

A Landscape of Case-Based Research: Methodological Rigor in an Emerging Economy Context

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Abstract: In the evolving field of Production Engineering, the robustness of case-based research plays a crucial role in theory development and practical application. Recognizing this criticality, this paper delves into a systematic examination of methodological rigor in Production Engineering case research, scrutinizing a significant corpus of research to discern patterns and practices in methodological execution. This work seeks to shed light on the prevailing trends and identify potential avenues for strengthening the methodological foundations of case study research within the Production Engineering domain. The search was based on case studies from select publications in the Scielo database, a relevant Brazilian source that make available journal articles published in journals in various areas of knowledge. The analysis delineates a framework of four quality criteria – construct validity, internal and external validity, and reliability – to augment methodological rigour. The findings reveal a critical need for a more explicit engagement with these criteria in research design, data collection, and analysis. The research highlights strategies to fortify rigour and, by extension, the quality of case-based research, paving the way for more robust theoretical contributions in Production Engineering. This work in progress not only considers the recent landscape of case-based research but also provides actionable insights to refine future research methodologies, ultimately fostering a paradigm of excellence in qualitative research. The enhancement of methodological rigour in Production Engineering case-based research within the scientific community in a developing country is of paramount importance. As scholars strive to amplify their voices in the international arena, the meticulous application of robust research methodologies becomes critical. It serves not only to fortify the validity and reliability of findings but also to ensure the reproducibility of research. Enhancing methodological rigour aids in building a legacy of credibility and trust in the Brazilian scholarship that can contribute significantly to both regional and global advancements in Production Engineering.

Keywords: Case study, Research quality, Methodological rigour, Methodology, Production engineering, Validity

1. Introduction

In the realms of Production Engineering and Operations Management, the case study methodology is prevalent, and lauded for its effectiveness in theory generation and deepening understanding (Cauchick-Miguel, 2007; Voss, Tsikriktsis, and Frohlich, 2002; Zomer et al., 2022). Despite its growing popularity, the method's rigorous application remains contentious (Abreu et al., 2022), as there are studies that do not present a sampling logic, or do not describe the data analysis for extracting the results (Barratt, Choi and Li, 2011). Case studies, typically employed in the nascent phases of theory development, can have enduring impacts if methodological issues aren't addressed early on, as they set the stage for further exploration and validation of relationships between variables (Eisenhardt and Graebner, 2007). Thus, this method has merits over quantitative methods, as it provides important information for assessing the empirical generalizability of results (Tsang, 2014), making inductive case research consistent with the emphasis of theory (Eisenhardt and Graebner, 2007). Consequently, there is an ongoing discourse urging the enhancement of qualitative research rigor (Grodal, Anteby, and Holm, 2021; Harley and Cornelissen, 2022).

Past scholarship has often debated the optimal development of case studies, especially within Operations Management (Cauchick-Miguel, 2007; Cauchick-Miguel et al., 2023a; Voss et al., 2002), but clarity on how methodological rigour is consistently integrated into such studies is lacking. Moreover, the scrutiny of case study quality, particularly in the context of emerging economies, is notably absent, leaving a gap in the literature regarding the challenges faced in these environments (Goffin et al., 2019; Abreu et al., 2022).

One of the concerns of Production Engineering and Operations Management is the methodological approaches used in the development of scientific research, of which the case study is one of the most widely adopted (Cauchick-Miguel, 2007). Case studies have been one of the most powerful research methods in Operations Management, especially for developing new theories (Voss, Tsikriktsis and Frohlich, 2002; Zomer et al., 2022), stimulating understanding, and deepening theory (Cauchick-Miguel, 2007). However, although the

use of this method has been growing, there are limitations to its applicability due to issues related to methodological rigour (Goffin et al., 2019).

