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REVIEW

Trends and patterns in entrepreneurial action research: a bibliometric overview and research agenda

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Abstract
Entrepreneurial action has attracted significant scholarly attention over the last decade. Given its rapid growth and conceptual complexity ranging from mental processes like judgmental decisions to behavioral manifestations, the literature is hard to navigate. This paper aims to review the EA literature by applying bibliometric analysis. Articles from 1993 to 2020 were analyzed to show how the literature has evolved over the years, identifying the most influential articles, journals, and authors and the knowledge structures. It has been found that EA research has evolved from a subsidiary concept serving other research streams to a mainstream with its own concepts and theories. EA has become a competent successor for entrepreneurial opportunity, as some scholars suggest its realistic and pragmatistic potential for studying entrepreneurship. Finally, by shedding light on more mature subfields and emerging trajectories, we develop a future research agenda for scholars interested in EA, especially new arrivals.

Keywords Entrepreneurial action · Bibliometric analysis · Science mapping · Conceptual structure

Introduction

Action is a prerequisite of entrepreneurship (McMullen & Shepherd, 2006). Any question to understand entrepreneurship revolves around action: "Who takes action? What type of individuals take action? How do they take action? When do they take action? Why do they take action? And where do they take action?"; but the tendency in the field has been to study individuals or firms (Corbett & Katz, 2012, p. xii). However, introducing the individual-opportunity nexus, as a turning point in the entrepreneurship scholarly field, provides a framework to study what entrepreneurs really do during the recognition and exploitation of entrepreneurial opportunities (Shane & Venkataraman, 2000). These studies increase our understanding of the interaction of "elements of the internal environment of an organism (the entrepreneur's cognition, emotions, actions, and aspirations) with elements of the external environment (market structures, institutions, stakeholders, resources, or cofounders)" and led to a more "atomic unit" in the field of entrepreneurship: actions and interactions (Venkataraman et al., 2012). Today, entrepreneurial action (EA) research progresses in "conceptual depth" by developing concepts such as effectuation, bricolage, and improvisation and in "empirical breadth" with an increase in the number of studies exploring entrepreneurial action in the real world (Corbett & Katz, 2012).

EA research has grown increasingly, especially in the last decade. Due to the nature of action, it can be seen as a multiplicity of academic discourses. The rapid development and multidimensional nature of action caused the EA literature spans various subjects (Arabiun et al., 2019), from being noticed implicitly in searching for the determinants of entrepreneurial intention as the predictor of action (Krueger et al.,

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2000) to study activities through creating new organizations (Carter et al., 1996). EA is shaped by these dimensions and their underlying assumptions, theoretical perspectives, the context in which EA is researched, and not least by the individuals who conduct EA research and their perspectives on the phenomenon. With the development of the field, scholars have tried to review the literature, analyze the findings, and identify the patterns (Townsend et al., 2018; Watson, 2013). For example, McMullen and Shepherd (2006) reviewed economic theories of entrepreneurship and provided a conceptual framework for entrepreneurial action by considering the role of uncertainty. In another attempt, Watson (2013) criticized the individualistic framework dominating the entrepreneurship domain rooted in the US-led mainstream of research and suggested EA as a "pragmatic and realistic frame of reference" by rendering a more balanced European and American research tradition. In another article, researchers review multiple research streams related to the knowledge problems associated with EA and suggested a research agenda to explore EA under ambiguity, complexity, equivocality, and uncertainty (Townsend et al., 2018). Although these literature reviews increase our understanding about EA, they are based on authors' expertise, experience, and exposure to investigate a part of the literature and do not use systematic methods (Kraus et al., 2022).

As a body of knowledge has been growing, there is a need to review the literature systematically and periodically (Landström et al., 2012). Given the growth of research on EA, it may be challenging for individual researchers to maintain an overview of the existing literature, track its development, and recognize fruitful research directions. This study uses bibliometric analysis to explore the relational nature of knowledge creation in the EA field. Bibliometric analysis is a rigorous method used to explore a specific field's evolution and present the intellectual structure through informed techniques and procedures beyond the limitations of individualistic and manual methods (Donthu et al., 2021). Being enabled to cover large databases, we include publications from high-ranked entrepreneurship-specific and management journals. Our analysis employs both performance analysis measures to present the field constituents' profile (publications, authors, and journals) and science mapping to explore the intellectual interactions and structural connections. Based on these bibliometric techniques, we explore constituents of EA knowledge and how they continue to shape different parts of the current field of EA. We also identify different subfields, characterize them with their contributions to the field, and suggest future research trajectories.

Our contribution is twofold. First, we use a novel methodology to review EA literature. Although scholars have done literature reviews on EA in recent years, they do not rely on systematic methods to map the field. Bibliometric analysis as a complementary tool in systematic literature reviews has been used increasingly in recent years (Anand et al., 2021; Chakma et al., 2021; Landström et al., 2012). Empowered by technology and possessing the benefits of machine learning, the bibliometric analysis provides useful data to track the evolution of a research field and format the knowledge structure around a topic through citation analysis, analysis of keyword co-occurrence, and other bibliometric indicators such as influential journals and authors (Kraus et al., 2022).

Furthermore, using a bibliometric approach allows us to understand better how the field of EA research is structured and how distinct subfields have evolved around key ideas. Second, we contribute to EA research by presenting a holistic view, mapping out focal points and blind spots culminating in future research agenda. We claim that this paper is one of the few studies that comprehensively investigated the EA field and its logical foundations through a bibliometric lens. Analyzing a dataset of 204 papers published in high-ranked journals, this article can provide an overview of the EA research. Therefore, an analysis of bibliometric performance and graphic mapping of the field of study is presented in order to show the most productive and influential studies and the connections between the different scientific actors participating in the EA field. While we find several very encouraging developments within the EA literature, most notably the diversity of research questions that have been addressed, some under-researched areas remain.

Overall, using the bibliometric method in reviewing the literature, we seek to answer three critical questions: What has happened in the development of this research field? Which paths were fruitful? And which directions need further study? The rest of the paper is structured as follows: after a brief review of the literature, we describe the paper's methodology. Subsequently, the study results are presented through performance analysis and science mapping. Finally, the last section discusses the study's main conclusions and outlines possible avenues for future research.

EA in entrepreneurship literature

The field of entrepreneurship continues to establish a distinct, independent, and modern theory of entrepreneurship (Alvarez, 2005; Gartner, 2001; Shane & Venkataraman, 2000) which requires a richer, deeper, and thorough exposition of action (Townsend et al., 2018) and its dimensions including who is an entrepreneur, what is being done, in what manner they act, when, where, or how they are doing it, and with what effect (Watson, 2013).

Action refers to doing something with a degree of intentionality and consciousness (Ajzen, 1991). This differs from mere thinking, judging, or mechanical responses (Berglund, 2005). As Brody and von Mises (1951) described, human action involves purposeful employment of means to achieve

desired ends. Regardless of conceptualizing as creating a new combination of factors (Schumpeter, 1934), entry into new markets (Lumpkin & Dess, 1996), new venture creation (Gartner, 1985), behavior in response to a decision under uncertainty about a possible profitable opportunity (Kirzner, Hebert and Link, 1983), perceiving and exploiting opportunities (Shane & Venkataraman, 2000), new economic activity (Davidsson, 2003), the pursuit of new business opportunities under uncertainty (McMullen & Shepherd, 2006), or the making of adventurous, innovative exchanges (Watson, 2013), EA is central to most theories of entrepreneurship (Berglund, 2005; McMullen & Shepherd, 2006; Watson 2013).

Scholarly breakthroughs have resulted in the development of different approaches and theoretical frameworks to explain and explore key aspects of EA's causes (i.e., taking into account EA as a dependent variable influenced by different ranges of antecedents) (Hunt & Lerner, 2018; Rostamian et al., 2022) and effects (Dosi, 1984; Shepherd & Patzelt, 2015) which in turn encounter scholars with both opportunities and challenges (Shepherd, 2015; Wiklund et al., 2018).

