



Fuzzy-set qualitative comparative analysis (fsQCA) in business and management research: A contemporary overview



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ABSTRACT

To make scientific inferences about business phenomena, it may not be sufficient to consider the real-world context of the business environment as statistically symmetrical (e.g., linearly, regular frequencies). This is why recently the use of asymmetrical techniques which draw on the reasoning of complexity theory – such as fuzzy-set qualitative comparative analysis (fsQCA) – to better predict and explain real-world business phenomena using a configurational approach is being increasingly promoted. This article aims to identify the key contributors and knowledge structure of business and management research involving the application of complexity theory and fsQCA. Using bibliographic data of 1,155 articles extracted from Scopus, our review conducts (1) a performance analysis to shed light on the field's key contributors based on the criteria of journal, article, author, institution, and country, and (2) a scientific mapping using keyword cooccurrence and PageRank to reveal three knowledge clusters and the prominent articles in each cluster. Taken collectively, this review is a useful resource to gain a comprehensive understanding of the state-of-the-art and promising avenues for future research involving the prediction of business phenomena using complexity theory and fsQCA.

1. Introduction

The decision-making methodology that is often adopted in business and management¹ studies, the outcomes of which are typically derived using linear statistical analysis with finite contextual factors, could suffer from prediction inaccuracy (Arrow et al., 2008; Pappas and Woodside, 2021; Tiberius and Rasche, 2011). This prediction inaccuracy may be caused by constantly shifting market circumstances, indicating that the environment in which businesses operate across sectors have intricate scenarios with ambiguous or inconsistent observations (Woodside, 2018), which in turn, may contradict projected insights derived from historical data. Prior research has reported on such instances in sectors such as energy (Höhne and Tiberius, 2020), healthcare (Ermolina and Tiberius, 2021), hospitality (Gassmann et al., 2021), media (Studen and Tiberius, 2020), and retailing (Weyer et al., 2020),

among others, and notably in business areas such as finance (Tiberius and Hauptmeijer, 2021), human resources (Prommer et al., 2020), marketing (Kumar et al., 2020), or entrepreneurship (Covin et al., 2020).

The outcomes of empirical analyses employing conventional statistical (symmetrical) approaches such as multiple regression and structural equation modeling may not adequately predict actuality and could be inappropriate (or misleading) in a specific scenario (Khedhaouria and Cucchi, 2019; Papatheodorou and Pappas, 2017), which is why researchers have increasingly turned to complexity theory for guidance (De Toni and Pessot, 2021; Jancenelle, 2021). Prior studies involving uncertain and nonlinear scenarios have laid the foundation for “complex adaptive systems” (Daniel and Daniel, 2019; Schneider and Somers, 2006; Reschke et al., 2010; Tapsell and Woods, 2010; Uhl-Bien et al., 2007), a clear reference to the application of complexity theory to

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¹ For reasons of simplification, the terms are considered largely synonymous in the following, and the former is predominantly used.

scientific investigation, with equivalent techniques such as fuzzy-set qualitative comparative analysis (fsQCA) or the Delphi method emerging in parallel. Noteworthily, fsQCA has emerged as a highly objective technique for deriving predictive conclusions as the technique is based on a statistically-informed configurational approach (Harms et al., 2009; Kraus et al., 2018; Lee, 2022; Olya et al., 2021; Thornton et al., 2019), whereas the Delphi method is also constructive, but more subjective in nature because the method relies on a consensus among experts to reach predictive conclusions (Flostrand et al., 2020; Markmann et al., 2021). The fsQCA approach has a relative advantage in depicting the combinations of conditions that lead to the absence of an outcome, a positive outcome, and a negative outcome (Huang and Yu, 2017). Unlike other methodological methods, fsQCA is backed by Boolean algebra and configurational relationship, which distinguishes it from the rest of the analytical pack (Di Paola, 2021; Ragin and Fiss, 2008).

As the call for the abolition of null hypothesis significance testing (NHST) around the world grows stronger (Prentice, 2019), asymmetrical techniques such as fsQCA have become highly noticeable as a scientific method to reflect the usefulness or accuracy of an investigative framework in anticipating a specific outcome of interest (Pappas and Woodside, 2021). The growing importance of fsQCA has prompted Pappas and Woodside (2021) to publish a technical note that discusses the foundational tenets of the technique, which guides interested researchers on how to employ the analytical method in their research. fsQCA, which is a form of configurational testing that focuses on Boolean algebra and set theory principles rather than the current prevalent research paradigm of combining matrix algebra with additive-based statistical methods, exemplifies the asymmetrical thinking of complexity theory (Llopis-Albert et al., 2021; Misangyi et al., 2017; Prentice, 2019). fsQCA accomplishes this by combining the reasoning and methodological rigor of case-oriented qualitative methods for capturing rich contextual information with variable-oriented quantitative methods that deal with a larger number of cases, resulting in much more generalizable analytical inferences (Acquah et al., 2021; Dahms, 2019; Huang and Roig-Tierno, 2016). As such, although fsQCA accordingly sits somewhere "midway between exploratory and hypothesis-testing research" (Kent, 2005, p. 226), the method is not adequate to be used for the latter (hypothesis-testing), but at most for the creation of "propositions" which determine the membership in certain configurations (i.e. pathways).

To further comprehend the methodological feature of fsQCA, a *configuration* is described as a set of favorable, unfavorable, or non-existent factors (or situations), while a *condition* is specified if a certain outcome cannot be attained without it (Kopplin and Rösch, 2021; Küçükergin et al., 2021; Mehran and Olya, 2020). A condition is declared sufficient if it results in the outcome without the need for any additional requirements (Prentice, 2019; Wagemann et al., 2016). The primary goal of fsQCA is to determine which configurations (i.e., combinations of factors) are substantially essential and/or sufficient to generate a certain outcome, as well as which permuted combinations of events (or instances) share a specific set of requirements (Bandara et al., 2021; Pappas and Woodside, 2021; Timmer and Kaufmann, 2017). fsQCA generates findings that are indicative of the key concepts of complexity theory (Mehran and Olya, 2020) that may be categorized into three types (Prentice, 2019). First, fsQCA demonstrates variables that are causally associated in one configuration yet irrelevant or negatively related in another, revealing an asymmetrical association (Gligor et al., 2021; Lee, 2022). Second, fsQCA technique identifies multiple equally effective alternatives to the same outcome, demonstrating equifinality (Dahms, 2019; Kopplin and Rösch, 2021; Ortiz de Guinea and Raymond, 2020; Russo et al., 2019). Third, fsQCA shows that the effect of precursors (or antecedents) on a certain event is determined by how the precursors (or antecedents) are coupled (or integrated) instead of the magnitude of the standalone indicators themselves per se, indicating complexity or conjunctural causation (Cheng et al., 2013; Mikalef et al., 2019; Romero-Castro et al., 2021).

Since the predicted associations between independent and dependent variables in prior research inquiries in a real-world setting could, in fact, be asymmetrical, researchers must recognize the need to use asymmetrical techniques to revisit past results established using symmetrical techniques (Nagy et al., 2017; Prentice, 2019; Woodside et al., 2020). Noteworthily, when the Scopus database was searched using five prominent keywords related to symmetrical techniques (i.e., "structural equation model", "SEM", "regression", "AMOS", and "PLS-SEM"), the search results returned consist of more than two million articles, with over 80,000 records in the subject area of "business, management and accounting", which indicate a large scope of symmetrical results that could be revisited using asymmetrical techniques. This is in line with the recommendation made by various scholars to revisit linear models and results in business studies (Nagy et al., 2017; Pappas and Woodside, 2021), especially given that NHST is no longer powerful enough to predict business outcomes due to the complexity of contemporary business environments (Prentice, 2019; Woodside et al., 2020). On the contrary, there is only a relatively low number of research articles that apply asymmetrical approaches, which would be discussed in subsequent sections. Since fsQCA promises to be a more viable approach for predicting business outcomes and explaining the complexity of management in the new-age environment that is disruptive, volatile, uncertain, complex, and ambiguous (DVUCA), any relevant prior studies conducted through the lens of complexity theory could also be re-examined with fsQCA to derive new or reaffirm existing insights, which is in accordance with past scholars who have called for new retrospective studies in the field (Gassmann et al., 2021; Prommer et al., 2020; Tiberius and Hauptmeijer, 2021).

The goal of this review is not to offer a detailed description of how to apply fsQCA, but rather to provide a comprehensive and inclusive overview of prior studies using complexity theory and fsQCA to guide prospective researchers interested in using this promising and powerful analytical technique for business research. While some researchers have sought to do so, several limitations exist. For example, Wagemann et al. (2016) conducted a first-of-its-kind inquiry that reviews past studies employing qualitative comparative analysis (QCA) in its many variations, examining 61 articles retrieved from the Compass database. However, their review offers little insights regarding fsQCA research in business, which may be due to the database that was employed for their study. Kraus et al. (2018) addressed this limitation by searching nine databases for fsQCA research, including ABI/Inform-ProQuest, EBS-COhost-Business Source Premier, JSTOR, ScienceDirect, Emerald, SAGE, SpringerLink, Web of Science (WoS), and Google Scholar. However, their search was specifically targeted at entrepreneurship and innovation research, and thus, it was unsurprising that their search yielded only 77 research articles. Noteworthily, both Wagemann et al. (2016) and Kraus et al. (2018) relied on bibliographic data acquired in 2016, which is now already over five years old. The usage of complexity theory and fsQCA has progressed much since then, and thus, an updated and more inclusive review of their usage in business studies is warranted. While there is a recent study by Gligor et al. (2021) that reviewed 62 research articles published in 23 journals on the use of fsQCA in B2B marketing research, the study suffers from the same limitation (i.e., scope) as Kraus et al. (2018). Therefore, the need for a fresh review that is more encompassing in scope (i.e., business) and period (i.e., up to the time the present review was conducted) can be constated.

Given the shortcomings of prior reviews on fsQCA research, this review is positioned as a pioneering effort to map the domain of fsQCA research, as well as the equivalent studies driven by complexity theory, through a technology-empowered systematic literature review (SLR) approach (Kumar et al., 2022) in which current insights and future research directions on fsQCA research are featured, taking exclusively the broad subject area of business research into consideration. Thus, the following research questions (RQs) are addressed:

RQ1. Who are the most notable and influential contributors (e.g., journals, articles, authors, institutions, countries) of business research using

complexity theory and fsQCA?

RQ2. What are the different research (or knowledge) clusters that have emerged from research using complexity theory and fsQCA in business research?

RQ3. What are the recommendations for advancing business research using complexity theory and fsQCA?

2. Methodology

The current review is inspired by numerous published review articles that emphasized the use of an SLR approach (Donthu et al., 2021c; Goodell et al., 2021; Goyal et al., 2021; Kumar et al., 2022, 2021; Lim, Rasul, Kumar, and Ala, 2022; Rao et al., 2021). Unlike traditional literature reviews that do not employ a review protocol, an SLR relies on a review protocol to guide and report the decisions made in the literature review, thereby making the latter more transparent and replicable as compared to the former (Lim, Kumar, and Ali, 2022). Though an SLR may take many forms (e.g., bibliometric, framework-based, meta-analytical, meta-systematic, narrative/thematic), the main difference lies in the evaluation of the literature (e.g., bibliographic data and analytical techniques in a bibliometric SLR versus content analysis of antecedents, decisions, and consequences in a framework-based SLR) (J. More importantly, the use of a review protocol remains necessary regardless of the form of the SLR in order for the literature review to be truly considered as systematic, and thus, transparent and replicable (Lim, Kumar, and Ali, 2022; Kraus et al., 2020; Kraus et al., 2021). The SLR approach applied herein is also technology-empowered through the use of a scientific database powered by artificial intelligence and machine learning (Scopus) and fit-for purpose software (Bibliometrix-R, Gephi), which is consistent with Kumar et al. (2022). Fig. 1. depicts the methodological design of the current review.

2.1. Assembling

The first stage of the review, *assembling*, is divided into two sub-stages: identification and acquisition. The sub-stage “identification” is more of a preparatory phase in which all activities that are relevant to the study’s purpose must first be identified to enable appropriate execution of the proposed methodological design.

The *identification* sub-stage is largely concerned with finding appropriate keywords capable of capturing all relevant business research using complexity theory and fsQCA following the review domain (complexity theory and fsQCA) and research questions (RQ1 to RQ3 on performance, intellectual structure, and future research, respectively). After several forward and backward searches accompanied by an abstract screening process for relevant keywords, the appropriate keywords identified and agreed upon by the authors were “complexity theory”, “fuzzy set qualitative comparative analysis”, “fsQCA”, “fuzzy sets”, and “qualitative comparative analysis”. Alternative keywords such as “business forecasting” were not included because (1) the search results would return with a large number of studies that are not related to complexity theory or fsQCA, which represent the main focus of this review, and (2) scientific databases have filters in place to enable the inclusion of business-related studies only (e.g., the “business, management and accounting” subject filter in Scopus). The next decision was which database to use for the current review, and Scopus was chosen since it covers more journals that meet stringent quality criteria for inclusion as compared to other databases such as WoS (Mongeon and Paul-Hus, 2016). Furthermore, most journals indexed in the WoS are indexed in Scopus (Singh et al., 2021) as well. Moreover, the user interface for Scopus is more comprehensive (i.e., more features) and user-friendly than WoS. Another criterion that must be established during the identification stage is the source type and quality. Conceptual and empirical “articles” in “journals” take center stage as they avoid replicative insights that avail in “reviews” and ensure that the corpus for review is made up of research that received the highest level of peer scrutiny,

unlike “editorials” and “notes” in terms of documents and “books”, “book chapters”, and “conference proceedings” in terms of sources, which typically receive little to no peer review. Moreover, in recent years, predatory journals have emerged as a global menace in the academic domain, accepting manuscripts as well as demanding money from authors but failing to provide the promised quality (Grudniewicz et al., 2019). As a result, we decided to conduct a quality check on journals before finalizing them for consideration). In order to accomplish this, and taking cues from prior studies (Goodell et al., 2021; Goyal and Kumar, 2021; Kumar et al., 2022, 2021; Millet-Reyes, 2021; Sahoo, 2021), we decided to use the list of journals ranked by the Australian Business Dean Council (ABDC) and rated by the Chartered Association of Business Schools (CABS) to select high-quality journals relevant to research centered on complexity theory and utilizing fsQCA.