While flaws in any research methodology are problematic, the lack of rigour in case studies is particularly elusive (Gibbert, Ruigrok and Wicki, 2008). Case studies are usually used in the early stages of theory development when key variables and relationships are being explored. A problematic approach in these early stages would imply cascading effects in later stages when relationships between variables are elaborated and tested (Eisenhardt and Graebner, 2007). Thus, there have been calls to increase the rigour of qualitative research (Grodal, Anteby and Holm, 2021). Previous studies have focused on discussing how case studies should be developed (e.g. Cauchick-Miguel, 2007; Cauchick-Miguel et al., 2023a; Voss et al., 2002), with a special focus on Operations Management (e.g. Cauchick-Miguel et al., 2023a; Craighead & Meredith, 2008). However, it is still unclear how methodological rigour is being addressed in these articles, as well as what systematic trends may interfere with the rigour and quality of the case studies (Abreu *et al.*, 2022). In addition, no articles were identified that analyze the quality of case studies in emerging economies, highlighting their challenges. As such, this research method has been questioned more than other methods commonly used in Production Engineering and Operations Management, especially since case studies are more prone to questions regarding methodological rigour (Stuart *et al.*, 2002).

Given the above, this research aims to analyze the quality and methodological rigour of case studies in the field of Production Engineering, considering the context of an emerging economy. To this end, a literature review was conducted using a Brazilian database (SciELO). In this way, an overview is provided of the quality and methodological rigour being addressed in Production Engineering, setting a precedent for future research efforts in a relevant region of Latin America. This paper is structured as follows: section 2 briefly describes the adopted research methods to achieve the results presented in section 3 and discussed in section 4. Finally, section 5 draws some concluding remarks on this work in progress.

2. Research Methods

This research includes an analysis of case study papers published in the past two years in Brazil in the field of Production Engineering. Figure 1 illustrates the stages for conducting the literature review.

Figure 1 illustrates the selection process used to identify relevant articles from SciELO, an electronic repository of Brazilian scientific journals (SciELO, 1998). The initial criterion for selection was the presence of any of these keywords in the abstract: "case study," "case-based research," or "estudo de caso" (the latter in Portuguese). This preliminary search yielded a total of 5642 publications. The focus was on analyzing case studies within the field of Production Engineering, which led to a refined search within the database categories of Engineering and Social Sciences. The inclusion of Social Sciences was justified by the existence of management-related journals that intersect with Production Engineering, such as *RAUSP Management Journal*, and *Revista de Administração de Empresas*. Further narrowing the scope to publications from the last two years (2022 and 2023) and those issued in Brazil resulted in a more targeted set of 283 articles.

Finally, articles published only in journals related to Production Engineering were selected, such as *Production, Gestão & Produção*, among others (a full list of selected journals is shown in Figure 1). Fifty-four articles were filtered out at this stage. One article (Cauchick-Miguel, Sousa-Zomer and Tortorella, 2023) was excluded, as the authors conduct a literature review to analyze the quality of case studies, considering the area of operations management. Thus, this research selected 53 articles to be analyzed.

2.1 Publications Analysis

The articles were then coded, and it was analysed how case studies are being applied in Production Engineering. To analyse methodological rigour, the stages of planning and conducting case study research were considered, as illustrated in Figure 2. This work focused on the data analysis stage. In addition, the quality of the case studies was also analysed, considering the criteria proposed by Zomer et al. (2022), as in Table 1.