Action as an individual phenomenon links the novel but the bounded capacity of the entrepreneur with environmental complexities (Berglund, 2005). Therefore, EA affects and is influenced by a vast majority of actor-centric (e.g., motivation and ability) and context-centric (e.g., difficulty and luck) conditions (Berglund, 2005; Kilby, 1971; McMullen & Shepherd, 2006; Reynolds, 1992; Shaver, 2012) and their interrelations (Aeeni, Motavaseli, Sakhdari, & Dehkordi, 2019). Hence, different ranges of approaches have developed to explicate EA's drivers and consequences with micro-foundations such as trait, behavioral and cognitive approaches (Berglund, 2005) on the one hand and macro-foundations such as institutional approach (Boettke & Coyne, 2009), entrepreneurial ecosystem (Stam, 2015), or external enablers (Davidsson et al., 2017) on the other hand. As one of the most unique and idiosyncratic facets of human action (Antonacopoulou & Fuller, 2020), EA is induced by ranges of motivations (i.e., planned and intentional, spontaneous, intricate, or unknowable) that can exert an undeniable influence on the business venturing process and outcome (Antonacopoulou & Fuller, 2020; Hunt & Lerner, 2018). Seeking to unfold such motivations behind EA, scholars try to study the action relying on various theories developed in other research fields (e.g., psychology, sociology, and economics). On the other side of the actor-context nexus, the macro level, research evidence has witnessed the critical influence of diverse dimensions of context, such as business, social, spatial, temporal, and institutional, on EA (Welter, 2011; Wadhwani et al., 2020). These research achievements improve our understanding of EA, its prerequisites, and outcomes. So, considering the extensive literature on EA and its dimensions, it is critical to draw the conceptual framework of the knowledge created in the field and its evolution during the last decades. Relying on such a conceptual map of EA literature, it would be possible to introduce a robust agenda for researching key problems within the context of EA research.

Method

Literature reviews are essential as they enable an understanding of a field's evolution and the knowledge gaps. Given the EA's research developments, it is time to provide a more holistic overview of the field. To cover the literature comprehensively, we put forward bibliometric analysis that applies "mathematical and statistical methods to analyze scientific activities in a research field" (Aparicio et al., 2019, p. 106). This methodology has recently been used to complement traditional reviews by providing a quantifiable way of exploring current and upcoming research trends (Anand et al., 2021).

We began our data search by selecting a database to collect articles. In this paper, the data have been extracted from the WoS database since its material contains the highest quality standard of research (Ellegaard & Wallin, 2015) and has been utilized in many bibliometric studies (Akbari et al., 2021). We used the keywords "entrepreneur*" and "action*" to search the TOPIC (title, abstract, or keyword) to ensure we did not leave any articles of interest[1]. As a result, the total number of documents found was 3092. Since this review intended to explore the evolution of the EA research field, our analysis was limited to high-ranked entrepreneurship journals and some management journals that publish entrepreneurship-related papers directing and influencing research trajectory. These journals include "Entrepreneurship Theory and Practice," "Journal of Business Venturing," "Journal of Small Business Management," "Journal of Small Business Economics," "Strategic Entrepreneurship Journal," "Entrepreneurship and Regional Development," "Academy of Management Journal," "Academy of Management Review," "Administrative Science Quarterly," "Journal of Management," "Journal of Management Studies," "Management Science," "Organization Science," and "Strategic Management Journal." Our search resulted in 365 journal articles over a 27-year time period (from 1993 to 2020).

We then proceeded to define our inclusion and exclusion criteria. Criteria sampling (Welch & Patton, 1992) was used to create the final list of articles. Since EA has

[1] An asterisk (*) can substitute for the absence of a character anywhere in word, e.g., entrepreneur. Entrepreneurs, entrepreneurial, action, and actions.

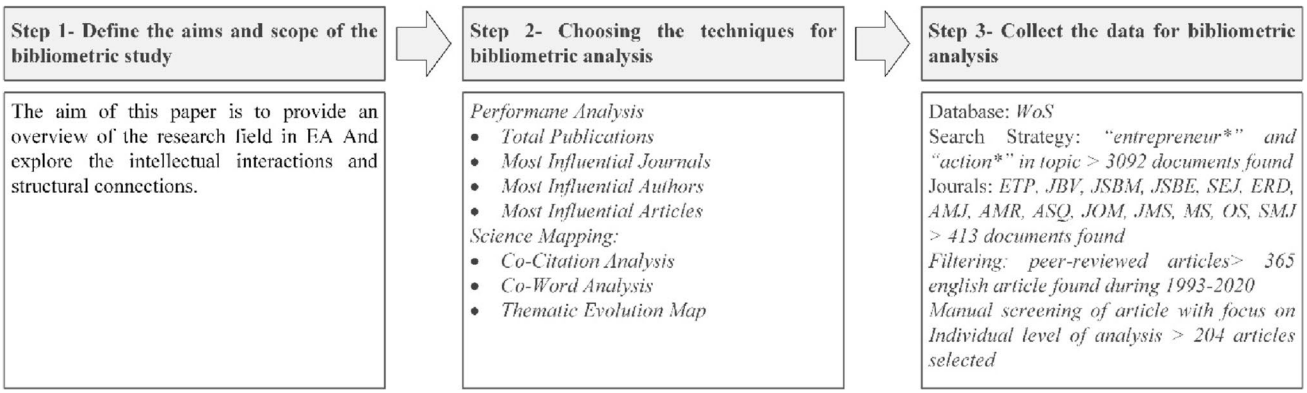

Fig. 1 The bibliometric analysis procedure

sometimes been applied as an equivalent to entrepreneurship, or similar concepts like entrepreneurial behavior, the definition proposed by McMullen and Shepherd (2006, p.134) as a "behavior in response to a judgmental decision under uncertainty about a possible opportunity for profit" was adopted to determine the scope of our dataset. Moreover, since this study focused on the EA at the individual level, publications that addressed entrepreneurial action at the corporate level were also excluded. Thus, two authors of this paper manually screened the abstracts to refine the sample and omitted articles that did not meet these criteria. Finally, a dataset of 204 papers was achieved.

Performance analysis and science mapping were used to analyze the data. Performance analysis is a descriptive technique that explores the contributions of research constituents (Cobo et al., 2011). However, science mapping examines the relationship between research constituents. Co-citation analysis is the most popular relational technique in bibliometric studies that depict the intellectual structure of a research field. Specifically, author co-citation analysis or ACA "allows us to trace the connections between researchers and fields emphasizing the idea that joint references contained by scientific articles let us identify the seminal documents, as well as the ones that contribute to develop the field" (López-Fernández et al., 2016, p. 625). The co-occurrence analysis focus on words and the actual content of the publications "identifying and classifying clusters or research topics" (López-Fernández et al., 2016, p. 625). In this article, we conduct a co-occurrence analysis based on key terms to map the conceptual structure of the field by assessing the most frequent terms used in articles. Researchers have widely used term co-occurrence analysis to study conceptual work, research hotspots, and trends in different research fields (Zhou et al., 2022). VOSviewer software was applied to analyze and visualize the structure and dynamics among contributions. In addition, the Bibliometrix® software was employed as an R tool to depict strategic diagrams. Fig. 1

Results

Bibliometric performance analysis

In this section, we present our dataset's performance analysis which is, as Donthu et al. (2021) argue, similar to the profile of participants in empirical studies and shows the contributions of research constituents. According to Fig. 2, EA research has increased significantly in recent years. Most papers in the sample (204 articles) have been published in the last decade (161 published between 2010 and 2020), representing 85% of the total volume. This diagram also shows that EA research's evolution has undergone three phases. The first period dates back to 1993–2004, covering 13 out of 204 articles, or almost 6.3%. The number of publications doubled in the second period (from 2005 to 2009). However, the trend increased sharply after 2010 (the third period). Several factors can explain this growth. First, as scholars searched for a framework to understand entrepreneurship beyond enterprising individuals and situations, "promise" appears to have set in motion several developments. As the investigation of the individual-opportunity nexus accumulated, the importance of finding the patterns of action and interactions between the inner and outer environment increased (Venkataraman et al., 2012). Furthermore, action has been a response to a more realistic and pragmatistic lens in the entrepreneurship field (Watson, 2013). Second, EA, as a research field, has grown both conceptually and empirically and represents much of the cutting-edge entrepreneurship research today (Corbett & Katz, 2012, p. xii).