The *acquisition* sub-stage was next, where the first activity relating to the search mechanism and material acquisition is performed. On November 24, 2021, a search syntax in the Scopus search function that used the identified aforementioned keyword in conjunction with Boolean operators yielded 10,454 documents. The review period was kept open in order to ensure that all relevant articles were included in the review corpus.

2.2. Arranging

The second stage, *arranging*, is divided into two activity-based sub-stages: organization and purification. The 10,454 documents found in the first stage must be sorted and filtered in order to extract articles relevant to the research objectives of the current review.

The *organization* activity consists of setting the organizing criteria required for extraction, for which we choose the subject area “business, management and accounting”, the source type “journal”, the document type “article”, and the language “English”. There are many convincing reasons to support this activity. To begin, the subject area “business, management and accounting” was chosen to suit our research intention of mapping the theoretical structure of research relating to complexity theory and using fsQCA exclusively in the broad subject area of business which when executed yielded a search result of 1,967 documents, excluding 8,487 documents from the first stage results. Because peer-reviewed journals have more stringent screening and inclusion standards than other types, numerous prior studies endorsed the screening of articles published in peer-reviewed journals (Goodell et al., 2021; Goyal and Kumar, 2021; Kumar et al., 2022; Rao et al., 2021; Secundo et al., 2020); as a result, we chose the criterion of selecting source type “journal” and document type “article”, yielding a search result of 1,636 documents. Here, 331 documents, including conference proceedings, books, editorials, and notes, were excluded from the total of 1,967 documents. Subsequently, a “language” filter was used to simplify and enhance the reliability of the current SLR, yielding a result of 1,623 documents.

The “purification” sub-stage, which follows the “organization” sub-stage, is predicated on the ABDC 2019 Journal Quality List (JQL) and the CABS 2021 Academic Journal Guide (AJG). ABDC JQL classifies journals into four categories (A*, A, B, and C) based on their degree of quality, with A*-ranked and A-ranked journals signifying high quality and B-ranked and C-ranked journals signifying comparatively decent quality. Likewise, CABS AJG provides ratings indicating journal quality, such as 4*, 4, 3, 2, and 1, where the rating of 4* signifies outstanding quality and the rating of 1 represents meeting the minimum level of quality required for inclusion into the AJG. Thus, in the penultimate sub-stage activity of arranging, we only included journals that were assessed by both ABDC JQL 2019 and CABS AJG 2021, taking into account the methodological approach of comparable prior studies (Goodell et al., 2021; Goyal and Kumar, 2021; Kumar et al., 2022; Sahoo, 2021). This activity uncovered 1,155 articles published in 129 journals as assessed by ABDC and CABS. A descriptive summary of the extracted review corpus of 1,155 articles is provided in Table 1.

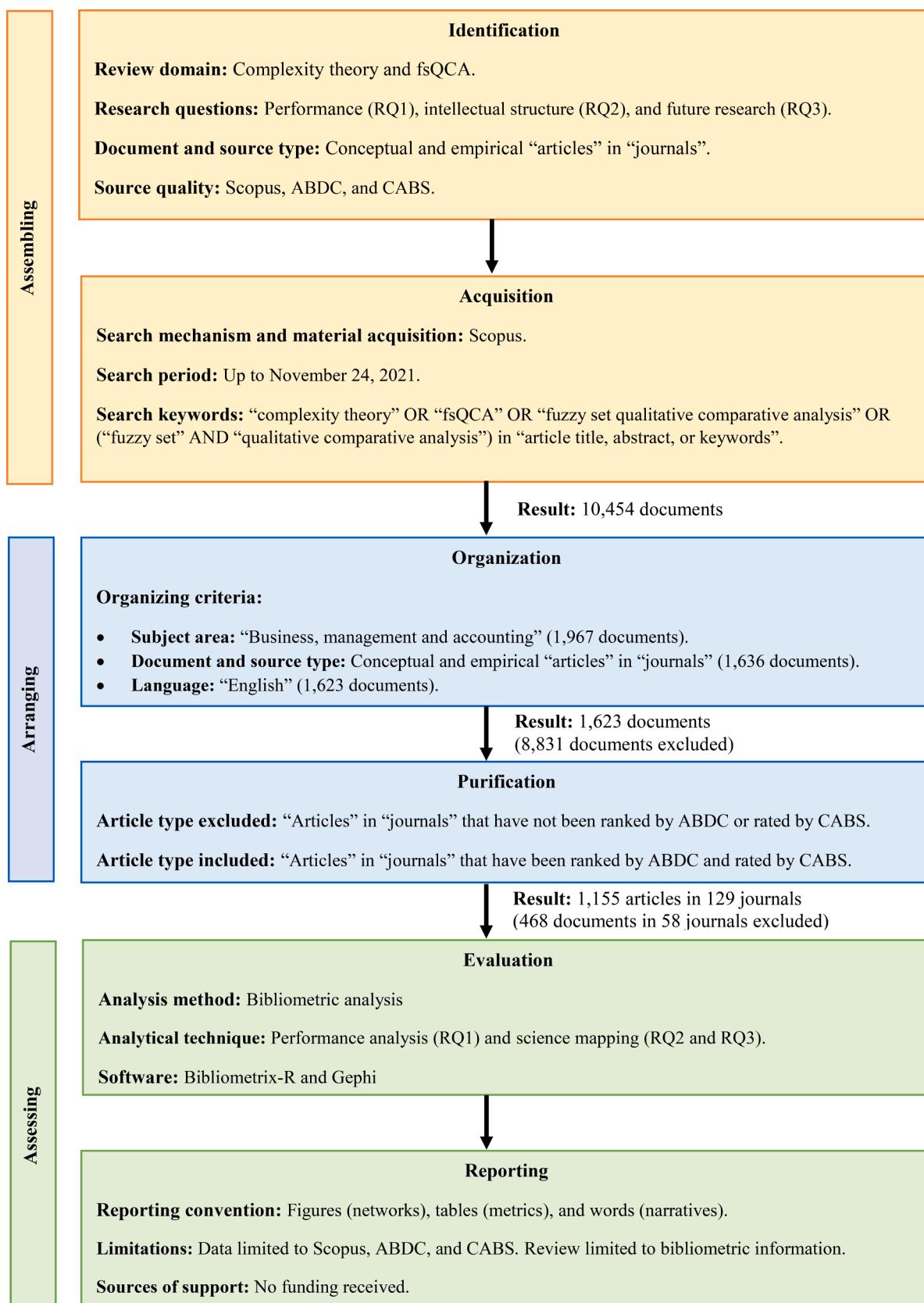


Fig. 1. Protocol for reviewing research using complexity theory and fsQCA.

Table 1

Summary of extracted review corpus

Articles	Journal title (Articles, ABDC rank, CABS rating)
20 or more	Journal of Business Research (336,A,3); Technological Forecasting and Social Change (37,A,3); Management Decision (26,B,2); IEEE Transactions on Engineering Management (25,A,3); Learning Organization (25,C,1); Industrial Marketing Management (23,A*,3); Psychology and Marketing (21,A,3).
10 to 19	Journal of Retailing and Consumer Services (17,A,2); International Journal of Contemporary Hospitality Management (13,A,3); International Journal of Entrepreneurial Behaviour and Research (13, B,3); International Journal of Project Management (13,A,2); Leadership Quarterly (13,A*,4); Tourism Management (13,A*,4); Journal of Cleaner Production (12,A,2); Systems Research and Behavioral Science (12,A,2); International Entrepreneurship and Management Journal (11, C,1); International Journal of Production Economics (11,A,3); Public Management Review (11,A,4); Foresight (10,C,1); Futures (10,B,2); Journal of Organizational Change Management (10,B,2); Organization Studies (10,A*,4); Systemic Practice and Action Research (10,B,2).
5 to 9	Australasian Marketing Journal (9,A,1); European Journal of Marketing (9,A*,3); European Management Journal (9,B,2); Journal of Business and Industrial Marketing (9,A,2); Journal of Business Ethics (9,A,3); Journal of Intellectual Capital (9,B,2); Journal of Knowledge Management (9,A,2); Corporate Social Responsibility and Environmental Management (8,C,1); International Journal of Hospitality Management (8,A*,3); International Journal of Information Management (8,A*,2); Journal of Services Marketing (8,A,2); Technology Analysis and Strategic Management (8,B,2); British Journal of Management (7,A,4); Current Issues in Tourism (7,A,2); International Journal of Organizational Analysis (7,B,1); Journal of Management Development (7,C,1); Journal of Travel Research (7, A*,4); Research Policy (7,A*,4*); Technovation (7,A,3); International Journal of Operations and Production Management (6,A,4); International Journal of Physical Distribution and Logistics Management (6,A,2); Journal of Business Venturing (6,A*,4); Journal of Management Studies (6,A*,4); Journal of Sustainable Tourism (6, A*,3); Long Range Planning (6,A,3); Organization Science (6,A*,4*); Business and Society (5,A,3); Business Process Management Journal (5, B,2); Business Strategy and the Environment (5,A,3); Decision Sciences (5,A*,3); Electronic Commerce Research and Applications (5,C,2); Industrial Management and Data System (5,A,2); International Business Review (5,A,3); Journal of Management in Engineering (5,A,2); Journal of Small Business Management (5,A,3); Journal of the Operational Research Society (5,A,3); Knowledge Management Research and Practice (5,A,1); Leadership and Organization Development Journal (5,B,1); Personnel Review (5,A,2); Service Industries Journal (5,B,2).
Less than 5	Asia Pacific Journal of Management (4,A,3); Asia Pacific Journal of Marketing and Logistics (4,A,1); Educational Management Administration and Leadership (4,B,2); Entrepreneurship and Regional Development (4,A,3); European Business Review (4,B,2); European Journal of Innovation Management (4,C,1); Human Relations (4,A*,4); Human Resource Management (4,A*,4); International Journal of Production Research (4,A,3); International Journal of Public Administration (4,B,2); International Journal of Tourism Research (4, A,2); Journal of Change Management (4,C,1); Journal of Conflict Resolution (4,A*,3); Journal of Information Technology (4,A*,4); Journal of International Business Studies (4,A*,4*); Journal of Operations Management (4,A*,4); Journal of Public Administration Research and Theory (4,A,4); Journal of Technology Transfer (4,B,3); The TQM Journal (4,B,1); Tourism Management Perspectives (4,A,2); Tourism Planning and Development (4,B,2); Tourism Recreation Research (4, A,2); Voluntas (4,B,2); Academy of Management Journal (3,A*,4*); Advances in Developing Human Resources (3,C,2); Annals of Tourism Research (3,A*,4); Baltic Journal of Management (3,C,1); Canadian Journal of Administrative Sciences (3,B,2); Chinese Management Studies (3,C,1); Decision Support Systems (3,A*,3); Economics of Innovation and New Technology (3,B,2); Human Resource Management Journal (3,A, 4*); International Journal of Consumer Studies (3,A,2); International Journal of Emerging Markets (3,B,1); International Journal of Management Reviews (3,A*,3); Journal of Applied Accounting Research (3,B,2); Journal of Business Strategy (3, B,1); Journal of Enterprise Information Management (3,A,2); Journal of International Management (3,A,3); Journal of Management (3,A*,4*); Journal of Management Inquiry (3,A,3); Journal of Supply Chain Management (3,A,4); Management Science (3,A*,4*); Organization and Environment (3,A,3); Organizational Research Methods (4,A*,3);

Table 1 (continued)

Project Management Journal (3,B,1); Public Money and Management (3,B,2); Public Performance and Management Review (3,B,2); Small Business Economics (3,A,3); Supply Chain Management: An International Journal (3,A,3); Team Performance Management (3,C,1); Total Quality Management and Business Excellence (3,C,2); Administration and Society (2,B,2); Asia Pacific Business Review (2, B,2); Business Ethics Quarterly (2,A,4); Competitiveness Review (2, C,1); Corporate Communications (2,B,1); Corporate Governance: An International Review (2,A,3); Entrepreneurship Theory and Practice (2, A*,4); European Journal of Industrial Relations (2,A,3); European Journal of Information Systems (2,A*,4); European Management Review (2,C,3); Family Business Review (2,A,3); Gender In Management (2,C,1); Information and Organization (2,A*,3).

Notes: ABDC = Journal Ranking as per Australian Business Dean Council 2019 Journal Quality List (A*, A, B, C); CABS = Journal as per Chartered Association of Business Schools 2021 Academic Journal Guide (4*, 4, 3, 2, 1). A* = 31 journals. A = 52 journals. B = 30 journals. C = 16 journals. 4* = 8 journals. 4 = 20 journals. 3 = 37 journals. 2 = 42 journals. 1 = 22 journals.

2.3. Assessing

The third stage, *assessing*, is constituted of activities related to evaluation and reporting, with a primary emphasis on analyzing the bibliographic data and reporting the findings.

In terms of *evaluation*, this review examines 1,155 articles extracted through a bibliometric procedure using an analytical framework centered on performance analysis and science-mapping to address the study's three research questions (RQ1, RQ2, and RQ3). Performance analysis considers the contribution of research constituents, whereas science mapping attempts to reflect the connections that exist between research constituents (Di Vaio et al., 2021; Donthu et al., 2021a, 2021b). Noteworthily, the performance analysis in a bibliometric review is akin to the reporting of the profile of participants in empirical research albeit with greater analytical rigor as the insights from the performance analysis enables readers to gain a better understanding on where research expertise in the field could be found (e.g., authors, institutions), as well as which regions in the field that remain underdeveloped (e.g., countries) (Donthu et al., 2021a). In this regard, the former could be useful to academic institutions that wish to form new collaborations in areas of similar research interest, academic scholars who wish to seek expert advice, as well as industry practitioners who wish to engage in expert commentary or consultancy, whereas the latter could be useful to develop new research in underexplored regions (Lim, Kumar, and Ali, 2022). The science mapping in a bibliometric review is akin to the main analysis in empirical research and thus takes the insights from the performance analysis a step further by delineating the knowledge structure in the field—it provides an objective overview of how knowledge in the field can be homogeneously clustered and yet remain heterogeneously diversified when the knowledge clusters that represent the main streams of research in the field are identified and revealed through science mapping techniques. To address RQ1, performance analysis was carried out using the Bibliometrix-R software, in which several tools and techniques outlined in bibliometric analysis guidelines (Donthu et al., 2021a) were used to identify the top journals, articles, authors, institutions, and countries. The results derived from each of these analyses were downloaded as "csv" and then generated or processed through appropriate Microsoft Office packages. Following the performance analysis, a science-mapping analysis was performed using the Bibliometrix-R software to address RQ2, in which the "cooccurrence network" tool was used to provide a network visualization of significant associations between authors' indexed keywords to map the thematic pattern (knowledge clusters) emerging from the review corpus. Furthermore, we used the "PageRank" tool in the Gephi software to determine significant research articles in each knowledge cluster (Donthu et al., 2021a; Goyal and Kumar, 2021; Kumar et al., 2022), which were then triangulated with knowledge clusters derived using Bibliometrix-R software.