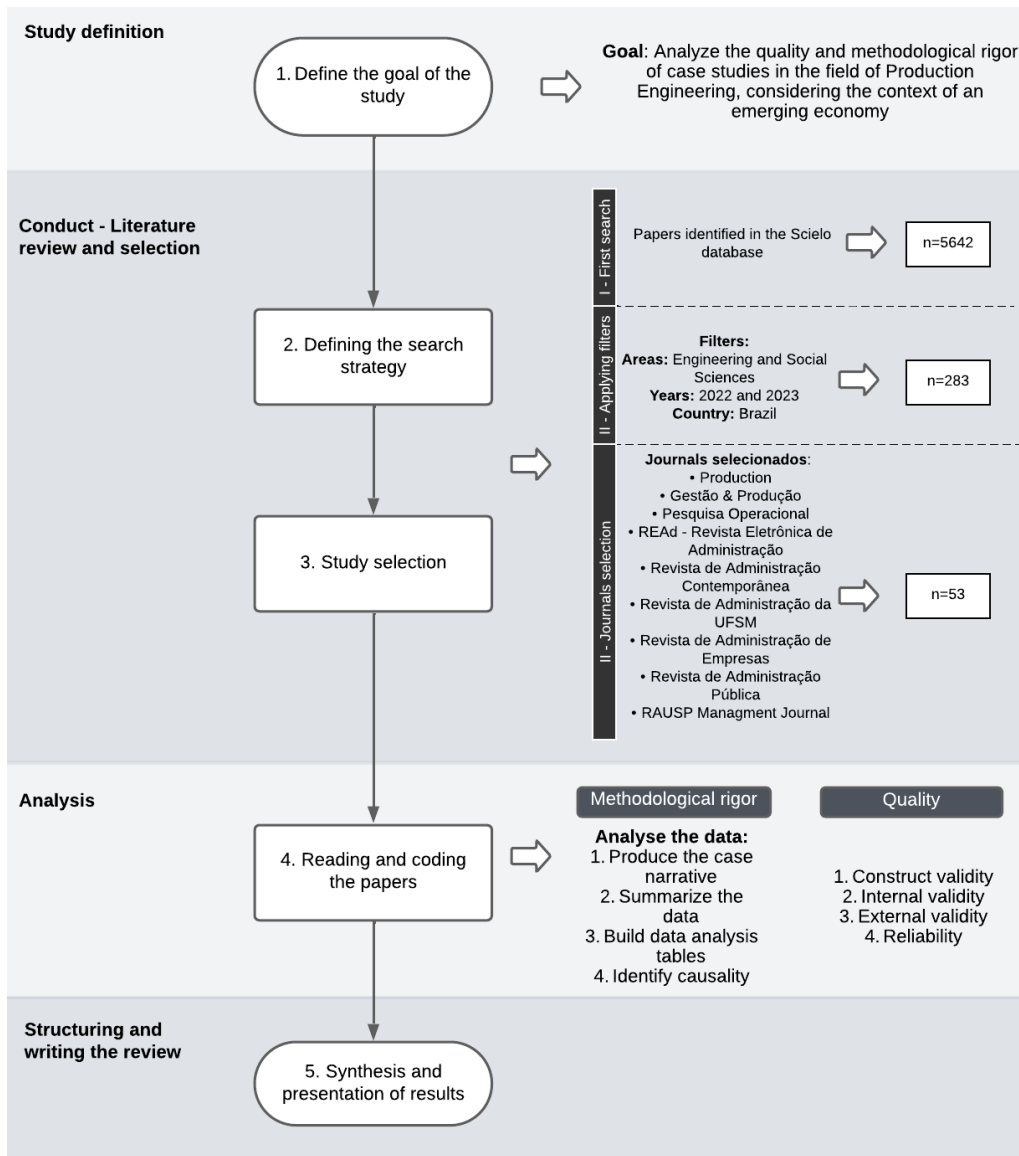


Figure 1: Literature review stages (adapted from Snyder, 2019)

