.jrurstud.2010.12.001>.
- Kumar, A., S. Choudhary, J. Garza-Reyes, V. Kumar, S. Rehman Khan, and M. Mishra. 2023. "Analysis of Critical Success Factors for Implementing Industry 4.0 Integrated Circular Supply Chain—Moving towards Sustainable Operations." *Production Planning & Control* 34 (10): 984–998. <https://doi.org/10.1080/09537287.2021.1980905>.
- Lamin, A., and G. Livanis. 2020. "Do Third-Party Certifications Work in a Weak Institutional Environment?" *Journal of International Management* 26 (2): 100742. <https://doi.org/10.1016/j.intman.2020.100742>.
- Lange, T., C. Kopkow, J. Lütznier, K. Günther, S. Gravius, H. Scharf, J. Stöve, R. Wagner, and J. Schmitt. 2020. "Comparison of Different Rating Scales for the Use in Delphi Studies: different Scales Lead to Different Consensus and Show Different Test-Retest Reliability." *BMC Medical Research Methodology* 20 (1): 28. <https://doi.org/10.1186/s12874-020-0912-8>.
- Lansing, J., N. Siegfried, A. Sunyaev, and A. Benlian. 2019. "Strategic Signaling through Cloud Service Certifications: Comparing the Relative Importance of Certifications' Assurances to Companies and Consumers." *Journal of Strategic Information Systems* 28 (4): 101579.
- Lieberherr, E., and B. Truffer. 2015. "The Impact of Privatization on Sustainability Transitions: A Comparative Analysis of Dynamic Capabilities in Three Water Utilities." *Environmental Innovation and*

- Societal Transitions* 15: 101–122. <https://doi.org/10.1016/j.eist.2013.12.002>.
- Lins, S., J. Becker, K. Lyytinen, and A. Sunyaev. 2023. "A Design Theory for Certification Presentations." *ACM SIGMIS Database: The DATABASE for Advances in Information Systems* 54 (3): 75–118. <https://doi.org/10.1145/3614178.3614183>.
- Liu, J., C. Yuan, M. Hafeez, and X. Li. 2020. "ISO 14001 Certification in Developing Countries: motivations from Trade and Environment." *Journal of Environmental Planning and Management* 63 (7): 1241–1265. <https://doi.org/10.1080/09640568.2019.1649642>.
- Logue, K. 2015. "Encouraging Insurers to Regulate: The Role (If Any) for Tort Law." *UC Irvine Law Review* 5 (6): 1355–1388.
- Lozano, M., and J. Vallés. 2007. "An Analysis of the Implementation of an Environmental Management System in a Local Public Administration." *Journal of Environmental Management* 82 (4): 495–511. <https://doi.org/10.1016/j.jenvman.2006.01.013>.
- Luthra, S., D. Garg, and A. Haleem. 2015a. "Critical Success Factors of Green Supply Chain Management for Achieving Sustainability in Indian Automobile Industry." *Production Planning & Control* 26 (5): 339–362.
- Luthra, S., D. Garg, and A. Haleem. 2015b. "An Analysis of Interactions among Critical Success Factors to Implement Green Supply Chain Management towards Sustainability: An Indian Perspective." *Resources Policy* 46: 37–50. <https://doi.org/10.1016/j.resourpol.2014.12.006>.
- Luthra, S., S. Mangla, R. Shankar, C. Prakash Garg, and S. Jakhur. 2018. "Modelling Critical Success Factors for Sustainability Initiatives in Supply Chains in Indian Context Using Grey-DEMATEL." *Production Planning & Control* 29 (9): 705–728. <https://doi.org/10.1080/09537287.2018.1448126>.
- Ma, Y., Y. Liu, A. Appolloni, and J. Liu. 2021. "Does Green Public Procurement Encourage Firm's Environmental Certification Practice? The Mediation Role of Top Management Support." *Corporate Social Responsibility and Environmental Management* 28 (3): 1002–1017. <https://doi.org/10.1002/csr.2101>.
- Marrucci, L., and T. Daddi. 2022. "The Contribution of the Eco-Management and Audit Scheme to the Environmental Performance of Manufacturing Organisations." *Business Strategy and the Environment* 31 (4): 1347–1357. <https://doi.org/10.1002/bse.2958>.