Following this, a content analysis approach was used to study the research articles in each knowledge cluster. To address RQ3, we used the “thematic map” tool in the Bibliometrix-R software to determine the centrality and density of topics in order to identify basic themes, motor themes, niche themes, and emerging themes in order to recommend future research avenues.

In terms of reporting, this study follows in the footsteps of prior SLRs (Goyal and Kumar, 2021; Kumar et al., 2022; Sahoo, 2021; Secundo et al., 2020) by presenting its findings (convention) using a combination of figures (network visualization), tables (metrics), and words (accompanying narratives). This review, like earlier studies, received no financing (source of funding), and admits that its outcomes may be restricted to the quality and completeness of bibliometric information on Scopus and the extent of what is achievable via an SLR using bibliometrics.

3. Results from performance analysis

3.1. Publication trend (RQ1)

The distribution of publications by year of publication, as shown in Fig. 2, suggests that complexity theory and fsQCA received considerable research attention during the previous five decades. According to the results of the extraction activity, which yielded a total of 1,155 articles, the first two publications on research using complexity theory and fsQCA were published in 1975 (Miller and Gordon, 1975) and subsequently in 1982 (Raphael, 1982) Fig. 2. shows that the trend of publication per year in single digits persisted from 1975 to 2003, and the trend of publication per year in double digits was maintained from 2004 to 2015 (except the year 2005). There was a significant increase in publications in 2016, with 181 publications, representing a 248% rise over the preceding year (2015), which may be due to a special issue in the *Journal of Business Research* that published 46 articles on QCA (Roig-Tierno et al., 2016). Although there was a dramatic drop in 2017 (approximately 65%), the trend of publishing per year has increased since 2018, with 248 articles being the highest in 2021 (until November 2021). With this rising trend over the last five years, it is obvious that asymmetrical techniques such as fsQCA and the usage of complexity theory are gaining traction, and researchers are being compelled to

reconsider the generalized association between numerous variables validated using symmetrical techniques.

3.2. Journal performance (RQ1)

The distribution of the number of articles by journals, as shown in Fig. 3, demonstrates that the *Journal of Business Research* is the most frequently chosen destination for research using complexity theory and fsQCA, with a total of 336 articles. This is followed by *Technological Forecasting and Social Change* and *Management Decision* which have 37 and 26 articles, respectively. Table 2. shows that when total citations (TC) and h-index are being considered as an awarding criterion, *Journal of Business Research* comes out on top of the list with 9,117 citations from 336 articles and an h-index of 53. The h-index is a journal-level metric that assesses both the productivity and citation impact of publications associated with the journal, and it is defined as the greatest value of h such that the given journal has produced at least h articles, each of which has been cited at least h times (Barnes, 2017; Hu et al., 2020). With total citations as the awarding criterion, *Leadership Quarterly* (TC = 2,496) and *Academy of Management Journal* (TC = 2,048) are second and third on the list. When we consider the h-index as the criterion for ranking, *Management Decision* (h -index = 15) and *Industrial Marketing Management* (h -index = 14) come in second and third place, respectively.

3.3. Article performance (RQ1)

3.3.1. Global citations

Global citations are the number of citations obtained without any filtering (e.g., topic filtration) and thus represents the overall number of citations to an article in the Scopus database (Donthu et al., 2021a; Goyal and Kumar, 2021; Kumar et al., 2021). The article with the most global citations in this review corpus of 1,155 articles, as shown in Table 3, is “Building better causal theories: A fuzzy set approach to typologies in organization research” (TGC = 1,529 citations), followed by “Supply networks and complex adaptive systems: Control versus emergence” (TGC = 918 citations). The top 20 global cited articles list in Table 3 shows five occurrences of top global cited articles published in *Leadership Quarterly* and two occurrences of top global cited articles published in *Academy of Management Journal*, *Journals of Operations*

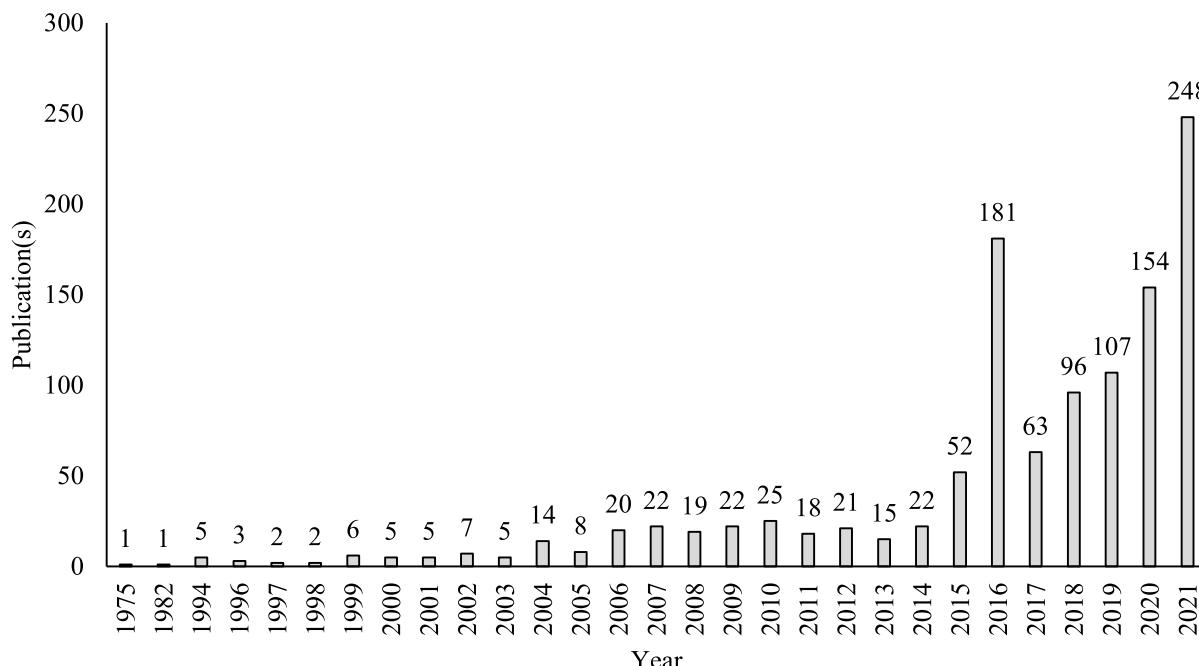


Fig. 2. Publication trend for research using complexity theory and fsQCA

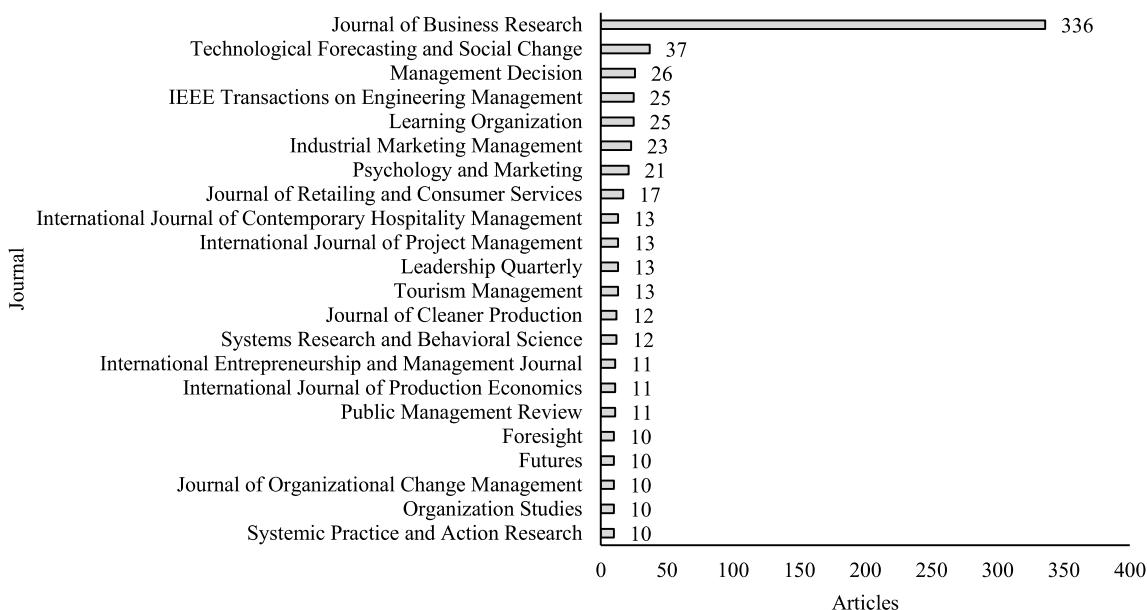


Fig. 3. Most productive journals for research using complexity theory and fsQCA **Note:** Top contributing journals with a minimum of 10 articles using complexity theory and fsQCA.

Table 2
Most impactful journals for research using complexity theory and fsQCA

Journal title	TC	TP	Start PY	<i>h</i> -index
Journal of Business Research	9,117	336	2007	53
Leadership Quarterly	2,496	13	2001	12
Academy of Management Journal	2,048	3	2007	3
Journal of Operations Management	1,329	4	2001	3
Management Decision	912	26	1998	15
Journal of Management	897	7	2017	3
Tourism Management	704	13	1999	11
International Journal of Project Management	687	13	2009	10
Annals of Tourism Research	596	3	2004	2
Organization Science	573	6	1999	6
Journal of Intellectual Capital	539	9	2006	7
International Journal of Production Economics	508	11	2003	9
Decision Sciences	497	5	1975	5
Journal of International Business Studies	464	4	2010	3
Industrial Marketing Management	430	23	2013	14
Journal of Knowledge Management	399	9	2000	7
Technological Forecasting and Social Change	386	37	1994	9
Management Science	367	3	2002	3
International Journal of Management Reviews	337	3	2005	3
Journal of Information Technology	330	4	2006	4

Notes: TC = total citations. TP = total publications. Start PY = start of publication year.

Management, and *Journal of Management*.

3.3.2. Local citations

The leading articles in the review corpus, arranged in ascending order of their rank in the list based on the total local citation (TLC) criteria, which indicates the number of citations in each article's reference list to other articles in the review corpus of 1,155 articles. Local citations, in other words, are citations obtained from articles within the review corpus (Donthu et al., 2021a). In the current review, the article with the highest number of local citations, as shown in Table 4, is also the one with the highest number of global citations. With 397 citations, the article "Building better causal theories: A fuzzy set approach to

typologies in organization research" received the most TLC, followed by the article "Mapping the institutional capital of high-tech firms: A fuzzy-set analysis of capitalist variety and export performance" with 120 citations Table 4, also shows that *Journal of Business Research* covers 13 of the top 20 locally cited articles.

3.4. Author performance (RQ1)

3.4.1. Authors

The distribution of the top 20 contributing authors ranked by the number of articles contributed to research using complexity theory and fsQCA is illustrated in Fig. 4. The figure shows that Arch G. Woodside, who is affiliated with three different institutions, namely Boston College (Chestnut Hill, United States), Curtin University (Perth, Australia), and Yonsei University (Seoul, South Korea), is at the top of the list with 30 articles. These 30 articles have been published in 12 journal titles, with the majority of them (17 articles) appearing in *Journal of Business Research* (seven articles), *Industrial Marketing Management* (five articles), and *Psychology and Marketing* (five articles). Hossein G. T. Olya ranks second on the list of top contributing authors, with 22 articles to his credit. Olya is currently affiliated with University of Sheffield (United Kingdom) and appears to be a pioneer in applying complexity theory and fsQCA in the tourism sector, as the majority of his research has been published in *International Journal of Contemporary Hospitality Management* (five articles), *Journal of Travel Research* (four articles), *Journal of Services Marketing* (two articles), and *Journal of Sustainable Tourism* (two articles). Sascha Kraus, who is currently associated with Free University of Bozen-Bolzano (Italy), is ranked third on the list of top contributing authors, having published nine out of 18 articles in *Journal of Business Research* (seven articles) and *Industrial Marketing Management* (two articles).

