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Methodological Choices in Innovation Ecosystem Research: A Literature Review

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METHODOLOGICAL CHOICES IN INNOVATION ECOSYSTEM RESEARCH: A LITERATURE REVIEW

1. INTRODUCTION

The attractiveness of innovation ecosystem studies has increased in the past few years (Gomes et al., 2018; Granstrand & Holgersson, 2020; Hakala et al., 2019; Ritala & Almpanopoulou, 2017), showing that it has become a trending theme in the management area (Oh et al., 2016; Ritala et al., 2013; Su et al., 2018). Through innovation ecosystems, firms can create additional value and deliver multiple solutions that are only achievable because they are part of an interdependent network (Autio & Thomas, 2014; Adner & Kapoor, 2010). Innovation ecosystem can be defined as "the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors" (Granstrand & Holgersson, 2020, p. 1). Due to innovation ecosystems growing relevance, several literature review articles recently emerged to explore the topics, characteristics, and directions of the field (Bassis & Armelini, 2018; Foguesatto et al., 2021; Gomes et al., 2018; Gomes et al., 2021; Hakala et al., 2019).

However, these literature reviews mainly focused on the content of innovation ecosystem studies and leave aside the methodological procedures that were applied. In line with Aguinis et al. (2020), we believe it is essential to analyze and evaluate the methods used in innovation ecosystems studies towards advancing and deepening the knowledge of the field. Efforts like this have already been made in other research fields in management (Aguinis et al., 2020), such as in the automotive industry (Sabbagh et al., 2017), lean manufacturing (Jasti & Kodali, 2014), marketing (Osobajo & Moore, 2017), sustainability (Lee et al., 2016) and tourism (Khoo-Lattimore et al., 2019). Nonetheless, to our knowledge, there is a lack of research analyzing methodological advances in the innovation ecosystem field.

The methodological choice, procedures, techniques, and rigor criteria adopted in empirical investigation are directly responsible for the quality of theorizing movements in any field of knowledge. By analyzing how a field of study has evolved methodologically, we can identify improvement points and recommend best practices for advancing empirical research (Aguinis et al., 2020). Methodological innovations have gained more space in academia. New methods, procedures, techniques, tools, and critical reflections on research practice have been pointed out for qualitative, quantitative, and mixed research approaches (*e.g.*, Aguinis et al., 2018; Bansal et al., 2018; Crawford et al., 2021; Hair & Fávero, 2019; Lindgreen et al., 2021; Nascimento & Steinbruch, 2019; Parente & Federo, 2019; Teodorovicz et al., 2019). Therefore, the analysis of methodological paths and trends in innovation ecosystem studies can support scholars in better positioning their research projects and even in the theoretical development process, *i.e.*, theory building and verification.

To fill this gap, we propose a systematic literature review based on 57 empirical articles focused on the methodological procedures used by innovation ecosystem studies. Our goal is to explore the research methods applied in the most relevant articles of the field and understand methodological choices and future trends. Our methodological literature review provides descriptive and critical discussions (Aguinis et al., 2020). The descriptive results show that most studies are based on a qualitative approach, cross-sectional analysis, and are carried out through case study design. The critical analysis revealed that the studies lack methodological detailing, generating doubts about the rigor and quality of the research. We then propose directions for the empirical advancement of the field. More precisely, we draw the attention of innovation ecosystem researchers to a paradigm shift in the theorizing process: from theory verification to theory building.

2. METHODOLOGICAL PROCEDURES

To analyze the method choices and advances in the innovation ecosystem field, we performed a methodological review of the empirical literature. Methodological literature reviews are studies that "formally or informally review the existing literature regarding practices about methodological issues, summarize the literature, and provide recommendations for improved practice" (Aguinis et al., 2020, p. 2). This type of systematic review makes it possible to analyze trust and transparency criteria applied in research methods (Aguinis et al., 2018; Aguinis et al., 2020). Specifically, a methodological literature review has three main contributions: (i) it allows researchers to improve their methodological knowledge (Wright, 2016); (ii) it helps to find out dubious research practices (Butler et al., 2017); and (iii) it identifies knowledge gaps and research opportunities (Kunisch et al., 2018). To ensure the quality of the investigation, we based our study on the guidelines and considerations of Aguinis et al. (2020) for methodological reviews, Parmigiani and King (2019) for systematic reviews of any nature, and Post et al. (2020) for systematic reviews-based theoretical advancements.