- Marshall, A., U. Ojiako, V. Wang, F. Lin, and M. Chipulu. 2019. "Forecasting Unknown-Unknowns by Boosting the Risk Radar within the Risk Intelligent Organisation." *International Journal of Forecasting* 35 (2): 644–658. <https://doi.org/10.1016/j.ijforecast.2018.07.015>.
- Mazzi, A., S. Toniolo, M. Mason, F. Aguiari, and A. Scipioni. 2016. "What Are the Benefits and Difficulties in Adopting an Environmental Management System? The Opinion of Italian Organizations." *Journal of Cleaner Production* 139: 873–885. <https://doi.org/10.1016/j.jclepro.2016.08.053>.
- Melnik, S., R. Sroufe, and R. Calantone. 2003. "Assessing the Impact of Environmental Management Systems on Corporate and Environmental Performance." *Journal of Operations Management* 21 (3): 329–351. [https://doi.org/10.1016/S0272-6963\(02\)00109-2](https://doi.org/10.1016/S0272-6963(02)00109-2).
- Meyer, M., and J. Booker. 2001. *Eliciting and Analyzing Expert Judgment: A Practical Guide*. Vol. 7. Philadelphia: SIAM.
- Mogyoros, A. 2023. "Improving Eco-Labels: are Green Certification Marks up to the Task?" *Journal of Intellectual Property Law and Practice* 18 (5): 367–374. <https://doi.org/10.1093/jiplp/jpad029>.
- Moratis, L. 2016. "Signaling Strategies for ISO 26000: A Firm-Level Approach." *International Journal of Operations & Production Management* 36 (5): 512–531. <https://doi.org/10.1108/IJOPM-08-2014-0402>.
- Mosgaard, M., and H. Kristensen. 2020. "Companies That Discontinue Their ISO14001 Certification—Reasons, Consequences and Impact on Practice." *Journal of Cleaner Production* 260: 121052. <https://doi.org/10.1016/j.jclepro.2020.121052>.
- Mosgaard, M., A. Bundgaard, and H. Kristensen. 2022. "ISO 14001 Practices—a Study of Environmental Objectives in Danish Organizations." *Journal of Cleaner Production* 331: 129799. <https://doi.org/10.1016/j.jclepro.2021.129799>.
- Negassi, S., S. Lhuillery, J. Sattin, T. Hung, and F. Pratlong. 2019. "Does the Relationship between Innovation and Competition Vary across Industries? Comparison of Public and Private Research Enterprises." *Economics of Innovation and New Technology* 28 (5): 465–482. <https://doi.org/10.1080/10438599.2018.1527552>.
- Netland, T., and A. Aspelund. 2014. "Multi-Plant Improvement Programmes: A Literature Review and Research Agenda." *International Journal of Operations & Production Management* 34 (3): 390–418. <https://doi.org/10.1108/IJOPM-02-2012-0087>.
- Ojiako, U., M. Chipulu, A. M. Almeile, L. Ika, H. Bashir, A. Marshall, and E. J. H. AlRaeesi. 2023. "Variations in Critical Success Factors of PPP-Procured Construction Projects over Lifecycle Phases." *Production Planning & Control* <https://doi.org/10.1080/09537287.2023.2294310>.
- Ojiako, U., E. J. H. AlRaeesi, M. Chipulu, A. Marshall, and H. Bashir. 2024. "Innovation Readiness in Public Sector Service Delivery: An Exploration." *Production Planning & Control* 35 (5): 437–460. <https://doi.org/10.1080/09537287.2022.2089266>.
- Palaniappan, M., P. Gleick, C. Hunt, and V. Srinivasan. 2004. "Chapter 3: Water Privatization Principles and Practices." In *The World's Water 2004–2005: The Biennial Report on Freshwater Resources*, edited by P. Gleick. Washington, DC: Island Press.
- Phan, T., and K. Baird. 2015. "The Comprehensiveness of Environmental Management Systems: The Influence of Institutional Pressures and the Impact on Environmental Performance." *Journal of Environmental Management* 160: 45–56. <https://doi.org/10.1016/j.jenvman.2015.06.006>.