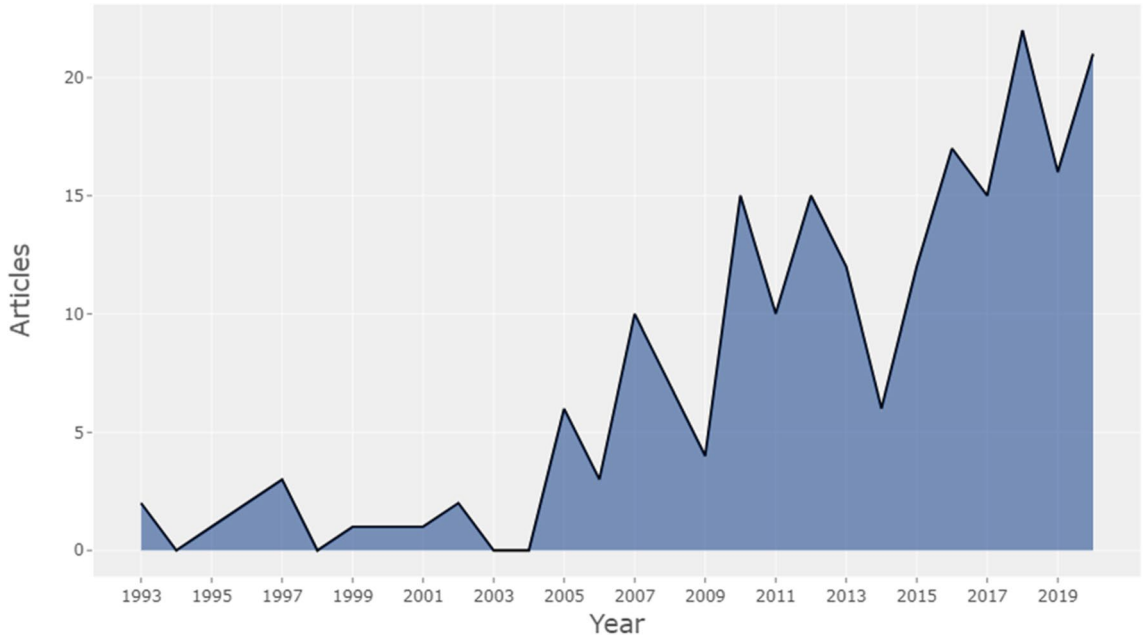

Fig. 2 Number of publications per year on EA

Table 1 Rankings of the most productive and cited journals in the EA field

R	Source	NP	%	TC	HEA	TC/NP	>=200	>=100	>=50
1	JBV	47	23.0%	5231	33	111.3	7	16	29
2	SEJ	30	14.7%	2199	17	73.3	3	5	9
3	ERD	28	13.7%	884	16	31.6	0	2	5
4	ETP	22	10.8%	2606	18	118.5	6	9	13
5	SBE	18	8.8%	350	10	19.4	0	0	3
6	JSBM	14	6.9%	422	8	30.1	0	1	2
7	AMJ	10	4.9%	883	9	88.3	1	4	7
8	JMS	9	4.4%	445	9	49.4	1	0	3
9	SMJ	9	4.4%	296	9	32.9	0	0	2
10	OSJ	6	2.9%	284	6	47.3	0	0	3
11	AMR	4	2.0%	273	4	68.3	1	0	0
12	AOM	3	1.5%	206	2	68.7	0	1	1
13	ASQ	3	1.5%	496	3	165.3	1	1	1
14	JOM	1	0.5%	166	1	166.0	1	1	1

Most influential journals

Performance analysis examines the contribution of research constituents (journal, author, and article) to a given field. As mentioned, we restricted our attention to 14 high-ranked management and entrepreneurship journals. Table 1 shows the ranking of these journals based on their productivity and influence on the EA research field, wherein publication is a proxy for productivity, and citation gauges the influence or impact. These journals have been ordered according to the number of publications (NP). As this table shows, the most productive journal in EA research is the "Journal of Business Venturing" (JBV), with 47 publications representing 23% of all articles in our dataset. Regarding productivity, entrepreneurship-specialized journals are at the top, accounting for almost 60% of publications, followed by organization and management journals.

Another critical indicator in the analysis is the h-index of EA papers (HEA) in a given journal. According to HEA, the most influential journal is JBV, with a HEA of 33 and 5231 citations. Another important aspect of this section is the analysis of all the EA citations (TC). The JBV again stands out for having the highest number of TC. Moreover,

Table 2 List of the most cited articles in the EA field

R	Title	Journal	Year	TC	TCY
1	Discovery and creation: alternative theories of entrepreneurial action	SEJ	2007	846	65.1
2	The effects of embeddedness on the entrepreneurial process (Jack, & Anderson, 2002)	JBV	2002	579	44.5
3	How entrepreneurs use symbolic management to acquire resources (Zott & Huy, 2007)	ASQ	2007	429	33.0
4	Social bricolage: theorizing social value creation in social enterprises	JBV	2010	419	17.5
5	Exploring start-up event sequences	JBV	1996	404	16.8
6	New business start-up and subsequent entry into self-employment	JBV	2006	379	27.1
7	Entrepreneurial learning from failure: an interpretative phenomenological analysis (Cope, 2011)	JBV	2011	336	37.3
8	A longitudinal-study of cognitive-factors influencing start-up behaviors and success at venture creation	JBV	1995	300	12.0
9	Effectuation, causation, and bricolage: a behavioral comparison of emerging theories in entrepreneurship research	ETP	2012	285	35.6
10	Darwinism, communitarians, and missionaries: the role of founder identity in entrepreneurship	AMJ	2011	277	30.8
11	Entrepreneurship as the nexus of individual and opportunity: a structuration view	JBV	2006	276	19.7
12	The development of an infrastructure for entrepreneurship	JBV	1993	270	10.0
13	Economic freedom and the motivation to engage in entrepreneurial action	ETP	2008	255	21.3
14	Time and the entrepreneurial journey: the problems and promise of studying entrepreneurship as a process (Mcmullen & Dimov, 2013)	JMS	2013	242	34.6
15	The social construction of entrepreneurship: narrative and dramatic processes in the coproduction of organizations and identities	ETP	2005	231	15.4

7 of these articles have been cited more than 200 times. Regarding the influence of the investigated journals, the "Entrepreneurship Theory and Practice" (ETP) journal takes second place, followed by the "Strategic Entrepreneurship Journal" (SEJ), "Entrepreneurship and Regional Development" (ERD), and "Small Business Economics" (SBE), respectively.

NP and h-index of a journal are the most popular performance analysis metrics. However, we present another metric in Table 1 to show the weight of publications in each journal by dividing the total citation (TC) by the NP. According to this metric (TC/NP), the last journal of the table, "Journal of Management" (JOM), takes the first place with a score of 166, which means that its papers have the most citation on average, compared to others. Interestingly, unlike other metrics, organization and management journals are highlighted, and "Administrative Science Quarterly" (ASQ) comes second, followed by ETP, JBV, and AMJ.

R ranking, *NP* number of publication, *TC* total citation, *HEA* h-index only EA, *JBV* Journal of Business Venturing, *SEJ* Strategic Entrepreneurship Journal, *ERD* Entrepreneurship and Regional Development, *ETP* Entrepreneurship Theory and Practice, *SBE* Small Business Economics, *JSBM* Journal of Small Business Management, *AMJ* Academy of Management Journal, *JMS* Journal of Management Studies, *SMJ* Strategic Management Journal, *OSJ* Organization Science Journal, *AMR* Academy of Management Review, *AOM* Academy of Management, *ASQ* Administrative Science Quarterly, *JOM* Journal of Management

Most cited articles

In the scholarly realm, journals can be regarded as organizations, authors as agents, and publications as productions that should attract attention and be sold. Selling here is to be cited by other authors. It reflects the popularity and influence of each article in the scientific community. Table 2 presents the fifteen most-cited articles in the EA field. The most cited and influential paper on this list is by Alvarez and Barney (2007), with over 800 citations. As shown in Fig. 2, 2007 was one of the turning points in the evolutionary path of the EA field. Let us compare the evolution of the scientific path based on Fig. 2 to the most cited articles (based on the TC column) in Table 2. The comparison of results reveals that despite the small share of the first period, i.e., 1993–2004, in producing EA papers, four of the fifteen most cited articles belong to this period. In contrast, six of the most cited articles belong to the second period and only five to the third period.