2.1 Search and article selection criteria

We used two widely accepted databases for the search and selection of articles: Scopus and Web of Science. The search was done on March 8th, 2021, and we used a few criteria: (i) documents containing "innovation ecosystem" or "innovative ecosystem" in the article's title, abstract, and keywords; (ii) "journal articles" as the document type; (iii) articles written in English; (iv) the areas "Business, Management and Accounting" in Scopus database and the areas "Business" and "Management" in Web of Science database (there was no option to select "Accounting"). The review period was from 2006 (the year of the first published article on the innovation ecosystem in the management area) until the end of 2020 (complete year) – a time horizon of 13 years. We reached 292 articles in Scopus and 187 in Web of Science.

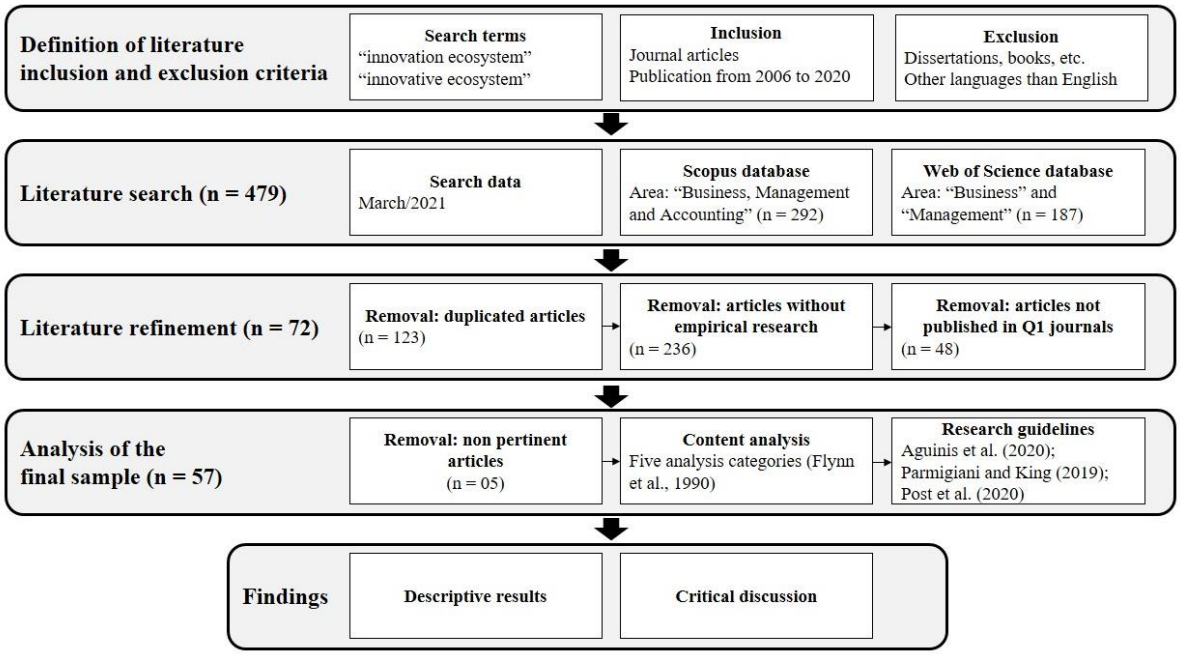
We then compared the articles from the two databases and excluded the repeated ones, resulting in 356 articles. We read the abstracts to identify and select empirical articles. In cases where there was no clear indication of empirical research in the abstracts, it was necessary to analyze the articles to identify whether they had a methods section. Empirical research is based on real world observation or experiments (Flynn et al., 1990), so it is adopted in field-based research using data. In this study, we have considered empirical articles the ones that contained data collection and analysis. After this first analysis, we found 120 empirical articles. We then filtered only the articles published in journals classified as Q1 at Scimago Journal Rank (SJR 2020), *i.e.,* journals classified in the first quartile and known as the most prestigious ones in the area. This filter resulted in 72 articles. We read the articles and identified a few ones that should be excluded from the sample because they (i) did not have innovation ecosystem at the core of the investigation, or they (ii) indicated empirical analysis in the abstract, but did not have a method section to be evaluated – such as articles for practitioners. Thus, our final sample consisted of 57 articles published in 26 journals. The research protocol is presented in Figure 1.

2.2 Data analysis

We performed the analysis through the content analysis method. We adopted the classification scheme of empirical research by Flynn et al. (1990). In the first stage, articles were divided according to the purpose of the study: theory building or theory verification. The second stage consisted of the research design classification, while the third stage contained the data collection method/technique. The fourth stage is dedicated to the implementation. Stage five focuses on the type of data analysis. These stages compose the analysis categories used in this methodological literature review. Next, we created an Excel spreadsheet to analyze the categories in the 57 articles. In order to avoid bias and solve doubts, more than two researchers

conducted the analysis of this study. The triangulation of researchers included specialists in both qualitative and quantitative research. This methodological literature review focuses primarily on a descriptive analysis, and second on a critical analysis (Aguinis et al., 2020). Therefore, the content analysis based on Flynn et al. (1990) allowed us to describe the main methodological choices in innovation ecosystem studies and, additionally, to criticize some methodological inconsistencies and absences that prevented us from appreciating the theorizing process of some articles.