- Phelps, D. 1949. "Certification Marks under the Lanham Act." *Journal of Marketing* 13 (4): 498–505. <https://doi.org/10.2307/1247789>.
- Podrecca, M., G. Orzes, M. Sartor, and G. Nassimbeni. 2021. "The Impact of Abandoning Social Responsibility Certifications: evidence from the Decertification of SA8000 Standard." *International Journal of Operations & Production Management* 41 (13): 100–126. <https://doi.org/10.1108/IJOPM-10-2020-0698>.
- Ponte, S. 2008. "Greener than Thou: The Political Economy of Fish Ecolabeling and Its Local Manifestations in South Africa." *World Development* 36 (1): 159–175. <https://doi.org/10.1016/j.worlddev.2007.02.014>.
- Prajogo, D., A. Tang, and K. Lai. 2014. "The Diffusion of Environmental Management System and Its Effect on Environmental Management Practices." *International Journal of Operations & Production Management* 34 (5): 565–585. <https://doi.org/10.1108/IJOPM-10-2012-0448>.
- Ramos, T., I. Alves, R. Subtil, and J. de Melo. 2007. "Environmental Performance Policy Indicators for the Public Sector: The Case of the Defence Sector." *Journal of Environmental Management* 82 (4): 410–432. <https://doi.org/10.1016/j.jenvman.2005.12.020>.
- Rao, H. 1994. "The Social Construction of Reputation: Certification Contests, Legitimation, and the Survival of Organizations in the American Automobile Industry: 1895–1912." *Strategic Management Journal* 15 (S1): 29–44. <https://doi.org/10.1002/smj.4250150904>.
- Rappaport, J. 2017. "How Private Insurers Regulate Public Police." *Harvard Law Review* 130 (6): 1539–1615.
- Rasmussen, T., and H. Jeppesen. 2006. "Teamwork and Associated Psychological Factors: A Review." *Work & Stress* 20 (2): 105–128. <https://doi.org/10.1080/02678370600920262>.
- Rathore, P., S. Rathore, R. Singh, and S. Agnihotri. 2018. "Solar Power Utility Sector in India: Challenges and Opportunities." *Renewable and Sustainable Energy Reviews* 81: 2703–2713. <https://doi.org/10.1016/j.rser.2017.06.077>.
- Remizov, A., A. Tukaziban, Z. Yelzhanova, T. Junussova, and F. Karaca. 2021. "Adoption of Green Building Assessment Systems to Existing Buildings under Kazakhstani Conditions." *Buildings* 11 (8): 325. <https://doi.org/10.3390/buildings11080325>.
- Rhodes, A. 2007. "ISO Enters the Public Sector through the United States Forest Service." *Colorado Journal of International Environmental Law and Policy* 18 (2): 417–458.
- Robson, I., U. Ojiako, and S. Maguire. 2022. "A Complexity Perspective of Dynamic Capabilities in Enterprise Project Organizations." *Production Planning & Control* <https://doi.org/10.1080/09537287.2022.2126953>.
- Rockart, J. 1979. "Chief Executives Define Their Own Data Needs." *Harvard Business Review* 57 (2): 81–93.

- Rockart, J. 1982. "The Changing Role of the Information System Executive: A Critical Success Factors Perspective." *Sloan Management Review* 24 (1): 3–13.
- Roehrich, J., S. Hojmoose, and V. Overland. 2017. "Driving Green Supply Chain Management Performance through Supplier Selection and Value Internalisation: A Self-Determination Theory Perspective." *International Journal of Operations & Production Management* 37 (4): 489–509. <https://doi.org/10.1108/IJOPM-09-2015-0566>.
- Ronnenberg, S., M. Graham, and F. Mahmoodi. 2011. "The Important Role of Change Management in Environmental Management System Implementation." *International Journal of Operations & Production Management* 31 (6): 631–647. <https://doi.org/10.1108/014435711111131971>.
- Rosenberg, E. 1976. "Standards and Industry Self-Regulation." *California Management Review* 19 (1): 79–90. <https://doi.org/10.2307/41164687>.
- Sambasivan, M., and N. Fei. 2008. "Evaluation of Critical Success Factors of Implementation of ISO 14001 Using Analytic Hierarchy Process (AHP): a Case Study from Malaysia." *Journal of Cleaner Production* 16 (13): 1424–1433. <https://doi.org/10.1016/j.jclepro.2007.08.003>.