However, the number of citations per year should also be considered, as the longer a paper's lifespan is, the more it could be cited. Therefore, the last column of this table shows the ratio of citations to years of publication, which neutralizes the effect of time. Regarding this criterion, again, the "Discovery and creation" article by Alvarez and Barney (2007) becomes the most influential. Then, "The effects of embeddedness on the entrepreneurial process" will be second, followed by "Entrepreneurial learning from failure." Thus, neutralizing the effect of time, it can

Table 3 The most productive and cited authors

R	Author	PY start	TCEA	TPEA	TC/TP
1	Shepherd DA	2007	787	7	112.4
2	Baron RA	2008	356	5	71.2
3	Dimov D	2007	776	5	155.2
4	Gartner WB	1993	858	5	171.6
5	McMullen JS	2007	701	5	140.2
6	Hunt RA	2016	90	4	22.5
7	Van Gelderen M	2000	213	4	53.3
8	Alvarez SA	2007	1094	3	364.7
9	Fisher G	2012	294	3	98.0
10	Haynie JM	2007	265	3	88.3
11	Hmieleski KM	2008	232	3	77.3
12	Kautonen T	2015	159	3	53.0
13	Lerner DA	2016	76	3	25.3
14	Vissa B	2012	131	3	43.7
15	Wood MS	2017	30	3	10.0

be observed that articles published in the last period have significantly attracted attention.

Another point is that more than half of the most influential articles have been published in JBV, which indicates this journal's undeniable role in entrepreneurship generally and in EA research specifically. The other influential articles belong to ETP, SEJ, ASQ, AMJ, and JMS.

TC total citation, *TCY* total citation per year

The most productive and influential authors

Total publications (TP) and total citations (TC) are used to identify the influential authors of the EA field. Table 3 presents the 15 most productive authors in the EA research community. Shepherd stood in the first place with seven publications. However, based on the total citations, the most cited scholar is Alvarez (1094), followed by Gartner (858), Shepherd (787), Dimov (701), and Baron (356). According to the TC/TP results, the top 5 most influential authors are Alvarez (364.7), Gartner (171.6), Dimov (155.2), McMullen (140.2), Shepherd (112.4), and Baron (71.2).

Regarding the evolution of EA publications, only two of the most influential authors published their first article in the first period. As mentioned, the first period of EA evolution has a small portion of the production. However, Gartner and his colleagues influenced the field significantly by introducing "emergence" to entrepreneurship literature and especially to EA by applying this concept to study the activities of entrepreneurs in starting a new venture. Afterward, other significant authors publish their first articles during the second and third periods.

Science mapping of the EA field

Previous sections described the EA field by analyzing the contribution of various research constituents. In the following, we will further map the relationships between these research constituents to understand their intellectual and structural connections. Co-citation, co-occurrence, and thematic analyses are employed to achieve this aim.

Co-citation analysis

In addition to analyzing the most prolific journal, article, and author, an attempt is made to identify the most cited references of the EA field, which Landström et al. (2012) believe represents the "core knowledge" of a field. The analysis of 12,709 references in the dataset reveals the 20 most cited references (see Table 4). While the most-cited reference is not specific to EA, Shane and Venkataraman's (2000) paper has undoubtedly paved the way for research about the actions and interactions in the opportunity discovery and exploitation process. Next, McMullen and Shepherd's (2006) paper is foundational to the development of EA research as it provided a definition and conceptual model of entrepreneurial action that researchers have well received in the coming years (McKelvie et al., 2011; Grégoire & Shepherd, 2012; Autio et al., 2013).

The following two articles, among references, have opened up new directions in the EA field by studying the logic and mechanisms of action in different contexts (Fisher, 2012). "Causation and effectuation" by Sarasvathy (2001) suggest two different logics that entrepreneurs apply during venture creation and development. The fourth most cited reference, "Creating something from nothing," discusses the mechanism and actions of entrepreneurs in a penurious environment and resource limitations. Moreover, Alvarez and Barney's (2007) research about two distinct approaches to entrepreneurial opportunities (discovery theory and creation theory) and their implication for entrepreneurial action is one of the most cited references. This article appeared twice in our data: (1) as the most cited article among 204 articles in our database and (2) as the most cited reference of the EA research (among 12,709 references).

Table 4 shows the influence of three economists: (1) Knight's (1921) attempt to explicitly distinguish between risk and uncertainty and define the entrepreneur as the uncertainty bearer, (2) Schumpeter's (1934) focus on the entrepreneur's function in economic development, and (3) Kirzner's (1973) theory of discovery on how alert entrepreneurs recognize opportunities in the entrepreneurship process.

Co-citation analysis assumes that the "publications cited together frequently are similar thematically" (Donthu et al., 2021, p. 288). It is a technique for mapping intellectual

Table 4 The most cited references

R	Reference	Citations	Total link strength
1	Shane and Venkataraman (2000). The promise of entrepreneurship as a field of research. Academy of management review, 25(1), 217–226.	64	388
2	McMullen and Shepherd (2006). Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. Academy of Management Review, 31(1), 132–152.	55	342
3	Sarasvathy (2001). Causation and effectuation: toward a theoretical shift from economic inevitability to entrepreneurial contingency. Academy of Management Review, 26(2), 243–263.	55	352
4	Baker, T., & Nelson, R. E. (2005). Creating something from nothing: resource construction through entrepreneurial bricolage. Administrative science quarterly, 50(3), 329–366.	44	285
5	Alvarez and Barney (2007). Discovery and creation: alternative theories of entrepreneurial action. Strategic entrepreneurship journal, 1(1–2), 11–26.	39	263
6	Shane and Venkataraman (2000). Prior knowledge and the discovery of entrepreneurial opportunities. Organization Science, 11(4), 448–469.	39	251
7	Knight, F. H. (1921). Risk, uncertainty, and profit (Vol. 31). Houghton Mifflin.	32	248
8	Aldrich and Fiol (1994). Fools rush in? The institutional context of industry creation. Academy of management review, 19(4), 645–670.	25	136
9	Kirzner, I. M. (1973). Competition and entrepreneurship. University of Chicago Press.	25	173
10	Schumpeter, Joseph A., The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle (1934). University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship	25	131
11	Venkatraman, S. (1997). The distinctive domain of entrepreneurship research. Advances in entrepreneurship, firm emergence and growth, 3(1), 119–138.	25	171
12	Eisenhardt, K. M. (1989). Building theories from case study research. Academy of management review, 14(4), 532–550.	23	81
13	Krueger et al. (2000). Competing models of entrepreneurial intentions. Journal of business venturing, 15(5–6), 411–432.	23	103
14	Shane, S. A. (2003). A general theory of entrepreneurship: the individual-opportunity nexus. Edward Elgar Publishing.	23	173
15	Kirzner, I. M. (1997). Entrepreneurial discovery and the competitive market process: an Austrian approach. Journal of Economic Literature, 35(1), 60–85.	22	180
16	Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. American journal of sociology, 91(3), 481–510.	21	77
17	Baker, T., Miner, A. S., & Eesley, D. T. (2003). Improvising firms: bricolage, account giving, and improvisational competencies in the founding process. Research Policy, 32(2), 255–276.	20	114
18	Baron, R. A., & Ensley, M. D. (2006). Opportunity recognition as the detection of meaningful patterns: evidence from comparisons of novice and experienced entrepreneurs. Management Science, 52(9), 1331–1344.	20	154
19	Santos, F. M., & Eisenhardt, K. M. (2009). Constructing markets and shaping boundaries: entrepreneurial power in nascent fields. Academy of Management Journal, 52(4), 643–671.	20	138
20	Weick, K. E. (1995). What theory is not, theorizing is. Administrative science quarterly, 40(3), 385–390.	20	148

linkages, especially foundational knowledge, since it focuses only on highly cited publications. Figure 3 demonstrates the co-citation analysis of the 20 most-cited references of the dataset. The bullet size indicates the number of citations to the article, and the colors of the lines show the clusters among references. We discussed the most cited references earlier, but the clusters are shown in three colors in response to the question of which articles were cited together.