Figure 1. Methodological literature review protocol



3. RESULTS: ANALYZING METHODOLOGICAL CHOICES OF INNOVATION ECOSYSTEM STUDIES

Innovation ecosystem is a relatively recent field, considering that the first articles about the topic were published in 2006 by *Harvard Business Review* (Adner, 2006) and *Industry and Higer Education* (Smith, 2006). These studies focus mostly on concepts, guidelines and suggestions related to innovation ecosystems. Later on, the first empirical article was published only in 2009 by *R&D Management* journal (Rohrbeck, Hölzle & Gemünden, 2009).

While the majority of the journals have one or two publications on innovation ecosystems, *Technological Forecasting and Social Change* has 14 publications, which represents 24,5% of the analyzed sample. This is not a surprise since this journal predominantly focuses on publishing trending topics about innovation in general. Every article in this sample was published in Q1 Journals (SJR 2020), which means they have a high significance in the area, even though three journals do not have a Journal Citation Report (JCR) index (*Electricity Journal, International Journal of Innovation Science* and *Thunderbird International Business Review*). This index is a resource for impact factor data, providing journals with impact factors and rankings. The journal of this sample with the highest JCR is the *Journal of Strategic Information Systems* (14.682), followed by *California Management Review* (11.678) and *Technovation* (11.373). In Table 1, we listed the JCR impact factor of the journals in which the articles were published.

Table 1. JCR classification

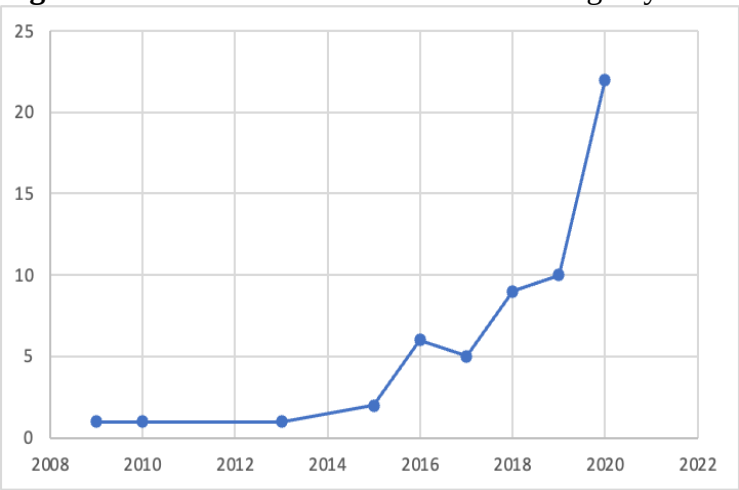
Journal	JCR 2021*

Journal of Strategic Information Systems	14.682
California Management Review	11.678
Technovation	11.373
International Journal of Production Economics	11.251
Journal of Cleaner Production	11.072
Journal of Business Research	10.969
Technological Forecasting and Social Change	10.884
IEEE Transactions on Engineering Management	8.702
International Business Review	8.047
Long Range Planning	7.825
Strategic Management Journal	7.815
Small Business Economics	7.096
Business & Society	6.740
International Journal of Entrepreneurial Behaviour & Research	5.995
R&D Management	5.962
Journal of Technology Transfer	5.337
Journal of Engineering and Technology Management	4.489
Engineering, Construction and Architectural Management	3.850
Industry and Innovation	3.819
Creativity and Innovation Management	3.644
Innovation: Organization & Management	2.453
Science and Public Policy	2.087
International Journal of Technology Management	1.526
Thunderbird International Business Review	NA
International Journal of Innovation Science	NA
Electricity Journal	NA

*Note. The impact factor of JCR 2021 was released in June 2022.

It is possible to observe, especially during the last five years, that it has been a growth in the number of empirical research on innovation ecosystem. To illustrate, the publications of 2020 represent almost 40% of our sample, as shown in Figure 2. In relation to the articles' citations, we verified on Google Scholar the number of citations of each article on June 8th, 2022. The most cited study (Adner & Kapoor, 2010) has 2.853 citations, published by *Strategic Management Journal*. The following most cited article (Rohrbeck et al., 2009) has 575 citations, and it was published by *R&D Management*.

Figure 2. Distribution of the articles according to year of publication



We believe that innovation ecosystem is not only an emerging field, but also an emerging theme within empirical research, since the innovation ecosystem concepts and foundations were explored mostly in the first years of its emergence. Therefore, this suggests that the topic is still ascending, giving space for practical studies involving data gathering.