- Rowe, G., and G. Wright. 1999. "The Delphi technique as a forecasting tool: Issues and analysis." *International Journal of Forecasting* 15 (4): 353–375.
- Santa, S., J. Ribeiro, G. Mazon, J. Schneider, R. Barcelos, and J. de Andrade. 2020. "A Green Airport Model: Proposition Based on Social and Environmental Management Systems." *Sustainable Cities and Society* 59: 102160. <https://doi.org/10.1016/j.scs.2020.102160>.
- Saxton, Gregory D., Lina Gomez, Zed Ngoh, Yi-Pin Lin, and Sarah Dietrich. 2019. "Do CSR Messages Resonate? Examining Public Reactions to Firms' CSR Efforts on Social Media." *Journal of Business Ethics* 155 (2): 359–377. <https://doi.org/10.1007/s10551-017-3464-z>.
- Schiavetti, D. 2021. "Genericness in US Certification Marks: The 'GRUYÈRE' Case." *Journal of Intellectual Property Law & Practice* 16 (4–5): 298–300. <https://doi.org/10.1093/jiplp/jpab021>.
- Schwarz, S. 2002. "Private Ordering of Public Markets: The Rating Agency Paradox." *University of Illinois Law Review* 2002 (1): 1–28.
- Scott, C. 2002. "Private Regulation of the Public Sector: A Neglected Facet of Contemporary Governance." *Journal of Law and Society* 29 (1): 56–76. <https://doi.org/10.1111/1467-6478.00211>.
- Simpson, D., and R. Sroufe. 2014. "Stakeholders, Reward Expectations and Firms' Use of the ISO14001 Management Standard." *International Journal of Operations & Production Management* 34 (7): 830–852. <https://doi.org/10.1108/IJOPM-02-2012-0063>.
- Sine, W., R. David, and H. Mitsuhashi. 2007. "From Plan to Plant: Effects of Certification on Operational Start-Up in the Emergent Independent Power Sector." *Organization Science* 18 (4): 578–594. <https://doi.org/10.1287/orsc.1070.0300>.
- Singh, P., and P. Mansour-Nahra. 2006. "ISO 9000 in the Public Sector: A Successful Case from Australia." *The TQM Magazine* 18 (2): 131–142. <https://doi.org/10.1108/09544780610647856>.
- Slacik, J., and D. Greiling. 2020. "Compliance with Materiality in G4-Sustainability Reports by Electric Utilities." *International Journal of Energy Sector Management* 14 (3): 583–608. <https://doi.org/10.1108/IJESM-03-2019-0010>.
- Soanes, C. and A. Stevenson, Eds. 2004. *Concise Oxford English Dictionary*. Vol. 11. Oxford: Oxford University Press.
- Sorooshian, S., and L. Yee. 2019. "Demotivating Factors Affecting the Implementation of ISO 14001: 2015 in Malaysia." *Environmental Quality Management* 29 (2): 85–95. <https://doi.org/10.1002/tqem.21664>.
- Spence, M. 1973. "Job Market Signaling." *Quarterly Journal of Economics* 87: 355–374.
- Sroufe, R. 2003. "Effects of Environmental Management Systems on Environmental Management Practices and Operations." *Production and Operations Management* 12 (3): 416–431. <https://doi.org/10.1111/j.1937-5956.2003.tb00212.x>.
- Stahl, K., and R. Strausz. 2017. "Certification and Market Transparency." *The Review of Economic Studies* 84 (4 (301)): 1842–1868.
- Steurer, R. 2013. "Disentangling Governance: A Synoptic View of Regulation by Government, Business and Civil Society." *Policy Sciences* 46 (4): 387–410. <https://doi.org/10.1007/s11077-013-9177-y>.
- Stohl, C., and G. Cheney. 2001. "Participatory Processes/Paradoxical Practices." *Management Communication Quarterly* 14 (3): 349–407. <https://doi.org/10.1177/0893318901143001>.