However, when it comes to ranking the authors with the greatest impact in research using complexity theory and fsQCA, it appears to be a slightly different story (as seen in Table 5). Peer C. Fiss, who is presently affiliated with USC Marshall School of Business (Los Angeles, United States), has the most citations (TC = 1,893 citations) with just three articles published in *Journal of Management*, *Journal of Business Research*, and *Academy of Management Journal*. Bill McKelvey (now at the University of California, United States) and Russ Marion (now at Clemson University, United States) are second and third on the list of influential

Table 3

Most impactful articles according to global citations for research using complexity theory and fsQCA

Article title	Author(s)	Year	Journal title	Subject category	TGC
Building better causal theories: A fuzzy set approach to typologies in organization research	Fiss	2011	Academy of Management Journal	BIM, MTI, SM	1,529
Supply networks and complex adaptive systems: Control versus emergence	Choi, Dooley, and, Rungtusanatham	2001	Journal of Operations Management	SM	918
Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era	Uhl-Bien, Marion, and McKelvey	2007	Leadership Quarterly	OBHRM	894
Fifteen years of research on business model innovation: How far have we come, and where should we go?	Foss and Saebi	2017	Journal of Management	SM	616
Integrating sustainable development in the supply chain: The case of life cycle assessment in oil and gas and agricultural biotechnology	Matos and Hall	2007	Journal of Operations Management	SM	397
Reconceptualizing tourism	Farrell and Twining-Ward	2004	Annals of Tourism Research	TLHM	379
Leadership in complex organizations	Marion and Uhl-Bien	2001	Leadership Quarterly	OBHRM	376
Toward a contextual theory of leadership	Osborn, Hunt, and Jauch	2002	Leadership Quarterly	OBHRM	373
Embrace perform model: Complexity theory, contrarian case analysis, and multiple realities	Woodside	2014	Journal of Business Research	GEN, MM	347
Mapping the institutional capital of high-tech firms: A fuzzy-set analysis of capitalist variety and export performance	Schneider, Schulze-Bentrop, and Paunescu	2010	Journal of International Business Studies	BIM, MTI, SM	340
Radical change accidentally: The emergence and amplification of small change	Plowman, Baker, Beck, Kulkarni, Solansky, and Travis	2007	Academy of Management Journal	BIM, MTI, SM	311
Complexity and adaptivity in supply networks: Building supply network theory using a complex adaptive systems perspective	Pathak, Day, Nair, Sawaya, and Kristal	2007	Decision Sciences	MTI, SM	298
Avoiding complexity catastrophe in coevolutionary pockets: Strategies for rugged landscapes	McKelvey	1999	Organization Science	MTI, OBHRM, SM	286
A fuzzy approach to construction project risk assessment	Nieto-Morote and Ruz-Vila	2011	International Journal of Project Management	BIM, MTI	282
Complex thinking, complex practice: The case for a narrative approach to organizational complexity	Tsoukas and Hatch	2001	Human Relations	MTI, SM	281
Organizations as complex adaptive systems: Implications of complexity theory for leadership research	Schneider and Somers	2006	Leadership Quarterly	OBHRM	277
Embracing causal complexity: The emergence of a neo-configurational perspective	Misangyi, Greckhamer, Furnari, Fiss, Crilly, and Aguilera	2017	Journal of Management	SM	276
Value network analysis and value conversion of tangible and intangible assets	Allee	2008	Journal of Intellectual Capital	MTI	268
Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: Findings from PLS-SEM and fsQCA	Mikalef and Pateli	2017	Journal of Business Research	GEN, MM	248
Complexity theories and organizational change	Burnes	2005	International Journal of Management Reviews	MTI, SM	247

Notes: Subject category derived from journal's and article's subject area. BIM = business and international management. GEN = general. OBHRM = organizational behavior and human resource management. MM = marketing management. MTI = management of technology and innovation. SM = strategy and management. TLHM = tourism, leisure, and hospitality management. TGC = total global citations.

authors, with 1,505 and 1,411 citations, respectively. However, when ranking authors based on *h*-index, it appears that Olya leads the list with an *h*-index of 17, followed by Woodside (*h*-index = 15) and Kraus (*h*-index = 13), as shown in Table 5.

3.4.2. Author collaborations

The “collaboration network” option categorized under the social structure tab in the Bibliometrix-R package (Donthu et al., 2021a) is essentially a scientific mapping to analyze prominent author partnerships that have occurred in research using complexity theory and fsQCA. The collaboration network of leading authors can be seen in Fig. 5. The size of the circle (node) represents the frequency of articles linked with the author, while the thickness of the lines between two nodes shows the frequency of collaboration between two authors.

According to the results of the collaboration network analysis (Fig. 5), there are eight clusters of author collaborations that emerge. S. Kraus (Free University of Bozen-Bolzano, Italy), C.-F. Cheng (National Taichung University of Science and Technology, Taiwan), R. B. Bouncken (University of Bayreuth, Germany), and M. L. Chang (National Chung Hsing University, Taiwan) comprise the first major author collaboration network (red). The second important collaboration network (blue) was formed by P. Jones (Swansea University, United Kingdom), D. Pickernell (University of Portsmouth, United Kingdom), and M. J. Beynon (Cardiff University, United Kingdom). K. H. Huarng (Feng Chia University, Taiwan), who has 14 articles in the review corpus to his credit, has partnered with T. H. K. Yu (Feng Chia University, Taiwan) in seven articles to establish the third substantial collaborative

network (green). Next, with eight publications in the review corpus to his credit, P. Torres (Universidade de Coimbra, Portugal) has collaborated with M. Augusto (Universidade de Coimbra, Portugal) on seven articles to form the fourth important collaboration network (purple). G. M. Silva and H. M. Gonçalves, both from the Universidade de Lisboa (Portugal), have nine and seven articles in the review corpus, respectively, and have collaborated on three articles with each other to create the fifth significant collaboration network (orange). The sixth major collaboration network (brown) can be observed between S. Agarwal (University of Central Florida, United States), A. S. Krishen (University of Nevada, United States), O. Berezan (California State University, United States), and P. Kachroo (University of Nevada, United States). P. Foroudi (Middlesex University, United Kingdom) teamed up with S. Gupta (Newcastle University, United Kingdom) and Z. Jin (Middlesex University, United Kingdom) to build the seventh collaboration network (pink). Lastly, the lead author for the eighth collaboration network (grey) was identified as A. Leischnig (Technische Universität Bergakademie Freiberg, Germany), who collaborated with S. C. Henneberg (Queen Mary University of London, United Kingdom) and K. Kasper-Brauer (West-sächsische Hochschule Zwickau, Germany). Surprisingly, only two of the eight collaboration networks (red and grey) were identified to have any form of cross-country research engagement.

3.5. Institution performance (RQ1)

The frequency of articles disseminated based on affiliation with institutions, as seen in Fig. 6, shows that Universidade de Lisboa (Portugal)

Table 4

Most impactful articles according to local citations for research using complexity theory and fsQCA

Article title	Author(s)	Year	Journal title	Subject category	TLC
Building better causal theories: A fuzzy set approach to typologies in organization research	Fiss	2011	Academy of Management Journal	BIM, MTI, SM	397
Mapping the institutional capital of high-tech firms: A fuzzy-set analysis of capitalist variety and export performance	Schneider, Schulze-Bentrop, and Paunescu	2010	Journal of International Business Studies	BIM, MTI, SM	120
Applying complexity theory to deepen service dominant logic: Configural analysis of customer experience-and-outcome assessments of professional services for personal transformations	Wu, Yeh, Huan, and Woodside	2014	Journal of Business Research	GEN, MM	108
Embracing causal complexity: The emergence of a neo-configurational perspective	Misangyi, Greckhamer, Furnari, Fiss, Crilly, and Aguilera	2017	Journal of Management	SM	89
Examining the role of CSR skepticism using fuzzy-set qualitative comparative analysis	Skarmeas, Leonidou, and Saridakis	2014	Journal of Business Research	GEN, MM	65
Configural paths to successful product innovation	Cheng, Chang, and Li	2013	Journal of Business Research	GEN, MM	40
Explaining online shopping behavior with fsQCA: The role of cognitive and affective perceptions	Pappas, Kourouthanassis, Giannakos, and Chrissikopoulos	2016	Journal of Business Research	GEN, MM	38
Cross-cultural differences in compensation level and inequality across occupations: A set-theoretic analysis	Greckhamer	2011	Organization Studies	MTI, OBHRM, SM	37
Configurational paths to organizational innovation: Qualitative comparative analyses of antecedents and contingencies	Ganter and Hecker	2014	Journal of Business Research	GEN, MM	36
Firm survival: The role of incubators and business characteristics	Mas-Verdú, Ribeiro-Soriano, and Roig-Tierro	2015	Journal of Business Research	GEN,MM	34
General theory of cultures' consequences on international tourism behavior	Woodside, Hsu, and Marshall	2011	Journal of Business Research	GEN, MM	34
Asymmetric modeling of intention to purchase tourism weather insurance and loyalty	Olya and Altinay	2016	Journal of Business Research	GEN, MM	33
Identifying single necessary conditions with NCA and fsQCA	Dul	2016	Journal of Business Research	GEN, MM	31
Employee adaptive behavior in service enactments	Leischnig and Kasper-Brauer	2015	Journal of Business Research	GEN, MM	31
On the use of qualitative comparative analysis in management	Kan, Adegbite, El Omari, and Abdellatif	2016	Journal of Business Research	GEN, MM	27
Understanding configurations of relational attractiveness of the customer firm using fuzzy set QCA	Tóth, Thiesbrummel, Henneberg, and Naudé	2015	Journal of Business Research	GEN, MM	27
Using fuzzy-set qualitative comparative analysis for a finer-grained understanding of entrepreneurship	Douglas, Shepherd, and Prentice	2020	Journal of Business Venturing	BIM, MTI	26
Country-based comparison analysis using fsQCA investigating entrepreneurial attitudes and activity	Beynon, Jones, and Pickernell	2016	Journal of Business Research	GEN, MM	26
The call of the whole in understanding the development of sustainable ventures	Muñoz and Dimov	2015	Journal of Business Venturing	BIM, MTI	26
Illuminating happy-low and unhappy-high performing frontline service employees	Hsiao, Jaw, Huan, and Woodside	2015	International Journal of Contemporary Hospitality Management	TLHM	25

Notes: Subject category derived from journal's and article's subject area. BIM = business and international management. GEN = general. OBHRM = organizational behavior and human resource management. MM = marketing management. MTI = management of technology and innovation. SM = strategy and management. TLHM = tourism, leisure, and hospitality management. TLC = total local citations.

tops the list with 51 articles. The Universitat de València (Spain) comes in second with 50 articles. Authors from these two institutions are from neighboring countries and actively using complexity theory and fsQCA in their research. Feng Chia University (Taiwan) and Universitat Politècnica de València (Spain) are third and fourth on the list, with 25 and 24 articles contributed, respectively. Boston College (United States) and Curtin University (Australia) are tied for fifth position, with each having published 18 articles. A secondary investigation of the collaboration network across institutions in Bibliometrix-R yielded seven significant institutional collaboration networks, which are: (1) Universitat de València (Spain), Universitat Politècnica de València (Spain), University of Verona (Italy), ESIC University (Spain), and University of Glasgow (Scotland); (2) Queen Mary University of London (United Kingdom) and University of Bamberg (Germany); (3) California State University (United States) and University of Central Florida (United States); (4) Swansea University (United Kingdom), Coventry University (United Kingdom), Cardiff University (United Kingdom), and University of Portsmouth (United Kingdom); (5) Boston College (United States), Curtin University (Australia), University of Tasmania (Australia), I-Shou University (Taiwan), and National Chiayi University (Taiwan); (6) Sheffield University (United Kingdom), Oxford Brookes University (United Kingdom), Eastern Mediterranean University (Cyprus), and Sejong University (South Korea); (7) Asia University (Taiwan), National Chung Hsing University (Taiwan), Loughborough University (United

Kingdom), and Liechtenstein University (Liechtenstein).

3.6. Country performance (RQ1)

A global heat map generated in Microsoft Excel, as seen in Fig. 7, represents the most prolific contributing countries to research using complexity theory and fsQCA. The global heat map is an interactive technique for quantifying the presence of a country associated with a certain article, with color ranges spanning from deep red to deep green, signifying areas with a low density (0 to 50) and a high density (200 to 250) of published research, respectively. Glancing at the global heat map, it is evident that the United Kingdom (deep green zone with 236 articles) and the United States (green zone with 210 articles) have contributed the most to the domain. This is followed by Spain (light green zone with 140 articles), Australia (yellow zone with 101 articles), and China (orangish yellow zone with 94 articles). These countries constitute the list of the top five contributing countries in the domain. However, in terms of cross-country collaboration, China leads with 50 instances of collaboration with 15 countries, followed by Australia with 48 instances of collaboration with 21 countries. In a subsequent ranking based on the criteria of total citations, as shown in Fig. 8, the United States received the most citations with 8,293 citations, followed by the United Kingdom with 3,535 citations.

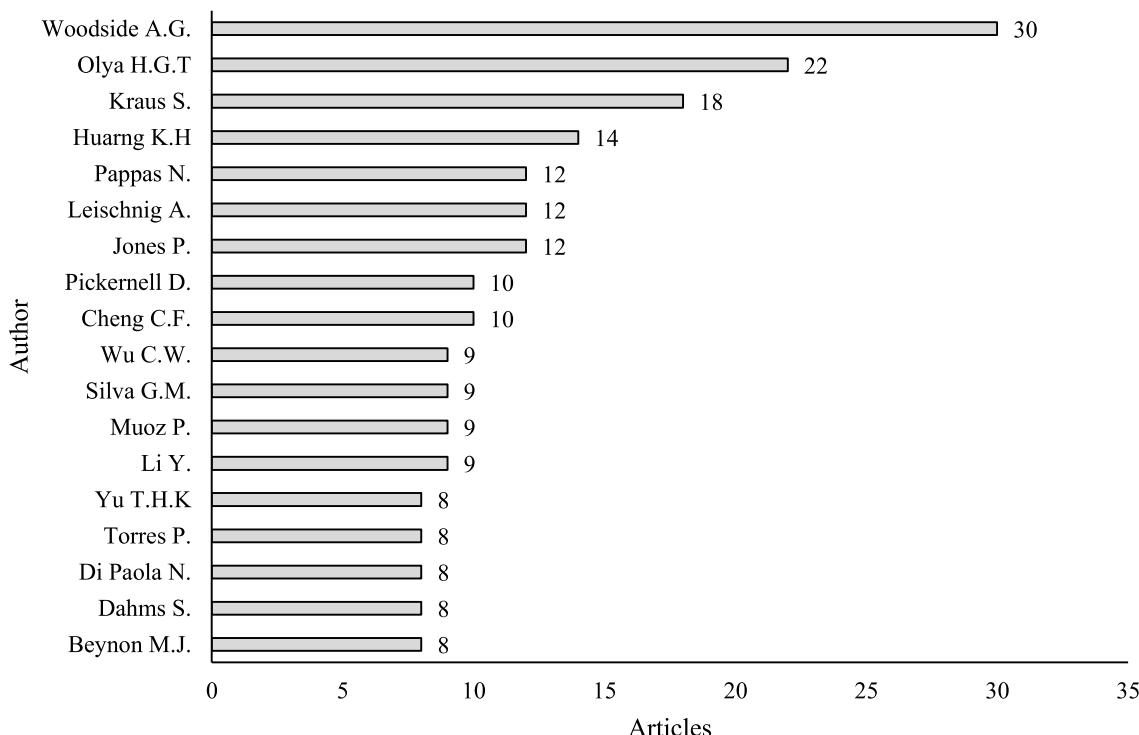


Fig. 4. Most productive authors for research using complexity theory and fsQCA Note: Top contributing authors with a minimum of eight articles using complexity theory and fsQCA.