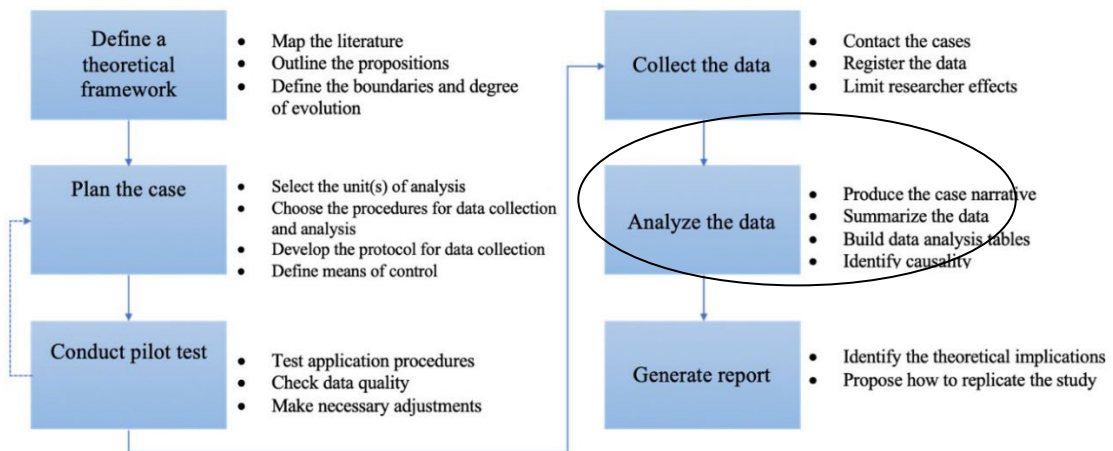


Figure 2: Stages for case-based research (Cauchick-Miguel, 2007; Cauchick-Miguel et al., 2023b)

Table 1: Quality criteria - case study (Zomer et al., 2022)

Quality criteria	Description	Analyzed points
Construct validity	It refers to the quality of the conceptualization or operationalization of a concept. Analyzes whether the study investigates what it claims to investigate	Clear chain of evidence - Does the article provide clear evidence that makes it possible to reconstruct how the researcher went from the initial research questions to the conclusions? Data triangulation - Does the paper take different angles to analyze the same phenomenon, use different data collection strategies and sources?
Internal validity	It refers to the causal relationships between variables and results. It analyzes whether the researcher provides a plausible causal argument and logical reasoning that is strong and convincing enough to defend the conclusions of the research	Research structure - Does the paper formulate a clear research structure that demonstrates that variable x leads to outcome y, and that y was not caused by a third variable? Pattern matching - Does the paper compare empirically observed patterns with predicted patterns or patterns established in previous studies and in different contexts? Theoretical triangulation - Does the paper address theoretical triangulation and verify the results by adopting multiple perspectives?
External validity	It is based on the fact that it must be demonstrated that theories serve to explain phenomena not only in the context in which they are studied, but also in other contexts	Cross-case analysis - Does the paper adopt multiple case studies (case studies from different organizations) or different case studies within one organization? Rationale for case study selection - Does the paper explain why the specific case study is appropriate based on the research question? Context of the case study - Does the article provide details about the context of the case study?
Reliability	It refers to the absence of random error, allowing other researchers to arrive at the same insights by following the methodological procedure adopted	Case study protocol - Does the article report on a research protocol? Case study database - Does the article provide evidence of a case study database with available documents, transcripts, archive data, etc.?

Finally, the results are presented next.

3. Findings

The results are firstly presented about the verification of the data analysis phase of the selected publications. Secondly, it is followed by the analysis of the quality of the papers and then discussion.

3.1 Verification of Data Analysis Phase

The data analysis stage includes four main steps: producing a narrative, reducing the data, building a panel, and identifying causality. As for producing the narrative and reducing the data, most of the papers analyzed carried out these steps. However, in articles where interviews are carried out, many papers comment that transcripts have been made, but these are not presented as a source of evidence (for example, in the Appendix section). In the case of coding interview data, some authors comment on this in the methods section, for instance by using Bardin (1977) - but coding is not presented in the results section. The data reduction stage must take place, but the data must be synthesized without failing to present the results and evidence of everything described in the methods section.

As for multiple case analysis, this is limited in the sample (13%). In addition, the articles that do carry it out fail to build a panel for each case, to cross-analyze the cases identified, analyzing convergence and divergence between the sources of evidence. The lack of this cross-checking affects the chain of evidence, limits generalization, generates a risk of confirmation bias, and makes conclusions fragile.