The next subsections are divided according to the five stages developed by Flynn et al. (1990), in which the sample is analyzed.

3.1 Purpose of the study – theoretical foundation

The theoretical foundation and empirical research has basically two objectives: to build or to verify a theory through data. On one hand, theory building articles can use already existing theories to develop new concepts and theoretical streams or start a theorizing movement from scratch. These articles focus on the constructs, how and why they connect, to whom they apply and when they can be pertinent (Dubin, 1978). On the other hand, theory verification aims to verify existing theory through tests and hypotheses in certain contexts (Flynn et al., 1990). The verification process validates and refutes previous theories, shedding new light on phenomena, conditions, contexts, relations, and factors not considered by the original theory. Table 2 presents the number of articles dedicated to theory building and verification. We observe that 78,9% of the articles adopt theory verification, while only 21,1% aim to build theory on the innovation ecosystem. Most theory verification articles were published in the last years (2018-2020), evidencing a preference for studies that verify existing theories.

Table 2. Theoretical foundation of the articles

Foundation	2009	2010	2013	2015	2016	2017	2018	2019	2020	Total
Theory Verification	1	0	1	2	4	2	6	10	19	45
Theory Building	0	1	0	0	2	3	3	0	3	12
Total	1	1	1	2	6	5	9	10	22	57

3.2 Research design methods

Multiple designs are used to perform innovation ecosystem studies, according to the study objective and context. Since we used the classification of Flynn et al. (1990), research designs are divided into six types: (i) single case study; (ii) multiple case study; (iii) field experiment; (iv) panel study; (v) focus groups; and (vi) surveys. In this research, we also classify the articles as *combined*, meaning that the authors used two or more research design methods.

A single case study can be defined as an individual, a group, an organization, an event, a problem or an anomaly. This type of research investigates a real-life phenomenon in its environmental context, allowing a deep understanding of the research objective (Yin, 2014). In these studies, the contextual conditions are not controlled or designed (Ridder, 2017), and the case is not randomly chosen. On the contrary, the case is intentionally selected because it is of interest (Stake, 2005) or for theoretical reasons (Eisenhardt & Graebner, 2007). In multiple case studies, data is gathered from several processes, locations, and research areas (Flynn et al., 1990). A multiple case study method allows the replication between cases and findings corroboration (Eisenhardt, 1991). In multiple case research, "the ability to compare cases enhances the opportunity to theorize" (Ridder, 2017, p. 289). Field experiment takes place in natural setting, and because of its richness, it can be useful in theory building and verification studies (Flynn et al., 1990). In this type of method, the researcher manipulates a certain feature (an independent variable) of the natural circumstance and observes its resulting changes (Stone, 1978). Panel studies use expert's knowledge in order to achieve a conclusion, so it is assumed that the information acquired is more reliable. Focus groups, in its turn, is a physical gathering

of all the experts and their points of view. The communication dynamics amongst the participants are what will conduct to data results and conclusions (Flynn et al., 1990). Finally, a survey is a scientific tool that provides quantifiable and reproducible results (Dillman, 2000). It is used to collect information from a large number of respondents and make generalizations about the results (Groves et al., 2009). Table 3 shows the research design type and the number of articles for each.

Table 3. Research design

Research design	Number of articles	Percentage
Single case study	29	50,88%
Multiple case study	9	15,79%
Field experiment	1	1,75%
Panel study	6	10,53%
Focus Groups	0	0,00%
Survey	5	8,77%
Combined	7	12,28%
Total	57	100%

The most popular choice of innovation ecosystem studies is single case studies, representing 50,88% (29 articles) of the sample, followed by multiple case study, with 15,79% of the total (9 articles). In line with that, Gomes et al. (2018) state that the majority of the innovation ecosystems research are theoretical-conceptual and case studies. There was no research that used exclusively focus groups as their research design, appearing only in combined research design. Articles classified as *combined* used field experiment and panel study (Adner & Kapoor, 2010); single case study and focus group (Villani & Lechner, 2020); single case study, survey and focus groups (Benitez et al., 2020; Chen et al., 2020); multiple case study and survey (Xie & Wang, 2020; Radicic, Pugh & Douglas, 2020); multiple case study, survey and focus group (Oskam, Bossink & de Man, 2020).

Single case studies have gained more attention since 2017, increasing the number of articles that applied it and having a peak in 2020. Multiple case studies have been almost evenly distributed throughout the years, with its peak also in 2020. Articles that used combined research designs were published mainly in 2020, showing that it might be a methodological trend towards future innovation ecosystem studies. It is not possible to make inferences regarding other research designs applied, since they do not have a particular concentration of publications during the years. Table 4 presents the research designs used between 2009 and 2020.