4. Results from science mapping

4.1. Knowledge cluster (RQ2)

Science mapping is a depiction of a network reflecting the interconnection among research in a domain, which can be done through various tools, techniques, and software (Di Vaio et al., 2021). Cooccurrence network analysis is one such method that can be used to account for the cooccurrence of two keywords from a text corpus. In this research, we used the cooccurrence network tool in the Bibliometrix-R software to determine the knowledge clusters in the field based on the author's indexed keywords in the articles within an extracted review corpus (Donthu et al., 2021a). This analysis generated a pictorial depiction of the network connection between the author's indexed keywords, as shown in Fig. 9, resulting in the identification of three major knowledge clusters relevant to research using complexity theory and fsQCA. Each keyword in the network map is represented by a node, with the size of the node representing the occurrences of the keyword in the review corpus, wherein the larger the node, the greater the occurrence, and vice versa (Sahoo, 2021; Wang et al., 2020.). The line connecting two nodes depicted in the network map is visually present only if these two keywords cooccur, and its thickness changes according to the frequency of instances of two keywords cooccurring, wherein the thicker the line, the higher the cooccurrence, and vice versa (Goodell et al., 2021; Lee and Su, 2010; Sahoo, 2021).

The information in Table 6 augments the attributes of three knowledge clusters identified using cooccurrence network analysis on three centrality parameters: "betweenness", "closeness", and "PageRank". "Betweenness" centrality indicates the measure of others' dependence on a certain node, and hence a measure of potential control (Abbasi et al., 2012; Brandes et al., 2016; Leydesdorff, 2007). In simplified terms, betweenness centrality gauges the extent to which a certain node resides on the shortest route connecting other nodes, wherein a greater betweenness centrality value implies a node's stronger influence (Wang et al., 2020). "Closeness" centrality is usually interpreted as either a measure of access efficiency or of independence from potential control

by intermediaries (Abbasi et al., 2012; Brandes et al., 2016; Leydesdorff, 2007). In essence, a node's closeness centrality is defined as the inverse of the average length of the shortest routes to/from all other nodes in the network, wherein greater closeness centrality implies more relatedness to other nodes (Lee and Su, 2010). Finally, "PageRank" centrality assesses the relevance of a node by analyzing the cooccurring network structure of the author's keyword in the review corpus as well as assigning a score of importance to each individual node by calculating how many in-links that node has in relation to other significant nodes (Lv et al., 2019; Tu et al., 2018). The information in Table 7 provides the top articles in each knowledge cluster revealed by the cooccurrence network analysis.

The red network of 12 nodes in Fig. 9 represents Cluster 1, which comprises prominent keywords based on PageRank scores (Table 6), such as "complexity theory", "leadership", "complexity", "chaos theory", "emergence" and "knowledge management". In this cluster, the keywords "complexity theory" and "complexity" have the highest values of both betweenness centrality and closeness centrality. This implies that research in this cluster explored firm configurations of "leadership", "learning", "project management", "self-organization", "knowledge management", "strategy", "change management", "emergence", and "intellectual capital" through the lens of complexity theory. As a result, it is possible to deduce that this cluster is predominantly concerned with topics stemming from *leadership and strategic management*.

The second cluster, represented by the blue network of nodes in Fig. 9, has five keywords: "qualitative comparative analysis", "QCA", "corporate social responsibility", "culture" and "fuzzy sets". According to the PageRank score of keywords, "qualitative comparative analysis", "culture" and "corporate social responsibility" appear to be significant keywords, with PageRank scores of 0.0446, 0.0202, and 0.0187, respectively (Table 6). This observation is reinforced by the fact that the betweenness centrality and proximity centrality of these keywords are relatively high in this cluster. Thus, this cluster is focused on *corporate social responsibility and culture*.

The third cluster is depicted in Fig. 9 by a green network of 14 nodes, where the keywords "fsQCA", "innovation", "performance" and

Table 5
Most impact authors for research using complexity theory and fsQCA

Author	Current affiliation	TC	TP	Start PY	h-index
Fiss	USC Marshall School of Business, United States	1,893	3	2011	3
McKelvey	University of California, United States	1,505	6	1999	5
Marion	Clemson University, United States	1,411	5	2001	5
Uhl-Bien	Texas Christian University, United States	1,328	3	2001	3
Woodside	Yonsei University, South Korea	1,291	27	2009	15
Choi	Arizona State University, United States	984	2	2001	2
Dooley	Arizona State University, United States	918	1	2001	1
Rungtusanatham	Schulich School of Business, Canada	918	1	2001	1
Kraus	Free University of Bozen-Bolzano, Italy	679	17	2016	13
Foss	Copenhagen Business School, Denmark	616	1	2017	1
Saebi	NHH Norwegian School of Economics, Norway	616	1	2017	1
Olya	University of Sheffield, United Kingdom	580	22	2016	17
Beck	University of Nebraska-Lincoln, United States	550	4	2007	4
Plowman	University of Nebraska-Lincoln, United States	537	3	2007	3
Hall	University of Sussex, United Kingdom	490	2	2007	2
Matos	University of Surrey, United Kingdom	490	2	2007	2
Kulkarni	Indian Institute of Management Bangalore, India	484	2	2007	2
Travis	North American University, United States	484	2	2007	2
Osborn	Wayne State University, United States	483	3	2002	3
Mikalef	Norges Teknisk-Naturvitenskapelige Universitet, Norway	478	5	2015	5

Note(s): TC = total citations. TP = total publications. Start PY = start of publication year.

“entrepreneurship” are being featured prominently, with PageRank scores of 0.1618, 0.0623, 0.0387, and 0.0357, respectively. However, there are some unique observations on the aspect of betweenness centrality, wherein “fsQCA”, “gender” and “innovation” have scores of 162.758, 29.00, and 11.8626, respectively, indicating that these keywords cooccur frequently to form the central theme of the cluster along with keywords “performance”, “entrepreneurship”, “configuration”, “entrepreneurial orientation”, “sustainability”, “trust”, “firm performance”, “motivation” and “satisfaction.” More specifically, the closeness centrality between 14 nodes (i.e., keywords) spans from 0.0116 to 0.0238, showing that each of the remaining 13 keywords is connected to the “fsQCA” keyword (which has the highest closeness centrality of 0.0238). All of these keywords culminate towards topic areas from innovation and entrepreneurship.

The cooccurrence network analysis, which resulted in the identification of three knowledge clusters, was triangulated further using Gephi, where network analysis was performed to identify different modularity classes (i.e., knowledge clusters) and determine the PageRank of articles within each knowledge cluster. The number of citations reveals an article’s popularity, while its prestige is determined by PageRank, which shows how many times an article is referenced by highly cited articles (Goyal and Kumar, 2021). It is not reasonable to assume

that a highly cited article is also a prestigious article, as illustrated by Table 7, which shows conflicting outcomes when comparing papers based on citation count (Table 3 and Table 4) and PageRank (Table 7). The PageRank scores of articles in each cluster complement the content analysis in order to stimulate focused debate on the thematic progression of each cluster, which we illuminate in detail in the next sections.

Given that the conduct of fsQCA is generally the same for all studies given that it is a methodology that has its own established set of procedures, the focus of the discussion for each knowledge cluster was on (1) the key bibliometric information for each knowledge cluster (i.e., based on the co-occurrence and PageRank analyses), and (2) the insights that were revealed by the articles in each knowledge cluster (i.e., based on a content analysis of the articles for each knowledge cluster revealed by the PageRank analysis), thereby showcasing the contributions of using complexity theory and fsQCA for understanding business phenomena.

4.2. Cluster 1: Leadership and strategic management

Cluster 1 surfaced as a modularity class in Gephi, with 259 articles, and it is the second biggest of three clusters that explore various sub-themes listed as keywords under Cluster 1 in Table 6. On the criterion of PageRank score, Cabriolo and Dahms’s (2018) article “How strategic knowledge management drives intellectual capital to superior innovation and market performance”, Mikalef et al.’s (2015) article “Purchasing alignment under multiple contingencies: A configuration theory approach”, and Crespo et al.’s (2019) article “The adoption of management control systems by start-ups: Internal factors and context as determinants” are the top three prominent articles in the cluster with PageRank scores of 0.002754, 0.002591 and 0.002230, respectively (Table 7). Since all of the articles within the cluster are grounded on complexity or chaos theory, they all blend together to underline the theme of leadership and strategic management.

Complexity theory asserts functional exchanges and the feedback mechanisms that underpin them, which continually modify systems (Jancenelle, 2021; Papathodorou and Pappas, 2017). While it asserts that institutional ecosystems have non-linear dynamics and are unpredictable (Hsiao et al., 2016; Nagy et al., 2017), it also contends that they are restricted by order-generating norms that enact change in order to facilitate adaptation and evolution (Crespo et al., 2019; Lee, 2022; Nagy et al., 2017). Therefore, the complexity theory is grounded on leadership (Schneider and Somers, 2006) that focuses on emergent processes within complex systems and argues that leadership should work at all functional levels in a process-specific, situational, and participatory manner (Bouncken et al., 2016; Cabriolo and Dahms, 2018; Plowman et al., 2007; Uhl-Bien et al., 2007). The core principles of complexity theory are the belief that the potency of a company’s leadership is based on the self-organization of intellectual capital, creativity, and learning within the firm (Burnes, 2005; Chollet et al., 2016; McKelvey et al., 2013; Tapsell and Woods, 2010), which translates into a successful strategy for knowledge management (Cabriolo and Dahms, 2018; Peris-Ortiz et al., 2018), change management (Cabriolo et al., 2020; Mikalef et al., 2015), and project management (de Rooij et al., 2019; Nieto-Morote and Ruz-Vila, 2011; Verweij, 2015).

Articles in this knowledge cluster explore diverse leadership configurations that prioritize settings in which responsive behaviors arise and establish new and accommodating knowledge with sufficient relevance and impact to implement change within a firm’s social structure (Chollet et al., 2016; Havermans et al., 2015; Plowman et al., 2007; Uhl-Bien et al., 2007). For example, leadership behaviors (such as adaptive, administrative, and enabling) can have different outcomes when linked to decision-making landscapes (such as simple, difficult, complex, chaotic, and disorder), and this is where the configurational approach to formulating recipes comes into effect to explain leadership behavior for achieving certain desired firm outcomes (Rosenhead et al., 2019; Uhl-Bien et al., 2007). In addition, the cluster emphasizes complex

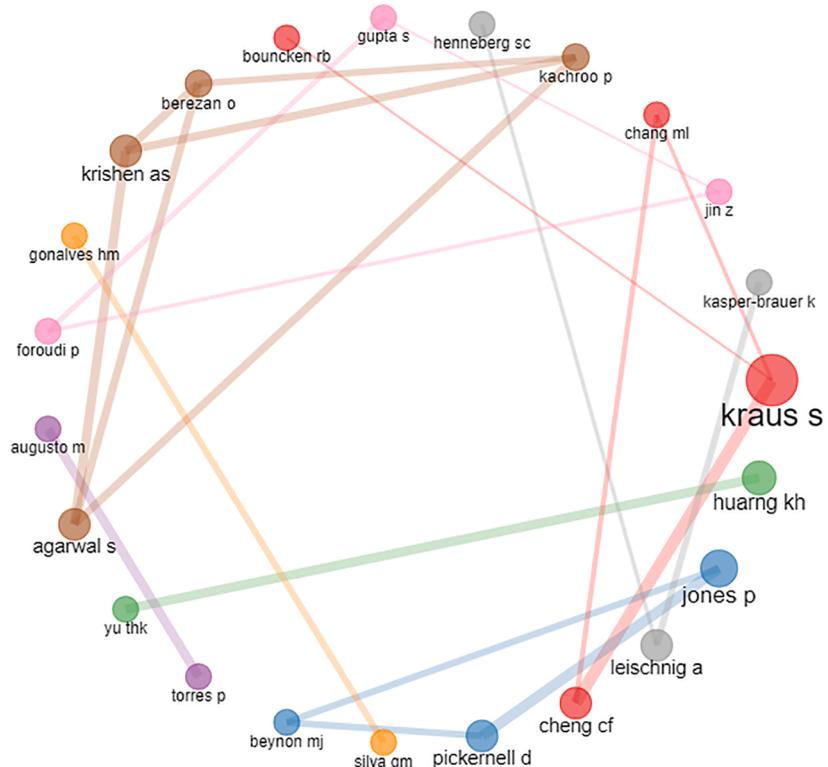


Fig. 5. Top author collaborations for research using complexity theory and fsQCA

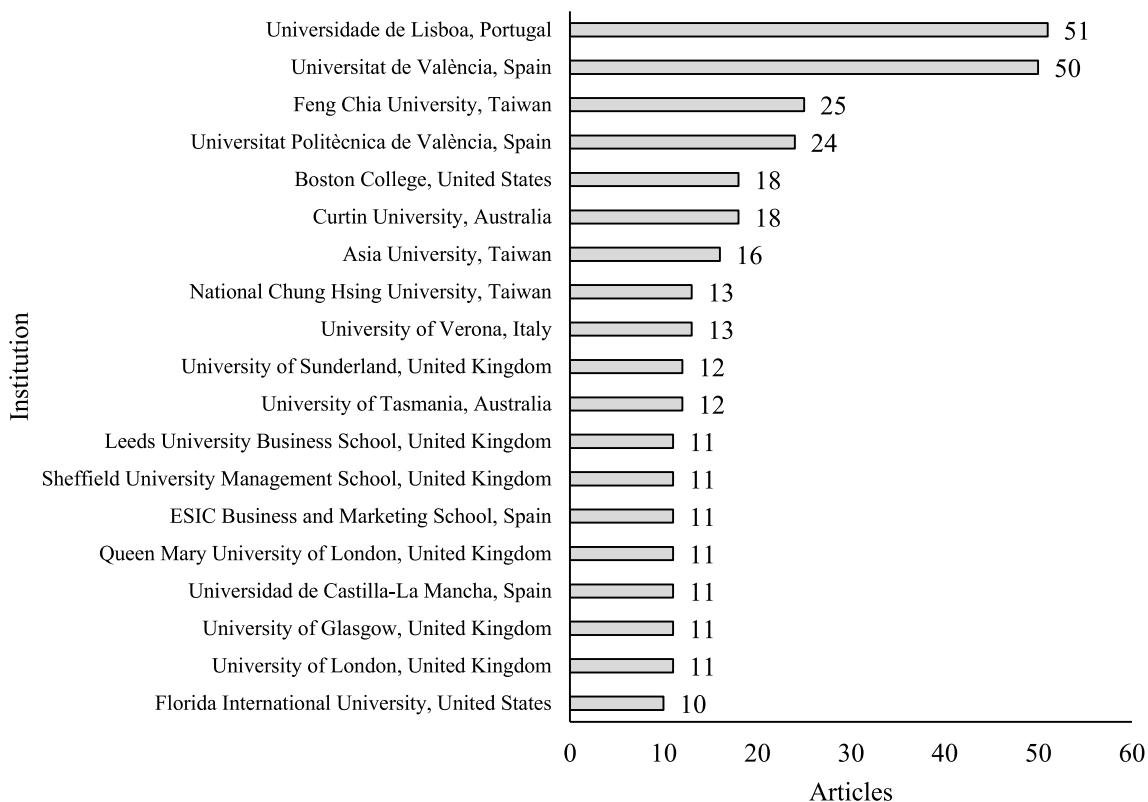


Fig. 6. Most productive institutions for research using complexity theory and fsQCA **Note:** Top contributing institutions with a minimum of 10 articles using complexity theory and fsQCA.