- Suazo, M., P. Martínez, and R. Sandoval. 2009. "Creating Psychological and Legal Contracts through Human Resource Practices: A Signaling Theory Perspective." *Human Resource Management Review* 19 (2): 154–166. <https://doi.org/10.1016/j.hrmmr.2008.11.002>.
- Suhi, S., R. Enayet, T. Haque, S. Ali, M. Muktadir, and S. Paul. 2019. "Environmental Sustainability Assessment in Supply Chain: An Emerging Economy Context." *Environmental Impact Assessment Review* 79: 106306. <https://doi.org/10.1016/j.eiar.2019.106306>.
- Sumecki, D., M. Chipulu, and U. Ojiako. 2011. "Email Overload: Exploring the Moderating Role of the Perception of Email as a 'Business Critical' Tool." *International Journal of Information Management* 31 (5): 407–414. <https://doi.org/10.1016/j.ijinfomgt.2010.12.008>.
- Sweidan, O. 2021. "The Environmental and Energy Policies to Enable Sustainable Consumption and Production in the Gulf Cooperation Council Countries." *Clean Technologies and Environmental Policy* 23 (9): 2639–2654. <https://doi.org/10.1007/s10098-021-02184-y>.
- Taj, S. 2016. "Application of Signaling Theory in Management Research: Addressing Major Gaps in Theory." *European Management Journal* 34 (4): 338–348. <https://doi.org/10.1016/j.emj.2016.02.001>.
- Tanner, B. 2000. "Independent Assessment by Third-Party Certification Bodies." *Food Control*. 11 (5): 415–417. [https://doi.org/10.1016/S0956-7135\(99\)00055-9](https://doi.org/10.1016/S0956-7135(99)00055-9).
- Tanveer, M., S. Khan, M. Umar, Z. Yu, M. Sajid, and I. I. Haq. 2022. "Waste Management and Green Technology: Future Trends in Circular Economy Leading towards Environmental Sustainability." *Environmental Science and Pollution Research International* 29 (53): 80161–80178. <https://doi.org/10.1007/s11356-022-23238-8>.
- Tawiah, V., and T. Soobaroyen. 2022. "The Relationship between the Adoption of International Public Sector Accounting Standards and Sources of Government Financing: evidence from Developing Countries." *Accounting Forum* <https://doi.org/10.1080/01559982.2022.2151073>.
- Taylor, D. 1958. "Certification Marks-Success or Failure." *Journal of Marketing* 23 (1): 39. <https://doi.org/10.2307/1248015>.
- Tayo Tene, C., O. Boiral, and I. Heras-Saizarbitoria. 2021. "Does Quality Management Improve the Internalization of Environmental Practices? An Empirical Study in Africa." *Business Strategy and the Environment* 30 (7): 3053–3064. <https://doi.org/10.1002/bse.2788>.
- Treacy, R., P. Humphreys, R. Mclvor, and C. Lo. 2019. "ISO14001 Certification and Operating Performance: A Practice-Based View." *International Journal of Production Economics* 208: 319–328. <https://doi.org/10.1016/j.ijpe.2018.12.012>.
- Umble, E., R. Haft, and M. Umble. 2003. "Enterprise Resource Planning: Implementation Procedures and Critical Success Factors." *European Journal of Operational Research* 146 (2): 241–257. [https://doi.org/10.1016/S0377-2217\(02\)00547-7](https://doi.org/10.1016/S0377-2217(02)00547-7).
- UAE (Ministry of Energy & Industry). 2019. "UAE State of Energy Report 2019." Accessed February 21, 2023. [file:///C:/Users/101585/Downloads/Energy%20Report-2019-Final-Preview-1%20\(1\).pdf](file:///C:/Users/101585/Downloads/Energy%20Report-2019-Final-Preview-1%20(1).pdf)
- UAE (Ministry of Energy & Industry). 2022. "UAE National Energy Strategy 2050." Accessed February 21, 2023. <https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/environment-and-energy/uae-energy-strategy-2050>
- United Arab Emirates (Ministry of Climate Change & Environment). 2022. "National Climate Change Plan of the UAE 2017–2050." Accessed February 23, 2021. [file:///C:/Users/101585/Downloads/Updated\\_NCCP%202017-2050\\_English%20\(1\).pdf](file:///C:/Users/101585/Downloads/Updated_NCCP%202017-2050_English%20(1).pdf).