The red cluster shows a strong link between Shane and Venkataraman (2000), McMullen and Shepherd (2006), Sarasvathy (2001), and Baker and Nelson (2005). Apart from the articles referenced generally in entrepreneurship research, like Shane and Venkataraman (2000), other articles of the red clusters focus on the logic and mechanisms of entrepreneurial action. More foundational classic works such as Knight (1921), Aldrich and Fiol (1994), Kirzner (1973), and Schumpeter (1934) placed in the blue cluster. The inevitable role of risk and uncertainty in shaping entrepreneurial actions in the field is rooted in the assumptions of Knight's notions of risk and uncertainty. It also turns out that articles concentrating more on methodological issues have appeared in the green cluster.

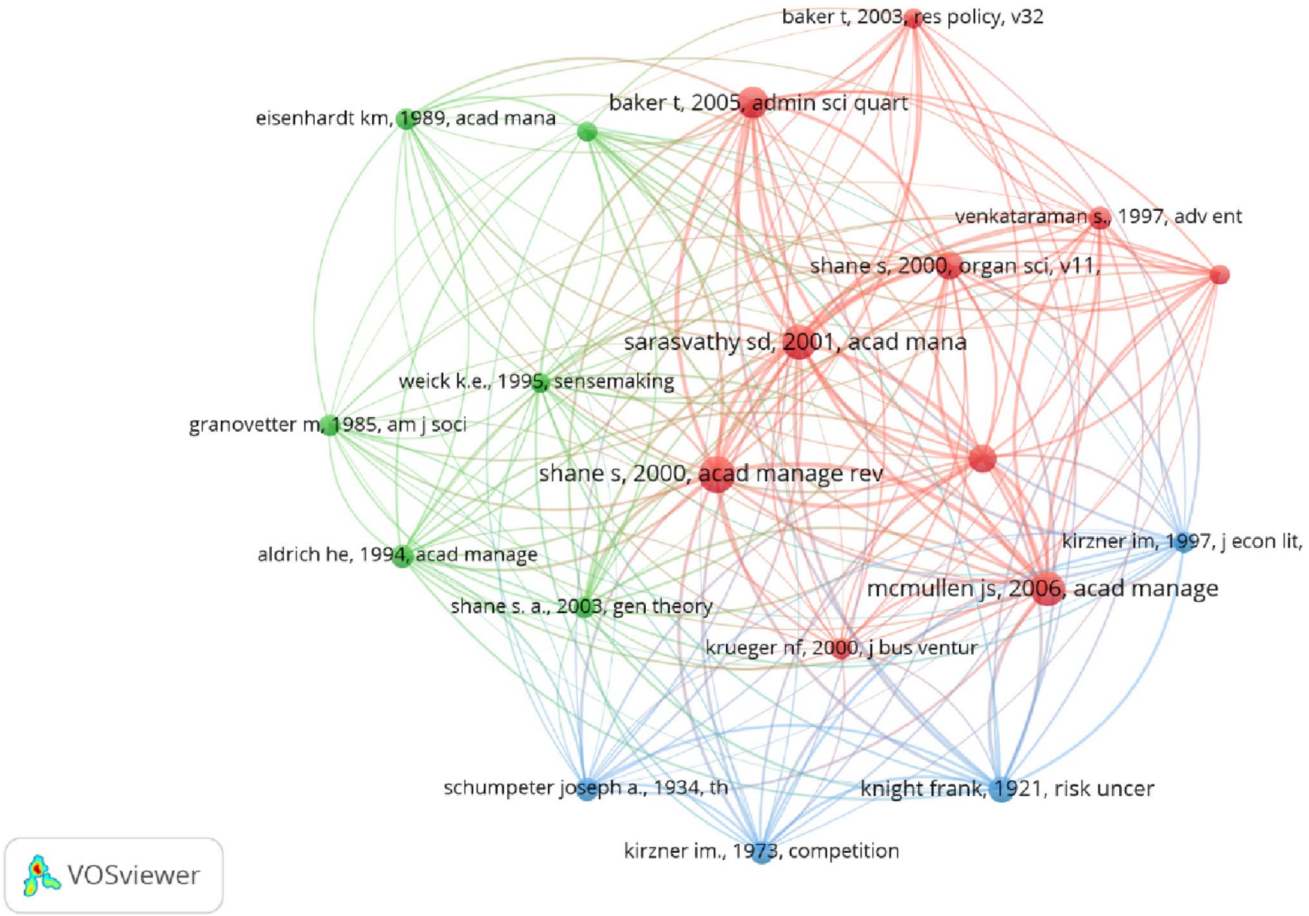

Fig. 3 Co-citation of the most-cited references in the EA field

Co-occurrence analysis

So far, the level of analysis was publications. This section further investigates the field's knowledge structure with co-occurrence analysis of words (Radhakrishnan et al., 2017). Co-occurrence analysis focuses on analyzing counts of co-occurring entities within a collection of units. Referring to term co-occurrence analysis, it is essential to remove the low-frequency items (Zhou et al., 2022). We take a sample of 204 articles and conduct an analysis of the relevant terms they use in their abstracts and titles. After imparting data into VOSviewer, we tried to identify the terms that best capture the intellectual structure of EA literature. From our dataset, only those that occurred at least ten times were selected to analyze the networks and clusters. Figure 4 presents the EA field's main terms and their frequent co-occurrences. From this analysis, it is possible to identify the most used topics in the field. In this figure, "entrepreneurial action" is the most frequent term followed by entrepreneurial opportunity, entrepreneurial process, and context.

The terms are clustered in three colors based on their co-occurrence (Fig. 4). The terms in each cluster mostly co-occurred in the field and may represent a topic (Table 5). For example, the terms *entrepreneurial action*, *opportunity*, *creation, strategy*, *effectuation*, and *bricolage* are related to how entrepreneurial action unfolds and entrepreneurial opportunities are recognized and exploited. So, we name this cluster "*entrepreneurial action and opportunities.*" The second cluster, depicted by green nodes, shows terms related to the external environment of action: *context*, *resource*, *legitimacy*, *uncertainty*, and *risk*, in addition to *new venture* and *performance* with a total occurrence of 293. This cluster of terms suggests the dimension of "*context*" in EA literature. Finally, the third cluster containing terms such as *entrepreneurial process*, *activity and entrepreneurial behavior*, *decision*, and *outcome* represents "*entrepreneuring*" first introduced by Steyaert (2007) to reflect the emergent and dynamic nature of entrepreneurship. This cluster is depicted in Fig. 4 by blue nodes.

Thematic visualization

Thematic visualization is used to illustrate the conceptual structure and understand the evolution of the EA field.