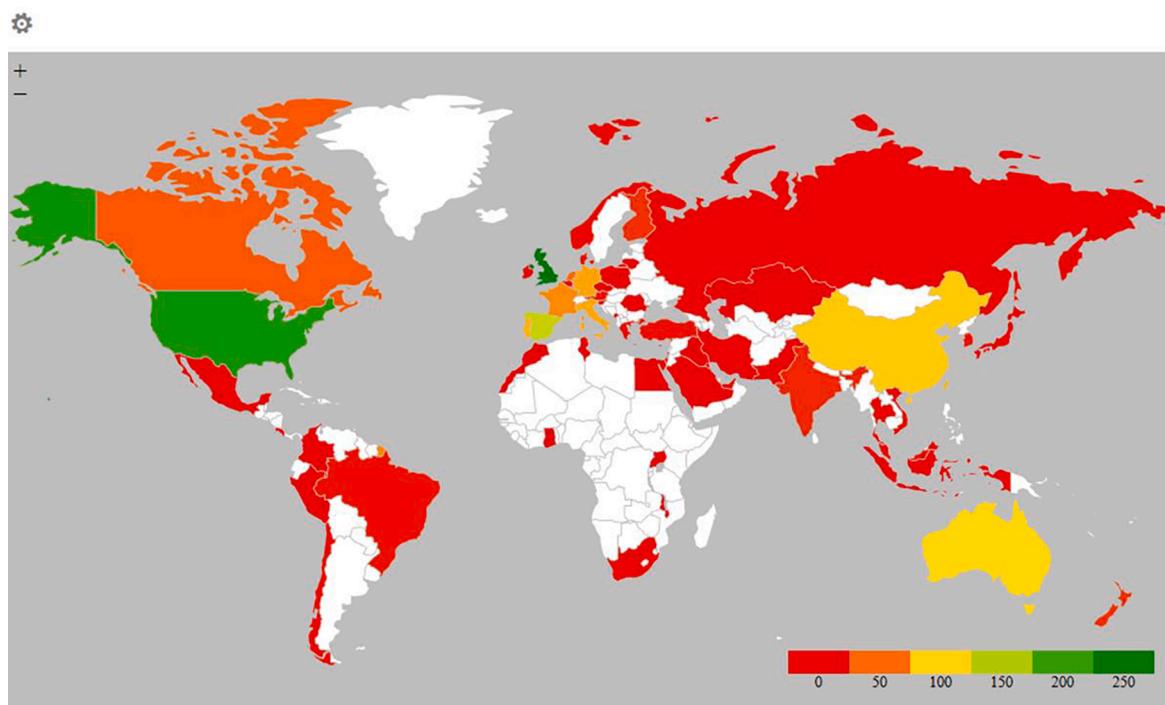


Fig. 7. Geographical density of research using complexity theory and fsQCA **Note:** Deep red reflects low density (0 to 50 articles) and deep green reflects high density (200 to 250 articles).

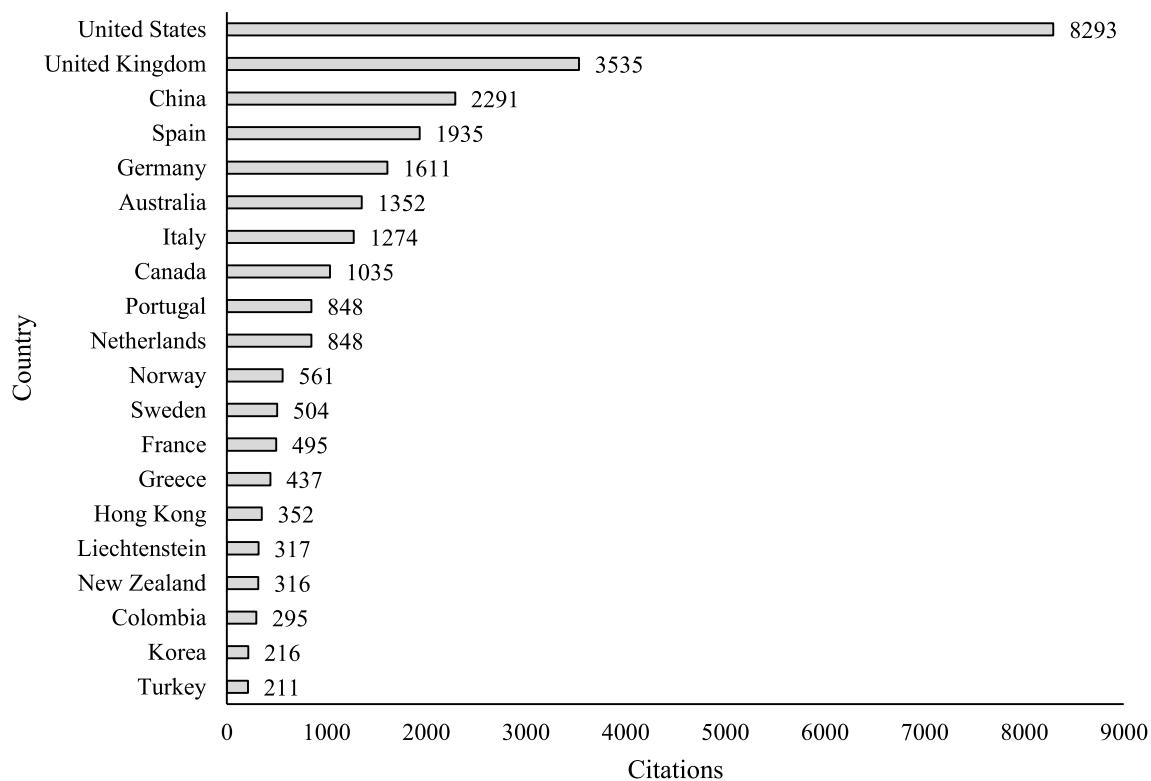


Fig. 8. Most impactful countries for research using complexity theory and fsQCA

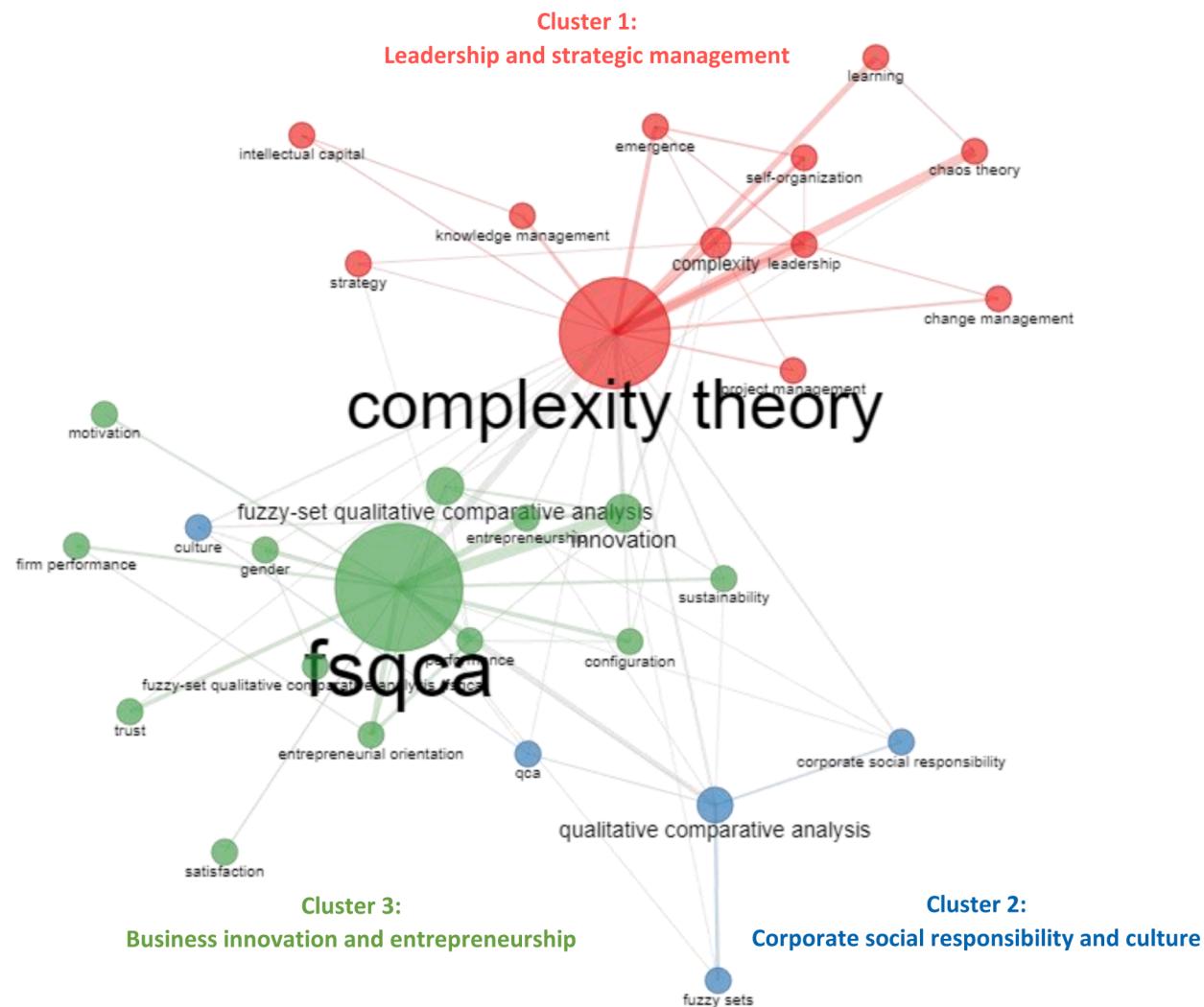


Fig. 9. Keyword co-occurrence network of research using complexity theory and fsQCA

adaptive systems, which implies that a life cycle of a firm goes through multiple distinct phases, such as disequilibrium, amplifying action, recombination, and sustaining feedback, to explain how leaders emerge from the necessities of the situation (Burnes, 2005; Hunt et al., 2009; Plowman et al., 2007; Rosenhead et al., 2019). Diverse circumstances need a unique configuration of abilities, knowledge, and personalities. Whenever a firm faces a crisis, it looks to its employees (emerging as situational leaders) who have the necessary expertise, knowledge, and talents to help the firm fulfill its objectives and build upon their success.

4.3. Cluster 2: Corporate social responsibility and culture

Cluster 2 is the smallest of the three clusters, with 138 articles containing the keywords “corporate social responsibility” and “culture” connected to “fuzzy sets” and “qualitative comparative analysis” (Table 6) Timmer and Kaufmann’s (2017) article “Conflict minerals traceability – A fuzzy set analysis” is the most notable article in this cluster, with a PageRank score of 0.002488 (Table 7). The second most prominent article in the cluster is Skarmeas et al.’s (2014) article “Examining the role of CSR skepticism using fuzzy-set qualitative comparative analysis”. The third most prominent article in the cluster is “Human capital and performance in young audit firms” authored by Samagaio and Rodrigues (2016). The top 10 articles in Cluster 2 reflect on the macro (national) and micro (organizational) perspectives of culture, as well as academic debates on corporate social responsibility

efforts, employing the QCA configurational approach.

As this cluster touches upon two verticals, we begin by outlining how the QCA technique is used to analyze the configurational aspect of culture. According to some researchers, the morals, beliefs, and preconceptions that comprise culture cannot or should not be quantified (Berger and Köhn, 2020; Lee et al., 2016). Nonetheless, other researchers suggest that a good culture, on the other hand, produces a set of qualitatively trackable behaviors, which is why numerous scholars have published articles centered on fuzzy sets discussing configurational approaches that can enhance supply chain collaborations (Acquah et al., 2021), customer servitization (Li et al., 2021a), innovation capability (Berger and Köhn, 2020), knowledge sharing (Oyemomi et al., 2019), brand equity (Chatzipanagiotou et al., 2019), strategic performance (Frambach et al., 2016), interorganizational negotiations (Ott and Kimura, 2016), audit capability (Samagaio and Rodrigues, 2016), employee motivation (Lee et al., 2016), and occupational compensation (Grechamer, 2011), among others.