Finally, about causality, few articles present the results compared to the theory. This raises the need to answer the question: can the theory explain the phenomenon analyzed in different contexts? (Cauchick-Miguel, 2007).

This and the other limitations presented can significantly affect the quality of the papers. This gave rise to the need to analyze the quality of case studies in greater depth, which is presented in the following section.

3.2 Quality of the case studies

3.2.1 Construct validity

Figure 3 shows the analysis of the construct validity of the sample of papers analyzed.

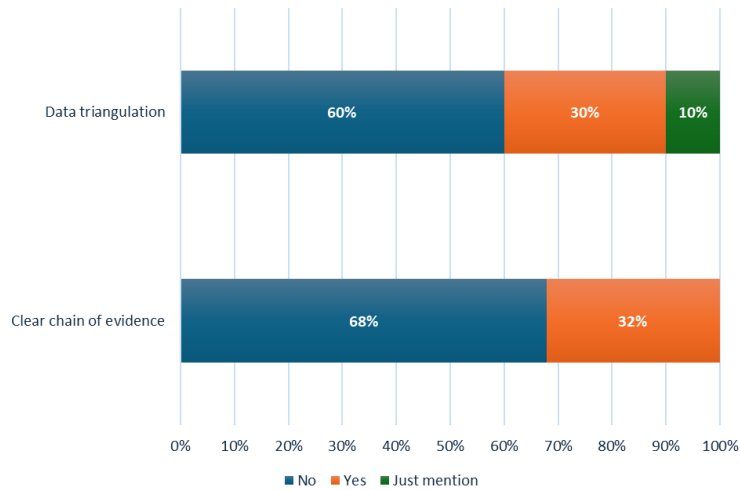


Figure 3: Construct validity

Triangulation is recommended as a good practice when conducting case studies and offers validity through the convergence of results, sources, or methods (Farquhar, Michels and Robson, 2020). However, a number of articles mention multiple sources of evidence and their triangulation, but do not describe how the sources were triangulated and what their purpose was. Furthermore, the lack of triangulation can lead to a distorted or limited understanding of the phenomenon studied, leaving gaps in the analysis and interpretation of the results. Some papers only carry out interviews (or comment on triangulation in the methods section, thus only discuss interview data in the results), which undermines the credibility of the information, as there is no proof of the veracity of the information reported by the interviewees.

Regarding clarity in the chain of evidence, it was observed that several publications do not provide details about the study protocol. In addition, 28% of the articles analyzed do not have a methods section, and the case study is only described in the results section. This information presentation results in a lack of context about how the data was obtained, a lack of transparency in the methods, and difficulty in replicating the research.

3.2.2 Internal validity

Figure 4 shows the analysis of the internal validity of the sample of papers analyzed. The figure shows that there is weak theoretical triangulation. This implies a possible difficulty in identifying biases or biased interpretations, weakening the robustness and reliability of the analysis. In addition, it can result in a limited understanding of the phenomenon studied, since by approaching the problem from only one theoretical perspective, there is a risk of missing important details and other interpretations of the results. The publications analyzed usually only discuss the main findings, and the evidence and theories that support these results are rarely presented.

As for pattern matching, the papers do not usually present empirical confirmation of the phenomenon analyzed, which may suggest that the patterns identified are not generalizable or consistent for different contexts. As for the research structure, the articles analyzed did not clearly explain how the research was conducted, which can lead to difficulties in interpreting and replicating the study.