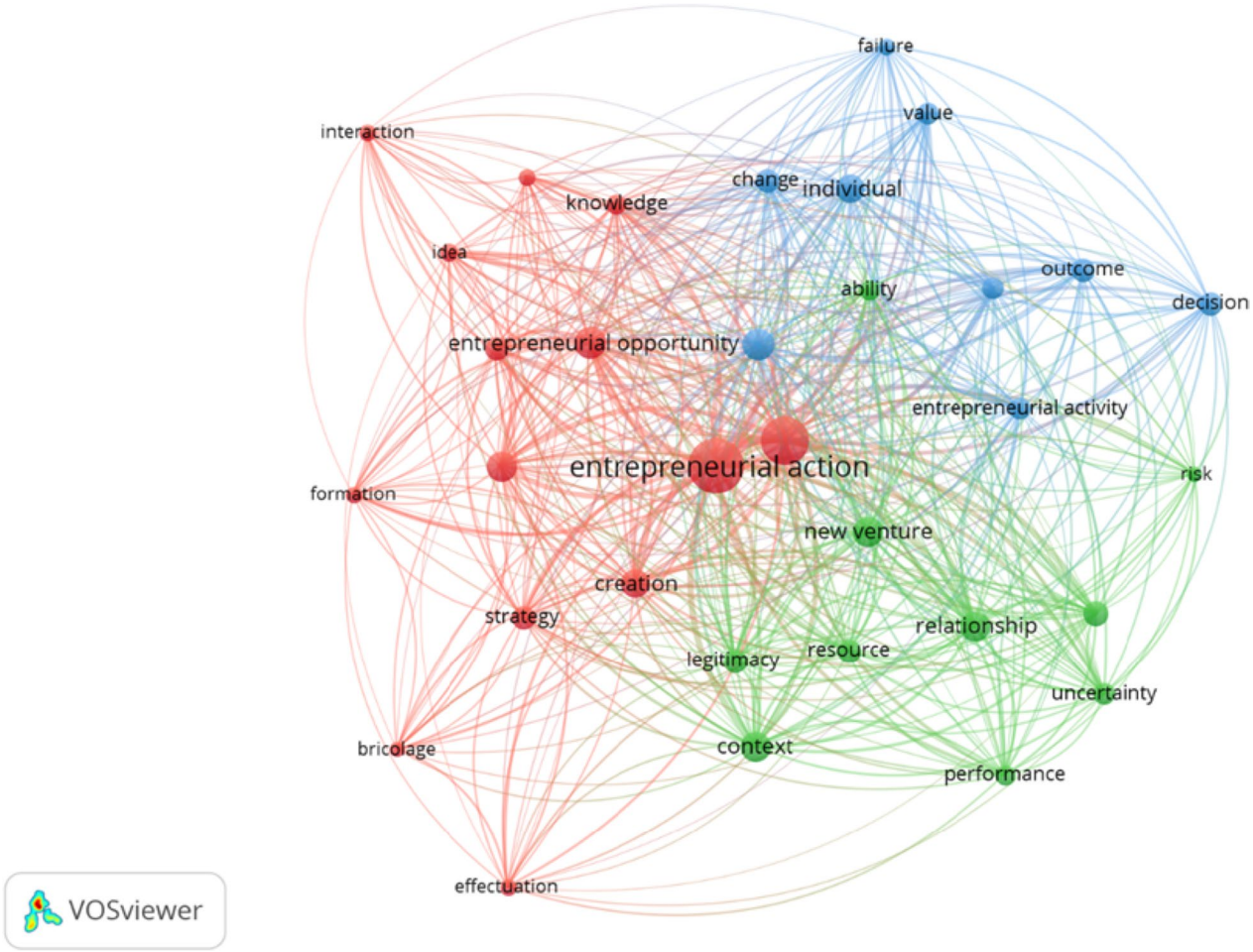

Fig. 4 Co-occurrence analysis of the EA field

Table 5 Term clusters

Cluster	Occurrences	Terms and topic
Cluster I	541	*Entrepreneurial action, entrepreneur, entrepreneurial opportunity, development, creation, strategy, knowledge, idea, effectuation, innovation, formation, interaction, bricolage*
Cluster II	293	*Context, new venture, relationship, environment, resource, legitimacy, uncertainty, ability, performance, risk*
Cluster III	253	*Entrepreneurial process, individual, change, outcome, decision, entrepreneurial activity, entrepreneurial behavior, value, failure*

Centrality and density are the two measures applied to visualize the detected themes. "Centrality" refers to the relational tie of a network with other networks, and "density" measures the internal strength of the network. Given both measures, a research field can be visualized as a set of themes in four quadrants of the strategic map. Themes in the upper-right quadrant have good interior and exterior relations and are known as motor themes (Verma & Yadav, 2021, p. 118).

On the other hand, themes in the upper-left quadrant are peripheral and very specialized in the field (Verma & Yadav, 2021), or as Akbari et al. (2021) mentioned, these themes are "highly developed and isolated." Themes in the lower left quadrant are "emerging or declining themes." They are not developed or have marginal importance to the field. Finally, "basic themes" are general to the field (Cobo et al., 2011). These themes are essential for a research field but have weak links. The Bibliometrix® package was used to create the strategic diagram for themes in the EA field from 2010 to 2020, and Fig. 5 shows the result.

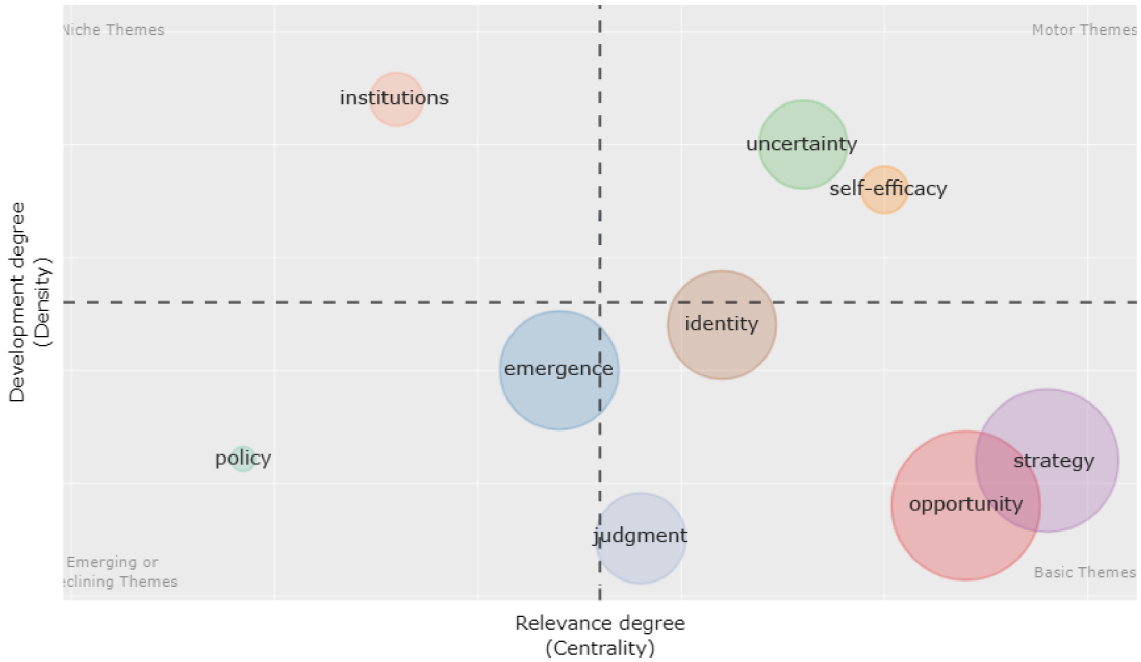

Fig. 5 Thematic visualization of EA

Basic themes Basic themes are indicated by *opportunity*, *strategy*, *identity*, and *judgment*. The "*opportunity*" theme includes *entrepreneurial opportunity*, *recognition (either creation or discovery)*, and *exploitation*. The "*strategy*" concerns how entrepreneurs form networks or legitimize their actions in a context and contains *embeddedness*, *legitimacy*, and *resilience*. The other theme is "*judgment*" and contains *heuristics*, *decision-making*, and *sense-making* in the course of EA.

Motor themes This quarter includes the *uncertainty* and *self-efficacy themes*. The "*uncertainty*" part includes keywords related to contexts such as uncertainty, ambiguity, and complexity and those related to mechanisms such as effectuation, causation, predictive logic, and bricolage. Moreover, "*self-efficacy*" consists of research about psychological factors of EA like intention, commitment, and individual differences.

Niche themes "*Institutions*" is the only group of keywords in the niche theme quadrant. It includes the keywords of institutional context, the path dependency of action, and property rights.

Emerging or declining themes The "*policy*" theme is in this quarter. It concerns how education or policy initiatives affect entrepreneurial action in emerging economies. The last theme is indicated by "*emergence.*" The studies of entrepreneurial action as an emerging phenomenon and the mechanism of improvisation are in this theme.