The second vertical addressed by this cluster is the use of the QCA technique to achieve the goal of corporate social responsibility (Cuadrado-Ballesteros et al., 2017; Dahms, 2019; Laguir et al., 2021; Skarmeas et al., 2014), with the best configurational recipe discussed in several articles to address social issues (Timmer and Kaufmann, 2017; Torres and Augusto, 2021; Villalba-Ríos et al., 2021), engage in humanitarian efforts (Mazzucchelli et al., 2021b), invest in environmentally-conscious activities (Dwekat et al., 2020; Santamaría

Table 6

Knowledge clusters and keywords for research using complexity theory and fsQCA

Keyword	Betweenness	Closeness	PageRank
Cluster 1: Leadership and strategic management			
Complexity theory	245.7522	0.0270	0.1788
Leadership	0.6245	0.0161	0.0363
Complexity	3.2869	0.0175	0.0316
Chaos theory	0.1502	0.0161	0.0290
Emergence	0.0000	0.0159	0.0250
Self-organization	0.0000	0.0159	0.0238
Learning	0.0000	0.0154	0.0196
Knowledge management	0.0000	0.0154	0.0172
Change management	0.0000	0.0154	0.0140
Intellectual capital	0.0000	0.0154	0.0131
Strategy	0.4677	0.0161	0.0120
Project management	0.0000	0.0154	0.0119
Cluster 2: Corporate social responsibility and culture			
Qualitative comparative analysis	9.1222	0.0189	0.0446
Culture	0.1801	0.0179	0.0202
Corporate social responsibility	0.1429	0.0175	0.0187
Fuzzy sets	0.0494	0.0147	0.0164
QCA	0.0727	0.0175	0.0144
Cluster 3: Innovation and entrepreneurship			
fsQCA	162.7580	0.0238	0.1618
Innovation	11.8626	0.0192	0.0623
Performance	5.0560	0.0161	0.0387
Entrepreneurship	0.3959	0.0182	0.0357
Fuzzy-set qualitative comparative analysis	4.3851	0.0189	0.0303
Entrepreneurial orientation	0.6405	0.0152	0.0288
Configuration	1.0368	0.0175	0.0211
Gender	29.0000	0.0175	0.0211
Sustainability	0.0165	0.0175	0.0196
Trust	0.0000	0.0169	0.0150
Firm performance	0.0000	0.0143	0.0130
Motivation	0.0000	0.0141	0.0094
Fuzzy-set qualitative comparative analysis (fsQCA)	0.0000	0.0116	0.0084
Satisfaction	0.0000	0.0141	0.0082

et al., 2021; Wu et al., 2021), and so on, all while meeting business objectives such as employee (Chen and Khuangga, 2021), marketing (Palone et al., 2021) and financial performance (Sinthupundaja et al., 2019).

4.4. Cluster 3: Innovation and entrepreneurship

Cluster 3 emerges as the largest cluster, as a modularity class, in Gephi, with 320 articles. The article “The role of accelerators in firm survival: An fsQCA analysis of Italian startups” by Del Sarto et al. (2020) is rated first in the cluster with a PageRank score of 0.002595. Leischnig and Kasper-Brauer (2015) authored the second-ranked article, “Employee adaptive behavior in service enactments”, while Leischnig et al. (2016) authored the third-ranked article, “Net versus combinatory effects of firm and industry antecedents of sales growth”. As shown in Table 7, the list of 10 prominent articles in Cluster 3 appears to be centered on the notion of *innovation and entrepreneurship*, with an emphasis on how firms can manage their technical competence and business fundamentals in order to build competitive advantage while also keeping their customers satisfied. Articles in this cluster cover a wide range of topics, including the start-ups ecosystem (Del Sarto et al., 2020; Gaio et al., 2022; Halberstadt et al., 2021), venture financing (De Crescenzo et al., 2021; Ribeiro-Navarrete et al., 2021; Standaert et al., 2021), technological innovation (Gerke et al., 2021; Mazzucchelli et al., 2021a; Waldkirch et al., 2021; Yu et al., 2021; Zhu et al., 2021), economic governance structure (Estevão et al., 2022), consumer consumption behavior (Kopplin and Rösch, 2021; Santos and Gonçalves, 2021), tourism (Kallmuenser et al., 2019; Küçükerşen et al., 2021), electronic commerce (J Wang et al., 2020.; Wang et al., 2021a), manufacturing management (Bustinza et al., 2021; Gomes et al., 2020;

Liu et al., 2021), service management (Leischnig and Kasper-Brauer, 2015), and supply chain management (Acquah et al., 2021; Stekelorum et al., 2021), among others.

Entrepreneurship is the act of establishing a new business or reinventing an existing one (Ferreira et al., 2019; Llanos-Contreras et al., 2020), while innovation is the process of creating and introducing new things, which may take the shape of a product (Sun, 2021; Thornton et al., 2019), a service (Ommen et al., 2016), a business model (Kulins et al., 2016), or a strategy (Cheng and Wang, 2021; Ciampi et al., 2021). Experts agree that although innovation is about creating something new (Barbosa et al., 2021; Huarng and Roig-Tierno, 2016), it does not always result in a business opportunity (Huang et al., 2020; Latif et al., 2020; Waldkirch et al., 2021). Entrepreneurship recognizes potential in outstanding innovations, generates opportunities, adds value, and grows its worth over time (Du and Kim, 2021). It becomes one of the primary antecedents to boosting sales, building strategic orientation, and increasing market worth of a business venture (Ho et al., 2016; Leischnig et al., 2016). Therefore, in today's fast-paced business setting, as continuous innovation is becoming crucial to entrepreneurial as well as firm success (Pinelli et al., 2021), and this is where complexity theory comes into the equation, emphasizing the fsQCA technique to derive a configurational recipe for entrepreneurs on how they would need an edge in various functional aspects (such as technology, resource management etc.) to sustain, survive, and stand out in the competitive market (Andrews et al., 2021; Del Sarto et al., 2020; Du and Kim, 2021; Kollmann et al., 2021; Khanin et al., 2021; Mikalef et al., 2019; Thornton et al., 2019). From a macroeconomic standpoint, it is vital to understand how the business climate in a specific country fosters economic competitiveness by studying alternative configurations of macro-economic variables that encourage the development of entrepreneurial endeavors (Estevão et al., 2022). As a continuation of the aforementioned discussion, articles in this cluster have looked at how circumstances from both a micro- and a macro-economic standpoint may be made more favorable for female entrepreneurs using the fsQCA methodology (Di Paola, 2021; Li et al., 2021; Santos et al., 2021; Wu et al., 2019).

5. Topic mapping and future research

5.1. Mapping of topics

As the review corpus converges into three unique knowledge clusters, it becomes apparent that the topics addressed in these clusters are pertinent since they reflect on functional business activities inherent in some form in all firms. To stimulate greater research interest and suggest promising avenues for future research that would benefit from using complexity theory and fsQCA to predict business phenomena and the management of that phenomena, it is necessary to reflect on the progress of business research using complexity theory and fsQCA. To do this, we utilized the Bibliometrix-R software's “thematic map” tool to comprehend the topics based on their degree of relevance (centrality) and development (density) in order to determine their progression classes. Using this tool, we created an intuitive map by combining centrality and density scores to categorize themes as basic, motor, emerging, and niche (Cobo et al., 2018), with the results reported in Table 8. The first topic in each cluster indicates the central topic, with other topics within the cluster relating to the first topic. For example, in the first cluster labelled “basic theme”, “leadership” is the first topic, and all subsequent topics are related to it.

Topics classified as basic and motor themes indicate that the research topics are well established (centrality). The primary distinction between basic and motor themes is that topics in basic themes are typically connected to other topics within the cluster and thus have lower density and impact, whereas the topics in motor themes are also connected to other topics outside the cluster and thus have higher density and impact (Cobo et al., 2011). Table 8 reveals three basic themes centered on

Table 7

Most prestigious articles across knowledge clusters for research using complexity theory and fsQCA

Article title	Author(s)	Year	Journal title	PageRank
Cluster 1: Leadership and strategic management				
How strategic knowledge management drives intellectual capital to superior innovation and market performance	Cabrilo and Dahms	2018	Journal of Knowledge Management	0.002754
Purchasing alignment under multiple contingencies: A configuration theory approach	Mikalef, Patel, Batenburg, and Van De Wetering	2015	Industrial Management and Data Systems	0.002591
The adoption of management control systems by start-ups: Internal factors and context as determinants	Crespo, Rodrigues, Samagaio, and Silva	2019	Journal of Business Research	0.002230
Organizations as complex adaptive systems: Implications of complexity theory for leadership research	Schneider and Somers	2007	Leadership Quarterly	0.002005
Market knowledge as a function of CEOs' personality: A fuzzy set approach	Chollet, Géraudel, Khedhaouria, and Mothe	2016	Journal of Business Research	0.002001
Achieving requisite variety in modeling firms' strategy heterogeneities: Explaining paradoxical firm-market performances	Nagy, Megehee, Woodside, Laukkanen, Hirvonen, and Reijonen	2017	Industrial Marketing Management	0.001967
Towards an econophysics view of intellectual capital dynamics: From self-organized criticality to the stochastic frontier	McKelvey, Salvador, Morcillo, and Rodríguez-Antón	2013	Knowledge Management Research and Practice	0.001856
Configurational answer to the ongoing riddle of formal and/or emergent planning practices	Bouncken, Fredrich, and Pesch	2016	Journal of Business Research	0.001829
Organizational learning capability and open innovation	Peris-Ortiz, Devece-Carañana, and Navarro-García	2018	Management Decision	0.001768
Configurational path to customer satisfaction and stickiness for a restaurant chain using fuzzy set qualitative comparative analysis	Hsiao, Chen, Chang, and Chiu	2016	Journal of Business Research	0.001743
Cluster 2: Corporate social responsibility and culture				
Conflict minerals traceability – A fuzzy set analysis	Timmer and Kaufmann	2017	International Journal of Physical Distribution and Logistics Management	0.002488
Examining the role of CSR skepticism using fuzzy-set qualitative comparative analysis	Skarmeas, Leonidou, and Saridakis	2014	Journal of Business Research	0.002388
Human capital and performance in young audit firms	Samagaio and Rodrigues	2016	Journal of Business Research	0.002244
How important is customer orientation for firm performance? A fuzzy set analysis of orientations, strategies, and environments	Frambach, Fiss, and Ingenbleek	2016	Journal of Business Research	0.002230
Internal capabilities, external cooperation and proactive CSR on financial performance	Sinthupundaja, Chiadamrong, and Kohda	2019	Service Industries Journal	0.002194
The team absorptive capacity triad: A configurational study of individual, enabling, and motivating factors	Lowik, Kraaijenbrink, and Groen	2016	Journal of Knowledge Management	0.001971
Culture, religiosity, and economic configural models explaining tipping-behavior prevalence across nations	Ferguson, Megehee, and Woodside	2017	Tourism Management	0.001835
Exploiting organizational culture: Configurations for value through knowledge worker's motivation	Lee, Raschke, and Louis	2016	Journal of Business Research	0.001629
How cultural impact on knowledge sharing contributes to organizational performance: Using the fsQCA approach	Oyemomi, Liu, Neaga, Chen, and Nakpodia	2019	Journal of Business Research	0.001591
board structure to enhance social responsibility development: A qualitative comparative analysis of US companies	Cuadrado-Ballesteros, Martínez-Ferrero, and García-Sánchez	2017	Corporate Social Responsibility and Environmental Management	0.001523
Cluster 3: Innovation and entrepreneurship				
The role of accelerators in firm survival: An fsQCA analysis of Italian startups	Del Sarto, Isabelle, and Di Minin	2020	Technovation	0.002595
Employee adaptive behavior in service enactments	Leischnig and Kasper-Brauer	2015	Journal of Business Research	0.002584
Net versus combinatory effects of firm and industry antecedents of sales growth	Leischnig, Henneberg, and Thornton	2016	Journal of Business Research	0.002532
Big data analytics and firm performance: Findings from a mixed-method approach	Mikalef, Boura, Lekakos, and Krogstie	2019	Journal of Business Research	0.002529
Foreign-owned subsidiary knowledge sourcing: The role of location and expatriates	Dahms	2019	Journal of Business Research	0.002460
Examining strategic orientation complementarity using multiple regression analysis and fuzzy set QCA	Ho, Plewa, and Lu	2016	Journal of Business Research	0.002434
It's in the mix: How firms configure resource mobilization for new product success	Thornton, Henneberg, Leischnig, and Naudé	2019	Journal of Product Innovation Management	0.002297
Identifying women's entrepreneurial barriers and empowering female entrepreneurship worldwide: A fuzzy-set QCA approach	Wu, Li, and Zhang	2019	International Entrepreneurship and Management Journal	0.002157
A configurational approach in business model design	Kulins, Leonardy, and Weber	2016	Journal of Business Research	0.002114
Qualitative comparative analysis, crisp and fuzzy sets in knowledge and innovation	Huarng and Roig-Tierno	2016	Journal of Business Research	0.002106

“leadership”, “innovation”, and “corporate social responsibility”, which are also visible from the cooccurrence network analysis results ([Fig. 9](#), [Tables 6](#), and [7](#)). Interestingly, there is just one motor mainly reliant on “project management”, featuring connections to topics both inside and beyond the cluster. It may be inferred that these four thematic clusters, labelled as either basic or motor themes, are well established within the research domain centered on complexity theory and fsQCA, given that the majority of high-quality studies have concentrated only on these themes. With this, interested researchers can deduce that configurational recipes for achieving firm objectives (or a desired outcome) in

business complexities involving leadership, innovation, corporate social responsibility, and project management are in abundance, and they can revisit these proposed configurations in different social, political, technological, and economic contexts.

Also seen in [Table 8](#) are four topic clusters categorized under emerging theme and niche theme. Emerging themes are regarded as budding or immature and thus have low centrality and impact at present, but could nonetheless have potential importance moving forward ([Cobo et al., 2018](#)). In contrast, niche themes have well-developed internal linkages within the cluster but insignificant outward linkages,

showing that these clusters of topics are rated high in centrality, and thus, indicating that they are highly specific and peripheral in nature (Cobo et al., 2011). This also implies that the topics labelled under emerging themes and niche themes are domains where interested researchers could concentrate their endeavors on, since the results are neither generalizable nor well established. Thus, the thematic areas centered on open innovation, motivation, satisfaction, and tourism are promising avenues, as noted through Table 8, for prospective researchers interested in complexity theory and fsQCA to focus upon.

5.2. Avenues for future research (RQ3)

To enrich the body of knowledge using complexity theory and fsQCA, four broad avenues identified as emerging and niche themes in the previous section are discussed for future research attention and consideration in the subsequent sections.