Table 4. Research design throughout the years

Research design	2009	2010	2013	2015	2016	2017	2018	2019	2020
Single case study	1			1	1	4	8	4	10
Multiple case study			1	1		1	1	1	4
Field experiment					1				
Panel study					3			2	1
Focus Groups									
Survey					1			3	1
Combined		1							6

3.3 Methods for collecting data

Data collection methods/techniques can be used alone or combined to allow better analysis and results. For this study, we consider the following well-known methods: (i) historical archive analysis (H); (ii) participant observation (P); (iii) outside observation (O); (iv) interviews (I); and (v) questionnaires (Q) (Flynn et al., 1990). We also classify articles that

used combined methods, *i.e.*, more than one method for collecting data, such as interviews and questionnaires (IQ). Historical archive analysis is based on unobtrusive measures containing physical traces and archives (Bouchard, 1976). One of its main advantages is its impartial nature, which is usually aligned with other methods (Flynn et al., 1990). Observation allows researchers to identify behaviors and events that are not said explicitly. This technique aims to verify episodes that are interesting to the study's objectives (Godoy, 1995). In participant observation, the observer usually has to be part of the system, which is an appropriate method for developing propositions and new theories (Soni & Kodali, 2011).

On the other hand, outside observation implies a neutral observer systematically collecting data. It is frequently used for case studies and panel studies (Flynn et al., 1990). Interviews are one of the most important sources of data collection because they might suggest further understanding of specific events (Yin, 2014). In this technique, there is an interaction between the researcher and the respondents while taking their opinion. Lastly, the questionnaire is a very popular method of collecting data (Flynn et al., 1990). The distribution of data collection methods used by the articles analyzed here is shown in Table 5.

Table 5. Data collection methods

Data collection method	Number of articles	Percentage
Historical archive analysis (H)	11	19,30%
Historical archive analysis and interviews (HI)	20	35,09%
Historical archive analysis, outside observation, interviews (HOI)	6	10,53%
Historical archive analysis, participant observation, interviews (HPI)	3	5,26%
Interviews (I)	9	15,79%
Interviews and questionnaire (IQ)	3	5,26%
Outside observation, interviews, questionnaire (OIQ)	1	1,75%
Questionnaire (Q)	4	7,02%
Total	57	100,00%

From the previous table, we can infer that the most frequent data collection method used by innovation ecosystem studies is the combination of historical archive analysis and interviews (HI), representing 35,09% of the articles analyzed here. It allows us to infer that most research pursues the dual-source of information, including primary data (interviews) and secondary data (historical archive analysis). This helps to enhance the studies' credibility and rigor. Used alone, these same methods also stand out in the innovation ecosystem field, since 11 articles use only historical archive analysis (19,3%) and nine articles use only interviews (15,79%). Used alone, questionnaires were applied to only four studies, while participant observation and outside observation were only used in combination with other methods. This might reveal that the last two data collection methods are insufficient to ensure a complete data collection. Table 6 shows the frequency distribution of data collection methods in relation to research designs. It can be seen that, for single and multiple case study research of innovation ecosystem, the most suitable data collection method is the combination of historical archive analysis and interviews.

Table 6. Distribution of data collection methods in research designs

Research design	H	HI	HOI	HPI	I	IQ	OIQ	Q	Total
Single case study	3	12	3	2	8	1		1	29
Multiple case study	1	6	1	1	1			2	12
Field experiment		1							1
Panel study	6								6
Focus Groups									0
Survey	1				1	2		1	5
Combined		1	2				1		4
Total	11	20	6	3	10	3	1	4	57

3.4 Implementation

Overall, implementation phases may vary. Therefore, we used a general classification scheme for implementation steps, classified in the following classes: (1) Quantitative, qualitative, or mixed; (2) longitudinal/cross-sectional data; (3) country of the innovation ecosystem; (4) industry of the innovation ecosystem.

3.4.1 Quantitative, qualitative, or mixed approach

Qualitative research can be exploratory, descriptive, or explanatory, characterized by emphasizing the social construction of reality and by revealing how the theory works in particular situations (Eisenhardt & Graebner, 2007). Based on exploring ideas, the great part of qualitative studies advances theory by building it inductively (Bansal & Corley, 2012). In fact, there is a trend toward the adoption of abductive reasoning (simultaneous deduction and induction) in qualitative research (Gehman et al., 2018). On the other hand, quantitative studies involve deductive reasoning, *i.e.*, deduction (Sekaran & Bougie, 2010). It uses a variety of quantitative analysis techniques and usually focuses on describing, explaining and predicting phenomena (Cooper & Schindler, 2006). The mixed method is when the study applies both qualitative and quantitative approaches. Table 7 shows the frequency of use of quantitative, qualitative and mixed data used in innovation ecosystem studies. From this analysis, we perceive that qualitative data was preferred over quantitative data in this field of study until the year of 2020. This might happen mostly because the subject of the innovation ecosystem is still in its infancy and it makes sense that, at this stage, theoretical advances occur through qualitative research. Besides that, Table 8 shows that single case studies heavily use qualitative data in order to achieve their research goals.