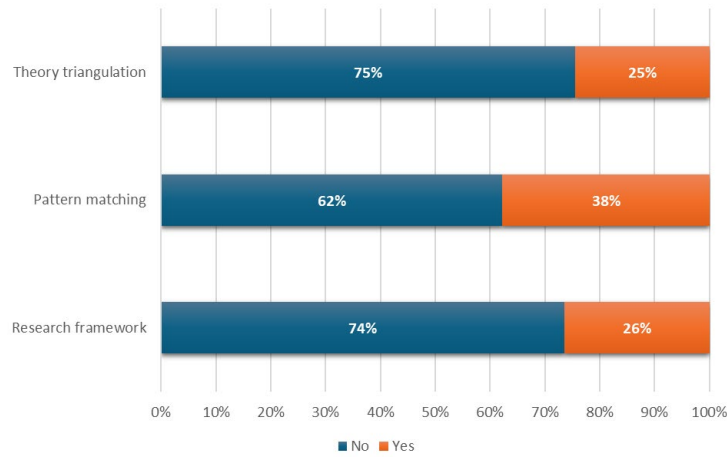


Figure 4: Internal validity

3.2.3 External validity

Figure 5 shows the analysis of the external validity of the sample of papers analyzed.

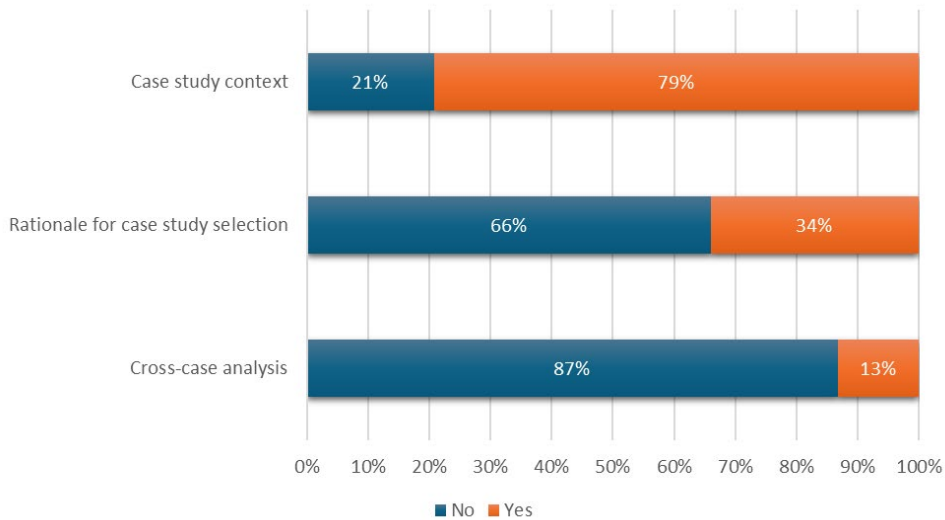


Figure 5: External validity

Most of the papers analyzed present the context to be analyzed, but don't explain why the case was selected. There are papers in which the study was conducted for the convenience of the researchers due to their links with the case being analyzed, because they work at the selected institution, which demonstrates a lack of methodological rigour. This lack of justification for the selection of cases can lead to selection bias, and the cases selected may not be representative of the phenomenon analyzed, compromising the external validity of the study's results.

In addition, only a small number of studies (13%) carry out cross-case analysis, i.e. analyzing multiple cases. Single case studies can provide important insights into a specific phenomenon but limit the applicability and relevance of the study's findings since comparing multiple cases allows trends, patterns, and variations in the phenomenon studied to be identified.

3.2.4 Reliability

Figure 6 shows the analysis of the reliability of the sample of papers analyzed.

