

REVISITING METHODOLOGICAL TAXONOMY: LOCATING DESIGN SCIENCE RESEARCH WITHIN RESEARCH DESIGN HIERARCHIES

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ABSTRACT

Design Science Research (DSR) is recognised as a leading paradigm in information systems, engineering disciplines, and construction management fields. Despite its wide use and application, confusion still exists regarding its methodological placement as a research strategy, approach, or methodology. Notably, some of the most widely accepted methodological frameworks, such as the "research onion" developed by Saunders, Lewis, and Thornhill, has not positioned DSR in their taxonomic framework. This paper fills this conceptual gap through a systematic literature review and thematic analysis of existing literature. A 40 number of peer-reviewed articles were examined to establish how DSR is labelled and conceptually justified in existing literature. The results of this synthesis suggest that DSR is positioned as a research strategy, as justified by its prescriptive epistemology, logic of DSR inquiry, and structuring of the entire research process. Based on this synthesis of existing knowledge, a modified version of the widely accepted "research onion" is presented with DSR positioned as part of the research strategy layer of this framework. This paper contributes to methodological clarity, informs doctoral design decisions, and refines existing knowledge in the theoretical debate on research methods.

Keywords: Design Science Research; Epistemology; Methodological Taxonomy; Research Onion; Research Strategy; Systematic Literature Review.

1. INTRODUCTION

DSR has emerged as the leading paradigm in the development of prescriptive knowledge in the realm of sciences that deal with artifact development, innovation, and problem-solving (Akoka et al., 2023). The intellectual antecedents of DSR can be traced to the concept of artificial sciences proposed by Simon (1969). Simon proposed that there are two types of science: (i) natural sciences, which explain the world, and (ii) design sciences, which develop useful, purposeful artifacts. Hevner et al. (2004), formalised DSR as a research paradigm in the context of information systems research and proposed a set of guidelines that deal with the integration of rigor and relevance in design science research through an iterative process of design and evaluation. Further elaboration of the

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design science research methodology, as proposed in the design science process model by Peffers (2006) and Vaishnavi (2007), has consolidated DSR as a research paradigm.

Yet, despite its maturity and application in information systems, engineering, management disciplines, and even in some built environment disciplines, a fundamental ambiguity exists regarding its methodological position (Holopainen et al., 2020). DSR is alternatively identified as a “research methodology” (Hevner et al., 2004), “research paradigm” (Gregor & Hevner, 2013), “design-oriented approach” (Johannesson & Perjons, 2021), and on some occasions as a “research strategy.” This is not simply a matter of terminology; it is a fundamental ambiguity regarding its position on the hierarchy of the research design architecture. This ambiguity is clearly highlighted when DSR is compared with existing methodological taxonomies. The “research onion” developed by Saunders et al. (2019) is arguably one of the most widely accepted taxonomies of structuring research design in management and construction research disciplines. The framework comprises different layers of research design, including research philosophy, research approach, research strategy, method choice, time horizon, and techniques. DSR is not mentioned in this framework. While strategies such as experiment, case study, survey, and action research are clearly defined, the absence of DSR raises a conceptual question: Does DSR operate at the level of research strategy, or does it belong at a different methodological layer?

This gap is theoretically significant for three reasons. Firstly, DSR establishes a unique logic of research that focuses on artifact development and evaluation (Hevner et al., 2004). Such a logic may be said to be closer to a research strategy that guides the overall direction of research rather than research method or research technique. Secondly, DSR establishes a clear epistemology (Estany, 2020). DSR research is often said to be associated with pragmatism and prescriptive theory building (Gregor & Hart, 2010). In methodology theory, research strategies are said to be informed by epistemology. If DSR establishes the foundation for valid knowledge creation, then its classification as a research method may not be conceptually sound. Thirdly, the lack of DSR in the dominant model of research methodology may create confusion in training doctoral research and research design in fields like construction management and digital innovation in the built environment (Rensburg & Goede, 2019). Such confusion may cause DSR to be considered as a research technique rather than its role in structuring research design. Although prior studies have refined DSR processes (Peffers, 2006), clarified its theoretical contributions (Gregor & Hevner, 2013), and debated its rigor, no study to date has systematically examined how DSR is positioned across the literature relative to established methodological taxonomies. In particular, there has been no systematic literature review combined with epistemological analysis aimed at determining whether DSR satisfies the defining criteria of a research strategy. Accordingly, this study addresses the following primary research question: ‘How should Design Science Research be positioned within established methodological taxonomies?’