Table 7. Quantitative, qualitative or mixed approach

Research approach	**Articles**	**Percentage**
Qualitative	35	61,40%
Quantitative	11	19,30%
Mixed	11	19,30%
Total	57	100,00%

Table 8. Research design x qualitative/quantitative/mixed methods

	Qualitative	**Quantitative**	**Mixed**	Total
Single case study	24	2	3	29
Multiple case study	8	0	1	9
Field experiment	0	0	1	1
Panel study	0	5	1	6
Focus Groups	0	0	0	0
Survey	0	4	1	5
Combined	3	0	4	7
Total	35	11	11	57

3.4.2 Longitudinal/Cross-sectional data

This classification describes the time horizon of the research. Longitudinal data represents the study of the same group over an extended period of time. Cross-sectional data, in its turn, is when data are collected at one particular period in time in order to represent a larger population. In general, longitudinal studies usually are more expensive and take more time than cross-sectional research (Rindfleisch et al., 2008). In Table 9, we show the number of articles corresponding to each category.

Table 9. Longitudinal and Cross-sectional data

Research horizon	Number of articles	Percentage
Cross-sectional	39	68,42%
Longitudinal	18	31,58%
Total	57	100%

Cross-sectional appeared to be the most appropriate option in this sample, with 68,42% of the total number of studies. Even though it only gives a snapshot of a certain time, it is less costly for researchers. It can be useful for a new theme of research (such as innovation ecosystem), because there is still not much information during the years to perform a complete longitudinal study about it. Longitudinal data were used in 31,58% of the articles. We believe it can be useful for topics that are more consolidated in the literature, since it tracks information over a longer period of time. It can be more accurate and detailed but also more expansive.

3.4.3 Country of the innovation ecosystem.

It is relevant to analyze the country in which data was collected because results may vary according to cultural, social, political, and economic differences. In addition, innovation ecosystems studies can present even more disparities between analyzed countries since they involve innovation and technology advances. For this analysis, if data were from two or more countries, we named it as *multiple*. The majority of studies (16 articles) did not choose a particular country to collect data, which represented 28,7% of the sample. Following that, China is the most popular for data collection in innovation ecosystems studies, representing 19,3% of the sample, with 11 articles. Brazil and the United States of America also contributed significantly, with 5 articles each, meaning 8,77% of the sample. These countries have been known for their efforts in developing and encouraging innovation ecosystems, so they might be an interesting and enriching target for data collection.

3.4.4 Industry of the innovation ecosystem

The industry of innovation ecosystem studies was also verified to check the existence of a trend. Table 10 shows the frequency of data collection in each industry. The technology industry is the favorite for innovation ecosystem studies. This is perfectly comprehensible since technology and innovation are closely related and sometimes one is inherent to another. Articles in the technology industry represent 43,86% of the sample, with 25 articles. The health industry was also often chosen (12,28%) for data collection in innovation ecosystem research. As particularities of this analysis, a considerable number of articles (9), representing 15,79%, did not specify the industry in which data was collected, and 3 articles (5,26%) had data collection from various industries, so they were classified as *multiple*.

Table 10. Industry of the innovation ecosystem

Industry	Number of articles	Percentage
Construction	1	1,75%
Education	2	3,51%
Energy	4	7,02%
Health	7	12,28%
Low tech	4	7,02%
Technology	25	43,86%
Telecommunication	1	1,75%
Transportation	1	1,75%
Multiple	3	5,26%
Not specified	9	15,79%
Total	57	100,00%

3.5 Data analysis method/technique

In empirical research, it is necessary to analyze data in order to make generalizations, validate an existing theory or develop new hypotheses and theoretical assumptions/propositions (Flynn et al., 1990). In this study, we divided this analysis in three sections: qualitative, quantitative and mixed. Since these approaches involve different analysis methods and techniques, we analyzed them separately, in order to identify possible trends. For quantitative analysis, we used the classification of Montoya-Weiss and Calantone (1994), while for qualitative analysis, we used the categorization of Carrera-Fernández, Guàrdia-Olmos & Peró-Cebollero (2014). Lastly, for mixed studies, we used the classification of both. Tables 11, 12 and 13 show the frequency of the use of empirical data analysis techniques on innovation ecosystem studies.