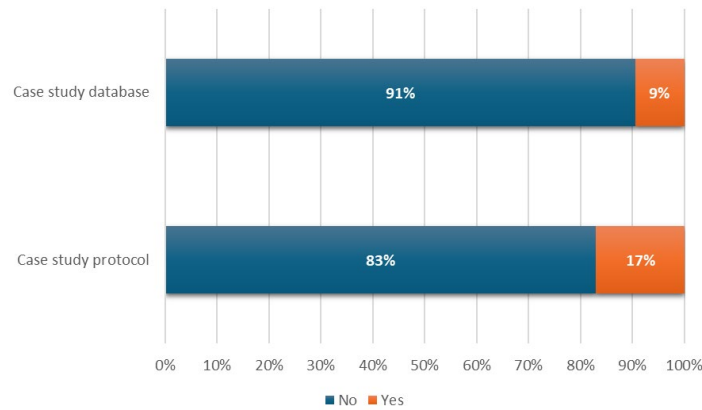


Figure 6: Reliability analysis

The Figure 6 reveals that most papers do not provide evidence of a case study database with available documents, transcripts, archive data, etc. To increase the credibility of the information presented, this data could be presented in the appendix section, which is done by few papers in the sample analyzed. This lack of evidence raises concerns about the integrity of the data used in the research, since there is no evidence to confirm the existence and quality of the database. In addition, most of the peers do not present a protocol for data collection, which may result in reviewers and readers having difficulty determining whether the methods used were rigorous and appropriate.

3.3 Discussion

The results revealed some difficulties in the development of case studies, which can compromise the quality of the research carried out. These include: (i) lack of data triangulation; (ii) lack of clarity regarding the methodological procedures; (iii) few papers used multiple sources of evidence, and many of those that did, focused on single case; and (iv) lack of interrelationship between the case and the literature. The fact that Brazil is an emerging economy can contribute to this context since domestic journals - although some of them in the Scielo database are indexed at Scopus - tend to have lower visibility and influence. Thus, researchers may prefer to publish their outlets in case studies in international journals, which can be a source of failure, since the rigour must be higher in overseas journals. These difficulties can result in lower quality publications nationally and the need for improvement to have publications abroad. In this context, Table 2 offers recommendations for conducting case-based research to enhance the quality of Brazilian publications.

Table 2: Recommendations for improving the quality of case-based research

Quality criteria		Recommendations
Construct validity	Clear chain of evidence	Describe in detail the methods used to collect data, including theoretical and empirical data sources, the collection instruments used, sampling procedures, and inclusion/exclusion criteria
		Critically analyze the results about the theoretical and practical context of the study
		Consider obtaining feedback from co-authors or external experts to ensure that the study narrative is understandable and convincing
	Data triangulation	Use a variety of approaches, such as interviews, documentary analysis, observations, literature review, questionnaires, among others
		Compare data from different periods and contexts, since phenomena can evolve or change over time or in different regions
		Check the consistency of the data, looking for convergences or divergences in the data

to be continued

Table 2: Recommendations for improving the quality of case-based research - continued.

Quality criteria		Recommendations
Internal validity	Research structure	Evidence of the protocol for data collection and analysis, to provide a clear chain of evidence
	Pattern matching	Review the literature to identify patterns and trends from previous studies related to your research topic
		Collect comparative data from other relevant research, contexts, or periods
		Interpret the results of the case study in the light of relevant theory and patterns identified in the literature
Theoretical triangulation	Compare the data collected with theories or models presented in the literature, analyzing them under different theoretical lenses	
External validity	Cross-case analysis	Include multiple cases to allow comparison and cross-analysis of data and identification of patterns, trends, and variations
		Compare cases over time to analyze how the phenomenon evolves over time
	Justification for selecting case studies	Provide a clear and relevant justification for the selection of cases and analysis methods, using robust criteria to justify their choice
	Context of the case study	Describe in detail the context of the case study, such as information about the environment, the participants, the culture, and the organizational context
Reliability	Case study protocol	Develop a case study protocol, describing the research objectives, data collection and analysis methods, case selection criteria, among others
		Present the case study protocol in an Appendix or a supplementary document to the paper
	Case study database	Describe the documents and the data set in detail. This data can be made available in the paper's Appendix

4. Conclusions

The results of this work present the limitations in case-based research adopted in Brazilian publications, which put the quality of the work at risk. By providing researchers with opportunities to increase the rigour of case-based research, this work contributes to the development of achieving greater practical relevance. In this way, this research complements previous ones by providing guidelines for increasing the methodological rigour of Production Engineering, in the light of an emerging economy, which presents specific challenges. However, this research has limitations, including the examination of only one Latin American context and the timeframe of the search. Thus, future studies could focus on extending this research to mitigate the barriers and difficulties faced in the country.

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