5.2.1. Integrating open-innovation and coopetition into practice

The cluster centered on “open innovation” surfaces as an emerging theme, with keywords related to “human capital” and “coopetition”. The current competitive environment provides several opportunities for businesses to benefit from the notion of “open innovation”, which specifies the conditions under which a firm does not rely solely on its own human capital but also seeks opportunities to collaborate with

Table 8
Centrality and density of topics for research using complexity theory and fsQCA in the review corpus

Topics	Category (CR, DR)	Centrality	Density
<i>Leadership</i> , change management, emergence, intellectual capital, knowledge management, learning, organizational change, organizational learning, and self-organization.	Basic theme (7,2)	22.92	93.67
<i>Innovation</i> , ambidexterity, business model innovation, crowdfunding, digital transformation, dynamic capabilities, entrepreneurial orientation, entrepreneurship, firm performance, firm survival, gender, service innovation, sharing economy, SMEs (small medium enterprises), social capital, social entrepreneurship, start-ups, sustainability, technology, and trust.	Basic theme (8,1)	25.58	92.46
<i>Corporate social responsibility</i> , business model, corporate governance, decision making, financial performance, market orientation, and value-creation.	Basic theme (5,3)	10.14	94.42
<i>Project management</i> , consumer behaviour, customer loyalty, servitization, and technological innovation.	Motor theme (6,8)	10.89	136.47
<i>Open innovation</i> , coopetition, and human capital.	Emerging theme (2,5)	6.66	99.11
<i>Motivation</i> , product innovation, and strategy.	Emerging theme (3,4)	7.94	94.50
<i>Satisfaction</i> , customer experience, emotion, eWOM (electronic word of mouth), and social media.	Niche theme (1,7)	5.50	130.55
<i>Tourism</i> and culture.	Niche theme (4,6)	8.66	100.18

Notes: Centrality reflects the degree of relevance (i.e., centrality value closer to zero reflects high centrality). Density reflects the degree of development (i.e., density value closer to zero reflects high density). CR = centrality rank (i.e., how close a topic in each cluster is related to other topics in the same cluster). DR = density rank (i.e., the cluster's degree of divergence in topics as well as quantity of associated articles). The first topic in each cluster indicates the central topic, with other topics within the cluster relating to the first topic.

external resources to innovate products, services, business models, processes, and so on (Barbosa et al., 2021; Carmona-Lavado et al., 2021; Peris-Ortiz et al., 2018). In a competitive landscape in which monopoly does not exist, this has given rise to a new strategic orientation characterized as “coopetition”, which is essentially the act of cooperating among competing enterprises (Czakon et al., 2020; Ricciardi et al., 2021). Firms that engage in both competition and cooperation are said to be in coopetition, which means that those businesses get a competitive advantage by careful collaboration with suppliers and firms that offer complementary or related products (Bacon et al., 2020; Santos, 2021). Although the business practices of open innovation and coopetition appear to be related, it is anticipated that these practices could very well become a more lucrative tool for firms to innovate since they can reduce costs, accelerate time to market, strengthen market differentiation, and create new revenue streams. In reality, these theoretical ideals of collaboration are accompanied by dimensions of distrust and tension among participating members (Barbosa et al., 2021; Ferrigno et al., 2021; Ricciardi et al., 2021; Santos, 2021), which opens up an intriguing research avenue for interested researchers to pursue. Prospective researchers are recommended to comprehend the forms and dimensions of trust and distrust (Cesinger et al., 2015), as well as their interaction in various cooperative circumstances, by drawing inspiration from complexity theory. They should be investigated further in light of the tensions that arise as a result of conflicting demand, ambiguity, and uncertainties. Prospective researchers undertaking research on these topics can propose configuration recipes that could offer to strengthen mutual coevolution among participating firms in both the cooperative arenas of open innovation and the competitive arenas of coopetition.

As a consequence, the following future research questions are proposed for interested researchers to investigate.

- What are the strategies for maintaining healthy coopetition among participating participants in order to facilitate a successful open innovation project?
- What are the various organizational competencies (intra-and inter-firm) required for managing open innovation so as to coopete successfully?
- How may this partnership approach (open innovation or coopetition) result in competitive advantages as well as the opportunity for the firms involved to outperform other market players?

5.2.2. Motivation and strategy for product innovation

The pursuit of successful product innovation is a challenging endeavor for most businesses, despite substantial investments and efforts by their human resources (Cheng et al., 2013; Meade and Rabelo, 2004; Yoruk et al., 2021). As the customer arena evolves, the pace at which product innovation initiatives fail is growing exponentially, and innovators who previously succeeded now struggle to sustain their performance, raising the question, “Why is it so difficult to establish and preserve the capacity to innovate?” (Nijssen and Ordanini, 2020; Sun and Zou, 2019). The issues are much more complex than just a lack of execution (Yoruk et al., 2021). The answer is in the central keyword, “motivation”, which is linked to “strategy” and “product innovation” in this emerging theme, underscoring that there is no strategy to successfully innovate without motivation. Motivation culminates in strategy to establish a strategic direction for product innovation (Crespo et al., 2019; Lanzolla and Markides, 2021), emphasizing the project team’s dedication to a set of coherent, mutually reinforcing policies or behaviors targeted at accomplishing a certain competitive objective (Lee et al., 2016; Slager et al., 2021). Effective strategies promote synchronization across disparate groups within the firm, as well as the establishment of common interests and objectives through brainstorming, which aids in the consolidation of appropriate resources for achieving technical feasibility, business viability, and customer desirability of product innovation (Lanzolla and Markides, 2021; Meade and Rabelo, 2004;

Yoruk et al., 2021). Turning to the central problem, future researchers must understand why these conditions continue to be difficult to achieve in practice. As a probable upshot, researchers may provide a configurational blueprint for how employees might be empowered to innovate or how the project team can be inspired to explore in order to effectively build a novel product offering. The following future research questions are offered as a consequence of these conversations:

- How could firms design policies and procedures that will encourage human capital while also enabling a motivating and learning environment conducive to successful product innovation?
- Given the varying nature of product categorization, what cultural traits should be developed in a firm to strengthen the relationship between employee motivation and product innovation performance?
- How can a strategic alignment be achieved between the organizational socio-technical system and the commercial performance of a product innovation, taking into account the various product life cycle stages?

5.2.3. Customer engagement and eWOM on social media

The thematic cluster circled on the keyword “satisfaction”, which has been coupled with other keywords like “social media”, “customer experience”, “emotion”, and “eWOM”, is a niche theme. Social media has grown in popularity among people of all backgrounds over the last decade (Martín-Rojas et al., 2021). With the democratization of information, the emergence of social media platforms and with electronic commerce (e-commerce) gaining popularity as a natural substitute for traditional commerce, electronic word-of-mouth (eWOM) casts a fresh light on how customers acquire, process, and exchange product information (Krishen et al., 2020; Torres et al., 2018). Customers are becoming more comfortable with social media and are more willing to share their buying experiences and thoughts, including opinions about what they bought and how it impacted them to other prospective buyers (Donthu et al., 2021c; Martín-Rojas et al., 2021). Marketers have recognized that eWOM is a potent market force because customers see it as an unbiased and trustworthy source of product information (Wang et al., 2021b). As companies recognize the effects of negative eWOM on their brand reputation, they have become more attentive to customer responses and emotions in order to improve their products and services (Donthu et al., 2021c). According to this viewpoint, interested researchers should seek to comprehend the functioning of eWOM using a configurational approach in order to increase product awareness and acceptability among customers during the early stages of product launch (Phung et al., 2020), or when a product initially developed for one market transcends to another market (e.g., product brand crossover) (Lim et al., 2020). The fsQCA technique may be used by researchers to better understand the benefits of social media and the degree to which eWOM offers support in the building of brand image, customer emotional connection, and the encouragement of purchase intent throughout all stages of the product life cycle. Even more research is needed into the ways in which firms can combat adversities and sustain their brand image in the face of negative eWOM and take proactive measures in the event of service failure, product recall, poor e-commerce interface, unavailability of products, controversial brand advertisements, or poor customer service (Donthu et al., 2021c). Furthermore, it would be an intriguing avenue for researchers to explore the following future research questions.

- How does the performance of the eWOM recommender system differ when different product categories and contexts are considered?
- How does the effectiveness dynamics of the eWOM recommender system change for product and service purchasing behaviors across various social media platforms?
- How can the use of social media for R&D–marketing collaboration be harmonized for commercial benefit in terms of product and service offering?

5.2.4. Tourism and culture

More research attention is required for this niche or underdeveloped thematic cluster centered on the keywords “tourism” and “culture.” Culture is increasingly being positioned as a key component of the tourism product, creating differentiation in a fragmented marketplace. Tourism, which is also an essential way of promoting culture and generating income for indigenous people, both supports and promotes the destination’s cultural heritage as well as the creative expression of its local population. Interested researchers may endeavor to develop a framework of multidimensional configuration circumstances (such as push forces, pull forces, and constraints) that foster the development of this built-up form of cultural tourism (Azimi Hashemi and Hanser, 2018; Mehran and Olya, 2020), or a combination of it with other forms of tourism such as ecotourism (i.e., eco-cultural tourism) (Jopp et al., 2021). Prospective researchers are recommended to employ the fsQCA technique for research avenues in three potential areas addressing tourism development (He et al., 2021), tourism management (Corne and PeyPOCH, 2020), and understanding tourist behavior (Akhshik et al., 2021; Küçükergin et al., 2021), based on prior recent studies. As a result of this contextual research (both micro and macro), policymakers and industry practitioners are anticipated to construct configurational recipes to enhance the tourism sector in their countries. Thus, the following research questions are proposed:

- How can diverse culture be better understood and leveraged for personalized tourism product offering and service experience?
- How can tourist destinations (e.g., hospitality service operators, tourism policy makers) engage in effective market targeting, segmentation, and positioning of tourists and tourism products and services in encompassing ways?
- How can tourists and tourism products and services be better matched for mutual satisfaction among interacting and transacting parties?

5.3. Strategic perspective for the future

One of the on-going issues for academic research is the theory-practice gap. While academic research offers intellectual stimulating insights that enable the theorization of business phenomena (e.g., frameworks, models), industry practitioners often lament that such insights tend to be academic and have little relevance for practice (e.g., idealistic, challenging to implement). In this regard, we wish to take this opportunity to encourage greater academic-practitioner collaboration that would leverage complexity theory and fsQCA to not only understand business phenomena but also solve complex business problems. Therefore, two strategic propositions are put forth for academics and industry practitioners to consider.

Academics can bring research-specific know-how into the academic-practitioner collaboration. While the philosophical insights of complexity theory and the technical know-how of performing fsQCA are both a given and thus expected from academics, it is important that academics also adopt a systems-thinking mindset (i.e., viewing phenomena as “wholes” rather than “in parts”) to ensure that business issues are not investigated in silos. That is to say, academics will need to avoid the tendency to confine themselves to narrowly-defined research questions and instead keep an open mind when collaborating with industry practitioners. The goal for academics in such collaborations is therefore to not only answer academic research questions, but to solve real-world issues in the pursuit of research with impact. In that sense, academics should courageously embrace the multi-faceted business issues with an asymmetrical rather than a symmetrical world view that industry practitioners often encounter and raise in their interactions with academics. Therefore, we do not discount the possibility of new research opportunities that go beyond the four promising avenues indicated through our bibliometric analysis of academic research in the previous section, and thus, highly encourage collaborations on novel pursuits to

solve complex business problems within and outside the scope covered in the present review.

Industry practitioners can bring industry-specific insights into the academic-practitioner collaboration. While industry practitioners have first-hand insights on the latest macro- and micro-environmental changes that are happening in the business environment, they often lack the ability and resources to engage in rigorous research and development (R&D) activities. R&D is critically important as investments into untested recommendations work against sound business logic and thus constitutes a recipe for failure (Lim, 2021). Unlike symmetrical methods, fsQCA is an asymmetrical method that provide a means to develop causal conclusions. In this regard, industry practitioners should view academics with fsQCA expertise as a valuable resource that they can leverage on to solve their complex business problems, thereby proactively solving the theory-practice gap—as opposed to lamenting about that gap. Such collaborations would also make financial sense given the tax incentives that are given for R&D across many countries (e.g., double corporate tax deductions, tax reliefs) (Ivus et al., 2021; Kuusi et al., 2016).

When collaborating to solve complex business problems, academics and industry practitioners should ask asymmetrical questions. Instead of asking and searching for definite solutions, academic-industry collaborations should pursue conditional solutions in line with the asymmetrical view of fsQCA to avoid potential issues of applying symmetrical solutions to asymmetrical business problems. Thus, we encourage academic-practitioner collaborations that work to solve complex business problems using complexity theory and fsQCA to consider the asymmetrical questions throughout the project, which may include but not limited to:

- Are there equifinal patterns that appear in a significant number of cases that lead to a common outcome?
- How do contextual variables at different functional levels interact with one another to produce a given outcome?
- What functional attributes are necessary and to what extent are they sufficient for achieving a desired outcome?
- Which attributes or features in a configuration arrangement are interchangeable or complementary?

6. Conclusion

The study employs an SLR methodology to analyze the research domain involving complexity theory and fsQCA. To find answers to the study's three RQs, this review attempted to present a large-scale perspective of 1,155 research articles in the domain using both performance and scientific mapping analyses. This review, to the best of our knowledge, is the first of its kind to report on how research related to complexity theory and fsQCA has evolved.

According to the results of the performance analysis, the number of articles published has steadily increased over the past five decades, with the majority of them originating in the United Kingdom, the United States, and Spain. This trend implies that an increasing number of researchers from the western world are using complexity theory to characterize a particular business situation and then employing the fsQCA technique to seek a configurational solution to it. The outcomes of the scientific mapping analysis revealed three prominent themes: *leadership and strategic management, corporate social responsibility and culture, and innovation and entrepreneurship*. In all of these prominent themes, research articles recognized using PageRank analysis span all complex scenarios of business research, including organizational behavior, marketing, finance, and operations, among others. With this review, we hope to motivate aspiring researchers to adopt complexity theory and fsQCA to study complex business phenomenon in today's VUCA world, as they have been shown to be persuasive and rigorous mechanisms for explaining and verifying non-linear relationships that mirror real-world business circumstances in contrast to the inability of conventional linear theoretical and analytical techniques to do so.

CRediT authorship contribution statement

Satish Kumar: Conceptualization, Data curation, Writing – original draft, Supervision, Project administration. **Saumyaranjan Sahoo:** Formal analysis, Software, Methodology, Validation, Investigation, Writing – original draft. **Weng Marc Lim:** Methodology, Visualization, Writing – review & editing, Supervision. **Sascha Kraus:** Conceptualization, Writing – review & editing, Visualization. **Umesh Bamel:** Resources, Methodology, Data curation, Writing – review & editing, Project administration.

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