Discussion and concluding remarks

Over the last decade, research on entrepreneurial action has gained significant attention. Due to conceptual challenges of "entrepreneurial opportunity" (Davidsson, 2015) and trying to search for a more pragmatic lens to understand entrepreneurship, "entrepreneurial action and interactions" are suggested as the "promise" of 2010s for the scholarly field (Venkataraman et al., 2012). As a body of knowledge has been growing, there is a need to review the literature systematically and periodically (Landström et al., 2012). This study presents a comprehensive bibliometric view of the entrepreneurial action literature. Drawing upon bibliometric analysis, we depicted the evolution of the "entrepreneurial action" literature between 1993 and 2020 based on publications selected from 14 high-ranked entrepreneurship and management journals. Although this study is not the first attempt to conduct a literature review of the EA field, it is the first to map the conceptual structure of this field through bibliometric analysis. The analysis was carried out using two different but complementary techniques, including performance analysis and science mapping.

The results of our sample reveal that EA research has increased significantly in recent years (Fig. 2), and almost

three-quarters of dataset were published in the third period—2010 to 2020. Although these recent publications play a prominent role in the EA research, they are rooted in articles of seminal works in the previous phases. Furthermore, the results of the bibliometric performance analysis indicate that the most influential and productive journal was JBV with 47 articles (out of 204) and 5231 total citations. This finding is consistent with our analysis of the most influential articles showing that 8 out of 15 influential papers were also published on JBV. This makes sense because JBV is a well-recognized top-level journal that publishes the most remarkable research achievements in entrepreneurship. Other influential journals in the field are SEJ, ERD, and ETP. However, it is interesting to note that some measures indicate the critical role of management journals, especially in the average citations received in proportion to the number of publications (TC/TP). According to this measure, JOM, ASQ, ETP, and JBV are the most influential journals among fourteen. Some influential references and most cited articles directing EA research have been published in leading management journals, specifically the AMR (e.g., McMullen & Shepherd, 2006).

Authors are agents and publications as productions that should attract attention and be sold. Selling here is to be cited by other authors. Alvarez and Barney's (2007) article appears in the most cited articles' list and also is among the most cited references. This article establishes a bridge between the assumptions related to entrepreneurial opportunity and its implications for entrepreneurial action. Moreover, Alvarez is the most influential author with 364.7 TC/TP though Shepherd is the most prolific author in EA with seven articles in the sample. A first look at the table of the most influential articles reveals the impressive contribution of the first and second period authors (1993–2004 and 2005–2009) despite their less share in publication comparing to the third period (2010–2020). According to Table 2, there is a focus on identifying the activities increasing the probabilities of success among new ventures by Gartner and his colleagues (Carter et al., 1996; Gatewood et al., 1995). Furthermore, other themes that emerge from these most influential articles are the influence and interaction of individual and environment (Jack and Anderson, 2002; Sarason et al., 2006; Mcmullen et al., 2008; Downing, 2005), entrepreneurial identity (Fauchart & Gruber, 2011), and also entrepreneurial approach (Di Domenico et al., 2010; Fisher, 2012) in the field of EA.

Visual mapping of most cited is useful to map the foundations of a field, analyze the relationships between authors, and recognize schools of thought (Anand et al., 2021; Donthu et al., 2021). More than 12,000 references from 204 articles in the dataset were analyzed to explore the knowledge base of EA. We found "*The promise of entrepreneurship as a field of research*" by Shane and Venkataraman (2000) to be the leading reference in the field of EA due to its role in elucidating the distinct realm of entrepreneurship. However, the most influential reference specific to EA research is "*Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur*" by McMullen and Shepherd (2006). This article defines entrepreneurial action precisely and proposes a conceptual model for EA. Furthermore, it has played an essential role in increasing our understanding of how uncertainty inhibits entrepreneurial action and has inspired many other theoretical and empirical studies (Autio et al., 2013; Grégoire & Shepherd, 2012; McKelvie et al., 2011; Shepherd et al., 2007). It is worth mentioning that the proposed definition is also indexed in the Wiley Encyclopedia of Management and widely accepted by scholars of the field. Another influential reference is "*Causation and effectuation*" by Sarasvathy (2001). This paper concerns how entrepreneurs utilize their available means to take entrepreneurial action by controlling the future and proposes effectuation as the logic of entrepreneurs to overcome uncertainty. "*Creating something from nothing*" by Baker and Nelson (2005), developing the new concept of entrepreneurial bricolage, is the third influential article. This article clarifies the entrepreneurs' initiatives in penurious environments. Causation, effectuation, and bricolage are widely accepted as the EA's logic and prove to have high research potential in the entrepreneurship field (Fisher, 2012). Co-citation analysis of most cited references shows three intellectual structures in the field of EA. The first group in red (Fig. 3) involves Shane, Shepherd, McMullen, Sarasvathy, Alvarez, and Baker. We can call this group as the developers of EA field due to their contribution to increase our understanding of entrepreneurial action. However, co-citation analysis also reveals the importance of economic theorists such as Knight (1921), Aldrich and Fiol (1994), Kirzner (1973), and Schumpeter (1934) and suggests their influence on entrepreneurial action literature. The third cluster in this group represents methodological issues concerning theory development.

We examine the field's conceptual structure through a co-occurrence analysis of terms. As Li et al. (2015) said, "the automatically construction of term taxonomy can enhance our ability for expressing the science mapping". From this analysis, it is possible to identify the most used topics in the field. The cluster of "*entrepreneurial action and opportunities*" with the most co-occurred terms mainly represents opportunity formation and exploitation processes. This cluster represents the underlying assumptions of opportunity formation (*development, formation and creation*) and the entrepreneurial approaches applied by entrepreneurs to develop their initiatives (*effectuation* and *bricolage*). The highest number of co-occurrences among the first cluster shows the dominance of entrepreneurial opportunity assumptions and its implications for entrepreneurial action.

Entrepreneurs do not take action in isolation, but are embedded in their social, institutional, and economic context (Watson, 2013). This argument is revealed by the second cluster representing the terms related to context: *environment*, *risk*, *uncertainty*, *resources*, and *context*. Entrepreneurs shape their environment, and the environment influences their *ability* and *performance* (Aeeni, Motavaseli, Sakhdari, & Saeedikiya, 2019). The terms in the third cluster are about the notion of entrepreneurship as a *process*. Entrepreneurial action has the potential to go beyond the static approach to entrepreneurship and apply a dynamic lens to understand the phenomena of interest (Steyaert, 2007). Furthermore, entrepreneurial action includes both mental processes (*decision-making*) and actual *behaviors* of entrepreneurs (McMullen & Shepherd, 2006).

The performance analysis and science mapping of EA literature provide insights into understanding the field's evolution. The processes of opportunity recognition and exploitation have been a fundamental theme in the field. Co-occurrence analysis of terms also acknowledges the prominent role of opportunity formation in developing the EA field. It is also aligned with the analysis of the most influential article: "Discovery and creation: alternative theories of entrepreneurial action." Alvarez and Barney (2007) discuss the underlying assumptions of entrepreneurial action and describe seven of these actions in each approach. Despite the important role of opportunity and its processes in EA, in the last decade, we have seen the emergence of a number of field-specific concepts and theories (Venkataraman et al., 2012). Logics, mechanisms, and strategies that entrepreneurs apply in the process of entrepreneurial action have taken a substantial share both in conceptual and empirical works in the field of EA (Sarasvathy, 2001; Baker and Nelson, 2005; Fisher, 2012). The outstanding role of uncertainty and the exploration of how entrepreneurs act under pure uncertainty is observable in our analysis of most cited articles (Fisher, 2012) and references (Knight, 1921; Sarasvathy, 2001). The Knightian framework of risk-uncertainty provides the environmental condition for entrepreneurial action (Townsend et al., 2018). The terms "*risk*" and "*uncertainty*" are among the most co-occurred terms in the cluster of "*context*." The other motor theme in the EA field examines the relationship between cognitive factors such as intention, orientation, self-efficacy, and entrepreneurial action. The cognitive approach tries to probe how entrepreneurs think and, subsequently, process information, make decisions, and choose among different paths in venture creation to answer why some people (and not others) take entrepreneurial action (Mitchell et al., 2002).