Table 11. Data analysis techniques in quantitative studies

Data analysis technique	Number of articles	Percentage
Descriptive statistics	2	3,51%
Statistical interpretation of parameters	2	3,51%
Descriptive statistics and Statistical interpretation of parameters	3	5,26%
Other	3	5,26%
Not informed	1	1,75%
Total	11	19,30%

Quantitative studies represent 19,30% of the sample. We observe that the majority of them use Descriptive statistics or Statistical interpretation of parameters, or even the combination of both. Only three articles used other methodological techniques not in the classification used for this study (*i.e.*, Network data envelopment analysis, Mapping techniques and Content Analysis), and one article did not inform the data analysis technique of the study.

Table 12. Data analysis techniques in qualitative studies

Data analysis technique	Number of articles	Percentage
Comparative analysis	1	1,75%
Content analysis	7	12,28%
Gioia methodology	1	1,75%
Grounded theory	6	10,53%
Hermeneutic analysis	1	1,75%
Narrative analysis	1	1,75%
Qualitative event history analysis and Narrative analysis	1	1,75%
Social network analysis	2	3,51%
not informed	15	26,32%
Total	35	61,40%

Qualitative studies represent the biggest part of this sample, with a percentage of 61,40%, showing that researchers have a tendency to use this method so far. However, it is surprising that 26,32% of the qualitative articles do not have information about data analysis techniques that were used. Besides this high percentage, the most frequently used data analysis technique in qualitative studies seems to be content analysis, with seven articles. The next preferred analysis method is grounded theory, with six articles.

Table 13. Data analysis techniques in mixed studies

Data analysis technique	Number of articles	Percentage
Descriptive statistics	2	3,51%

Descriptive statistics and Tests of differences/similarities	1	1,75%
Descriptive statistics and Statistical interpretation of parameters	1	1,75%
Qualitative Comparative Analysis (QCA) and Measures of dimensionalities	1	1,75%
Social network analysis	1	1,75%
Content analysis and Social Network analysis	1	1,75%
Content analysis	1	1,75%
Fuzzy-set qualitative comparative analysis (fsQCA)	2	3,51%
not informed	1	1,75%
Total	11	19,30%

In studies involving qualitative and quantitative methods, there are a variety of used techniques, so it is not possible to make any conclusions or identify trends. However, 3 studies use variations of the Qualitative Comparative Analysis (QCA). Instead of performing a qualitative and a quantitative step separately in the same study, the QCA method integrates both qualitative and quantitative aspects and factors.

4. DISCUSSION: ADVANCING INNOVATION ECOSYSTEM RESEARCH PRACTICE AND THEORY

Our methodological literature review identified a growing trend in the number of empirical articles on innovation ecosystems, mainly in the last three years. This is in line with previous studies that indicate the increasing theoretical and practical relevance of innovation ecosystems (Foguesatto et al., 2021; Gomes et al., 2018). This growth highlights the importance of research methods for the effectiveness of knowledge arising from data-based theorizing. Therefore, in addition to pointing out the main methods used, the results allowed us to carry out some critical reflections and point out methodological directions for future empirical research in the innovation ecosystem field.

Overall, the articles lack details in the methods section. For instance, some studies did not indicate the number of respondents interviewed, which actors were analyzed in the ecosystem (*e.g.*, company, government, university, society), and which quality criteria were adopted. More precisely, the data analysis description appeared to be the most incomplete and with missing information in the methods section. Some articles inform that data was analyzed, but they do not specify with which technique that was done. Others only inform that data was analyzed based on the information obtained crossed with the literature, but also do not classify the applied technique. Furthermore, some articles do not indicate the method of analysis adopted but describe the steps of the performed analysis. As a consequence, this requires more effort from the reader to decipher which method or technique of analysis was used, since different techniques can be performed even in a connected way. This lack of detailing is a critical point.

Methodological detailing is essential to ensure rigor in qualitative research (Fayard & Weeks, 2007; Mays & Pope, 2000; Nascimento & Steinbruch, 2019). We extend this understanding to quantitative studies as well. The detail exposes the choices, paths traced, difficulties and the way researchers overcome the research limitations, ensuring reliable results. If readers do not identify which method of analysis was adopted or even which methodological path was followed, they will hardly have subsidies to analyze the quality of the research (Nascimento & Steinbruch, 2019). Without such detailing, other researchers will not be able to replicate the study (Mays & Pope, 2000). It is a matter of transparency and trustworthiness. Indeed, to evaluate a theoretical proposal, we need to understand the methodological process of creating it (Fayard & Weeks, 2007, p. 612). To ensure the validity of theoretical development from empirical studies, researchers in the field of innovation ecosystems need to better detail

in the methods section all methodological choices and procedures performed. In doing so, it is possible to enhance the credibility of empirical research conducted in our scientific community.