- United Arab Emirates (Telecommunications Regulatory Authority). 2019. "UAE Green Growth Strategy." Accessed February 21, 2023. <file:///C:/Users/101585/Downloads/CS19.pdf>.
- United States Energy Information Administration. 2022. "Analysis: United Arab Emirates." Accessed February 21, 2023. <https://www.eia.gov/international/analysis/country/ARE>
- United States Environmental Protection Agency. 2023. "Sources of Greenhouse Gas Emissions." Accessed August 28, 2023. <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

- Van der Hoek, M., S. Groeneveld, and B. Kuipers. 2018. "Goal Setting in Teams: Goal Clarity and Team Performance in the Public Sector." *Review of Public Personnel Administration* 38 (4): 472–493. <https://doi.org/10.1177/0734371X16682815>.
- Van Steden, R., and R. Sarre. 2020. "The Growth of Privatized Policing: Some Cross-National Data and Comparisons." *International Journal of Comparative and Applied Criminal Justice* 31 (1): 51–71. <https://doi.org/10.1080/01924036.2007.9678760>.
- Vanacker, T., D. Forbes, M. Knockaert, and S. Manigart. 2020. "Signal Strength, Media Attention, and Resource Mobilization: Evidence from New Private Equity Firms." *Academy of Management Journal* 63 (4): 1082–1105. <https://doi.org/10.5465/amj.2018.0356>.
- Volmar, E., and K. Eisenhardt. 2020. "Case Study Research: A State-of-the-Art Perspective." In *Oxford Research Encyclopedia of Business and Management*. Oxford, UK: Oxford University Press.
- Warfield, J. 1974. "Developing Interconnection Matrices in Structural Modeling." *IEEE Transactions on Systems, Man, and Cybernetics* SMC-4 (1): 81–87. <https://doi.org/10.1109/TSMC.1974.5408524>.
- Wateridge, J. 1995. "IT Projects: A Basis for Success." *International Journal of Project Management* 13 (3): 169–172. [https://doi.org/10.1016/0263-7863\(95\)00020-Q](https://doi.org/10.1016/0263-7863(95)00020-Q).
- Waxin, M., S. Knuteson, and A. Bartholomew. 2019. "Outcomes and Key Factors of Success for ISO 14001 Certification: Evidence from an Emerging Arab Gulf Country." *Sustainability* 12 (1): 258. <https://doi.org/10.3390/su12010258>.
- Weerasinghe, I., and V. Jayasooriya. 2020. "Assessment of the Critical Factors in Implementing ISO 14001: 2015 Environmental Management Systems for Developing Countries: A Case Study for Sri Lanka." *Environmental Quality Management* 29 (3): 73–81. <https://doi.org/10.1002/tqem.21684>.
- Wong, C., C. Wong, and S. Boon-Itt. 2020. "Environmental Management Systems, Practices and Outcomes: Differences in Resource Allocation between Small and Large Firms." *International Journal of Production Economics* 228: 107734. <https://doi.org/10.1016/j.ijpe.2020.107734>.
- Yasar, B., T. Martin, and T. Kiessling. 2020. "An Empirical Test of Signalling Theory." *Management Research Review* 43 (11): 1309–1335. <https://doi.org/10.1108/MRR-08-2019-0338>.
- Yin, R. 2017. *Case Study Research and Applications: Design and Methods*. 6th ed. Los Angeles, CA: Sage Publications.
- Zadeh, L. 1965. "Fuzzy Sets." *Information and Control* 8 (3): 338–353. [https://doi.org/10.1016/S0019-9958\(65\)90241-X](https://doi.org/10.1016/S0019-9958(65)90241-X).
- Zoller, H., R. Strohlic, and C. Getz. 2020. "Agricultural Workers' Participation in Certification as a Mechanism for Improving Working Conditions: The Equitable Food Initiative." *Journal of Applied Communication Research* 48 (6): 654–674. <https://doi.org/10.1080/00909882.2020.1824075>.
- Zutshi, A., A. Sohal, and C. Adams. 2008. "Environmental Management System Adoption by Government Departments/Agencies." *International Journal of Public Sector Management* 21 (5): 525–539. <https://doi.org/10.1108/09513550810885813>.