The interaction of entrepreneurs and her/his environment has been a main topic in the EA field according to co-occurrence analysis and thematic visualization. Research into institutions in EA remains relatively limited, even though advancement has been made in recent years. These explain why the "institution" theme is in the niche quadrant. As it appears, the paper "*Fools rush in?*" by Aldrich and Fiol (1994) is one of the most-cited references in EA literature. The impact of institutional arrangements on EA has recently attracted scholars' attention (Spedale & Watson, 2014; Watson, 2013). Beyond the one-sided study of the influence of institutions on EA (Mcmullen et al., 2008), some recently conducted studies explain the interaction between entrepreneurs and institutions under the general title of *context-agent nexus* (Sarason et al., 2006). We can argue that compared with the entrepreneur-opportunity nexus as the basic theme, we are shifting towards a new research stream emphasizing the interrelation between context dynamism and EA relying on paradigms such as social construction borrowed especially from sociology (Downing, 2005). Even beyond this, some recent studies have explored the influence of entrepreneurs on institutions by introducing the new concept of "*institutional entrepreneurship*" (see, for example, Alvarez et al., 2015; Canales, 2016; Goel & Karri, 2020).

The "institutions" theme has two more insights. First, recent research on EA has shifted toward how policy reinforces or hinders entrepreneurial action. Specifically, studies explore the impact of educational policies on entrepreneurial action, while previous research examined the relationship between education and subjective factors such as intention (Nabi et al., 2017). Therefore, the effect of education on long-term behaviors such as venture creation has become an emerging theme in the EA field. Second, some scholars study entrepreneurial action in the under-explored context of developing, emerging, and transition countries (see, for example, Wang, 2016; Shirokova et al., 2020). The unique context of these countries could lead to more profound and insightful theories of EA.

Overall, our bibliometric analysis tried to illuminate the literature evolution of the EA field and highlight insights that may guide future research toward under-examined themes and subjects. From our analysis, it appears that EA is a rather changeable field of research, closely linked to research fields such as "entrepreneurial opportunity." Over time, the field has become more formalized with its own knowledge, research specialties, and an increasing number of "insider works." During the last two decades, we have seen the emergence of a number of new field-specific concepts and theories. We argue that to successfully develop EA research in the future, we need to relate new research opportunities to earlier knowledge within the field.

Implications for researchers

Crucially, the bibliometric approaches applied in our study allow us to uncover the relational nature of knowledge creation in the field of EA. An in-built characteristic of EA

research is its multidimensionality nature, spanning across various boundaries. Therefore, it does not come as a surprise that the research field is somewhat heterogeneous, with multiple subfields emerging, each with different characteristics and trajectories. In line with our argument above, a stronger "knowledge-based" focus can be achieved by borrowing concepts and theories from other research fields (Alvarez & Barney, 2007). This has mainly involved the fields of entrepreneurial opportunity. In borrowing theories and concepts from other research streams, one need to understand the foundations and assumptions on which these theories are based. However, our study demonstrates that, over time, the number of influential "insider" works has increased, and the clusters of research in EA have come closer to each other. Over recent years, we have seen several attempts in this direction, for example, with the emergence of concepts such as "effectuation" (Sarasvathy, 2001) and bricolage (Baker and Nelson, 2005).

Despite the fact that EA has borrowed theories from other fields, it has remained surprisingly disconnected from the neighboring field of sociology and institutional economics. The literature of EA is dominated by the dualism of risk-uncertainty that led to overlook the social and institutional context that entrepreneurial action occurs (Watson, 2013). According to performance analysis and science mapping, research on opportunity recognition and exploitation processes has become heavily researched. Both the logics and mechanisms of action under different circumstances continue to represent the key theories and concepts in the field. However, environmental factors affecting EA such as institutions (i.e., exploring the contribution of institutions to EA) and the interactive influence of context and an entrepreneur through entrepreneurial action remain particularly sparse.

A wealth of trends and patterns have emerged from our systematic analysis of EA publications. Building on the organizing framework of EA research presented in Fig. 5, an encouraging finding is that pockets of research can be identified to populate each domain of the framework. At the same time, it becomes clear that even though some areas have become heavily researched, a number of blind spots remain. Both opportunity and strategy continue to represent the basic themes in the field (Alvarez & Barney, 2007; Jack and Anderson, 2002). In contrast, research into policy initiatives remains relatively limited, even though progress has been made in more recent years. At the same time, another overarching impression is that research into the institutional dimension of entrepreneurial action remains more embryonic within and more mature outside of the EA literature (Bylund & McCaffrey, 2017; Watson, 2013). To sum up, the EA field call for more contextualized and institutionalized approaches to understand entrepreneurs' action (Bylund & McCaffrey, 2017; Watson, 2013). According to the strategic diagram, more promising themes for research could be found in the motor themes. Motor themes such as uncertainty and self-efficacy with high degrees of density and centrality include hot topics with well-developed literature and relationships with other themes that can be vivid, secure, and promising choices for research.

Implications for practitioners

One of the main questions in the field of entrepreneurship research is "how potential entrepreneurs act" (McMullen & Shepherd, 2006). Entrepreneurial action by providing a "practical and realistic reference framework" has led to a better balance between attention to individual actors and organizational, social, and institutional contexts (Watson, 2013). Research on EA has increased our understanding of the causes, processes, mechanisms, circumstances, and outcomes of action that, in turn, could lead to more insights for educators, policymakers, and even entrepreneurs. The present article provides a comprehensive map of EA knowledge and enables us to utilize the research in a more relevant way. Also, the results of the study introduce opportunity recognition and exploitation processes—discovery and creation—as a main research subfield. Educators should pay attention to a wide variety of logics, strategies, and mechanism entrepreneurial actions in different contexts as their effectiveness is different (Alvarez & Barney, 2007). The study of the decision-making and selection process of entrepreneurs led to the recognition of a set of heuristics and logics, strategies, and procedures that entrepreneurs are equipped within the path of business creation and development (Sarasvathy, 2001; Baker et al., 2003). Effectuation theory explores how entrepreneurs create and exploit opportunities under conditions of uncertainty (Galkina et al., 2022). As a decision-making logic, effectuation theory leads us to rethink how we would be able to teach entrepreneurship going beyond (broadly applicable) causation-based tools (e.g., business plan) and approaches (e.g., strategic planning) (Perry, Chandler, and Markova, 2012; Galkina et al., 2022). Since entrepreneurs are faced with a range of unknown problems in which logics, decision-making rules, and actions work differently in each (Packard et al., 2017; Townsend et al., 2018), what is important in the study of EA is the perception of the entrepreneur because entrepreneurs decide and act not based on the actual context out there but based on their perception of the environment (Shaver, 2012).

Limitations

Although bibliometric analysis is an effective method for sketching the evolution of a given field, our study is not without limitations. First, databases such as WoS and Scopus were not designed exclusively for bibliometric analysis; thus, data cleaning was required. We eliminated errors by

reviewing abstracts based on specific criteria and removed unrelated articles. However, there could be articles that should have been included but were not or should have been removed but did not. In the same vein, various exclusion and inclusion criteria may influence the collection of papers in a way that affects and changes the analysis. Second, the bibliometric analysis is quantitative, and extracting qualitative inferences is challenging. The authors tried to describe the data and commit to bibliometrics analysis. Third, our research is limited to the most influential journals in entrepreneurship and management, assuming they publish high-quality articles and shape the field. Nevertheless, due to the challenges of publishing in these journals, other articles, especially by less well-known scholars from less-contributing regions, could be included in future bibliometric analyses. Finally, we should note that the bibliometric results are restricted to time and changes due to the development of the field.

Availability of data and material The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

Code availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions The authors confirm contribution to the paper as follows: AA have made a substantial contribution to the conception and design of the research; NS drafted the article and revised it critically for important intellectual content; ZA reviewed the results and approved the final version of the manuscript; AK is responsible for the acquisition, analysis, and interpretation of data for the article.

Declarations

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

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