In the theoretical development process, theory verification is preferable against theory building in innovation ecosystem empirical research. However, because this is an emerging field (Gu et al., 2021), theory building would be more coherent in predicting cause and effect relations in this development stage of the innovation ecosystem field. Empirical studies have focused on analyzing how previous theories, commonly derived from other fields, behave in the analysis of innovation ecosystems dynamics. Although this movement of theoretical validation/refutation is important, we also need to advance in the process of building new theories, if not a unified theory, based on the particularities, conditions, contexts, and limitations of innovation ecosystems. It is not a matter of disregarding previous theories. On the contrary: we can use previous theories as long as they help us to build original ones, which means they are born from and directed to multifaceted phenomena of innovation ecosystems.

Qualitative research by far represents the most popular methodological approach in the field. Qualitative research is commonly used in new areas or fields of knowledge (Cooper & Schindler, 2016), where the theorizing process is directly linked to exploration rather than generalizations. However, we believe that quantitative research is an opportunity for theoretical advancement of the field. The empirical studies carried out so far already give us subsidies to seek theoretical generalization through quantitative techniques. We also encourage the adoption of mixed approaches to boost theory development based on quantitative and qualitative settings. Integrative mixed methods such as QCA and Q-methodology (not identified in the sample analyzed) are good tools to boost the theorizing process.

Single case study is the prevalent research design in the articles of the sample. This is common given the emerging nature of the field, leading researchers to focus on a single ecosystem and thus explore the specificity of some phenomena. However, we must move towards other research designs, especially multiple case studies. The analysis of multi-cases enables the comparison of different social realities and contexts for generalization of the findings. The comparison of cases between countries (*e.g.*, developed and developing) can generate great advances for the field. Besides that, the majority of data was collected using historical archive analysis and interviews. To increase research credibility and to reach better results, we believe every study must use more than two data collection methods. Surprisingly, data collection through observation is under-explored in the field. As most articles adopt the analysis of case studies, and considering that this research design requires triangulation of data collection through interviews, documents and observation (Lindgreen et al., 2020), it becomes necessary to improve the quality of case studies in innovation ecosystem research.

Regarding the time horizon of the research, cross-sectional analysis is more adopted than longitudinal. However, the innovation ecosystem is a theme that needs more details and monitoring its evolution, so it would be interesting to perform more longitudinal studies. In addition, the discourse analysis method was not adopted in the sample. It is a method to be considered, given that the innovation ecosystem is made up of many actors (public, private, organized society, etc.), so multiple motivations and objectives may be behind the actions of these actors. Such aspects can be effectively captured through discourse analysis. As the motivation and focus of actors in the innovation ecosystem can change over time, discourse analysis through longitudinal studies is a fruitful methodological path for future studies.

The critical points and directions for methodological advances discussed in this study can be appreciated not only by researchers but also by journal editors and reviewers (Aguinis et al., 2020; Nascimento & Steinbruch, 2019). Therefore, the engagement of the scientific community (*i.e.*, those who do, evaluate, and read scientific research) in favor of the quality of empirical investigation can extend the frontiers of knowledge and the way of theorizing in the innovation ecosystem field.

5. CONCLUSION

This research is the first attempt to systematically analyze methodological procedures of the most relevant empirical studies of the innovation ecosystem literature. Results show there is a growing number of empirical studies over the innovation ecosystem in the last years. Most studies are based on a qualitative approach, cross-sectional analysis, and are carried out through case study design. Therefore, we indicate that empirical research on innovation ecosystems needs to advance through other methodological paths: quantitative and mixed research, longitudinal analysis, and comparison between cases from different countries. A weakness found in the studies is the lack of detail on the methodological choices and procedures adopted, especially in data analysis. We therefore call the attention of researchers in the field to improve the rigor of empirical research, mainly through methodological detailing that allows the replication of studies and demonstrates the clarity of the theorizing process. Lastly, the field is evolving based on verification of existing theories, requiring a paradigm shift towards building theories specific to the innovation ecosystem. Such directions for future empirical research can lead the field towards its advancement and maturity.

Although this methodological literature review has presented implications for the theory and scientific research practice in innovation ecosystems, some limitations appeared that can be addressed as opportunities for future studies. It can be done a comparative analysis of methods and theoretical development processes considering the two main approaches of the field: regional ecosystems and platform ecosystems. Further research could also analyze whether empirical research has advanced through deduction, induction or abduction reasoning. Additionally, it would be relevant to analyze which theories innovation ecosystem studies use (*e.g.*, institutional theory, actor-network theory, resource-based theory, dynamic capabilities, etc.), and trace whether new theories or theoretical approaches derived from these seminal theories are being proposed from the specifics of innovation ecosystems.

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