To operationalise this inquiry, four sub-questions are examined:

How is DSR labelled across peer-reviewed literature (strategy, approach, methodology, or method)?

What conceptual arguments are used to justify these labels?

Does DSR satisfy the defining characteristics of a research strategy as articulated in methodological theory?

Where should DSR be located within an extended research onion framework?

By systematically mapping the positioning of DSR in the literature and evaluating its epistemological characteristics, this study seeks to provide conceptual clarification and to propose a theoretically justified extension to existing methodological taxonomies. In doing so, it contributes to methodological rigor and supports clearer research design decisions in construction and built environment scholarship.

2. THEORETICAL FOUNDATIONS

2.1 RESEARCH STRATEGY, RESEARCH APPROACH, AND RESEARCH METHOD

Research design literature commonly distinguishes between research philosophy, research approach, research strategy, and research methods (Abutabenjeh & Jaradat, 2018). These layers collectively determine how knowledge is generated and validated within a study. The philosophy of research comprises underlying beliefs about the nature of reality (ontology), the nature and limits of knowledge (epistemology), and the importance of values in research (axiology) (Assoreira, 2025). Research approaches describe the rules of reasoning (e.g., deductive, inductive, or abductive), research strategies provide the plan for conducting the study, and research methods represent the techniques used to collect and analyse data (Phillips, 2023). The hierarchical nature of research design has been widely illustrated through the research onion model developed by Mark Saunders and colleagues. The model conceptualises research design as a set of nested methodological layers that guide the development of systematic and coherent research processes. At its outer layers, the model addresses philosophical assumptions and research approaches, while the inner layers focus on research strategies, methodological choices, time horizons, and data collection techniques (Snyder, 2019). In this structure, research strategies represent the overarching methodological frameworks used to address research problems. Common strategies include experiments, case studies, surveys, grounded theory, and design-oriented research (Stoecker & Avila, 2021). Research methods, by contrast, represent the operational techniques used for data generation and analysis, including interviews, surveys, observations, modelling, or computational analysis. Despite the widespread adoption of the research onion framework, ambiguity remains regarding the positioning of design-oriented research within the hierarchy. DSR is frequently described interchangeably as a research paradigm, methodology, strategy, or method, leading to conceptual inconsistencies in research design reporting. Addressing this ambiguity requires examining the theoretical development of DSR and its methodological characteristics.

2.2 EVOLUTION OF DESIGN SCIENCE RESEARCH

The intellectual foundations of design-oriented research originate in the work of Simon (2019) who distinguished between natural sciences that explain phenomena and sciences of the artificial that focus on the creation of artefacts intended to solve practical problems. Simon's perspective introduced the notion that scientific inquiry could legitimately involve the systematic design and evaluation of artefacts. Building on this foundation, DSR was formalised as a methodological approach for developing and evaluating artefacts that address real-world problems (Johannesson & Perjons, 2021). The framework proposed by Hevner et al. (2004), articulated design science as a rigorous

research paradigm emphasising the creation of artefacts such as models, methods, constructs, and systems. Subsequent methodological developments further operationalised DSR. The design science process model introduced by Peffers (2006) structured DSR activities into sequential stages, including problem identification, objective definition, artefact design, demonstration, evaluation, and communication. In parallel, theoretical contributions from Shirley Gregor emphasised the role of design theory in linking artefact creation with knowledge production. Despite these contributions, the terminology used to describe DSR remains inconsistent. Studies alternately refer to DSR as a paradigm, methodology, strategy, or research method, which complicates its integration within established research design frameworks such as the research onion. This inconsistency motivates the need for a systematic examination of how DSR is positioned within the methodological hierarchy.

3. RESEARCH DESIGN AND METHODOLOGY

3.1 OVERALL RESEARCH DESIGN

This study adopts a qualitative research design to clarify the methodological positioning of Design Science Research. The research process integrates systematic literature review (SLR), thematic analysis, and philosophical reflection to develop a framework positioning DSR within the hierarchy of research methodology. The overall workflow consists of four sequential stages: systematic literature review, thematic coding of methodological definitions, philosophical reflection of the extracted concepts, and development of an extended research onion framework incorporating Design Science Research. Systematic review procedures follow established guidelines for evidence synthesis proposed by (Kitchenham, 2004; Tranfield, 2002).

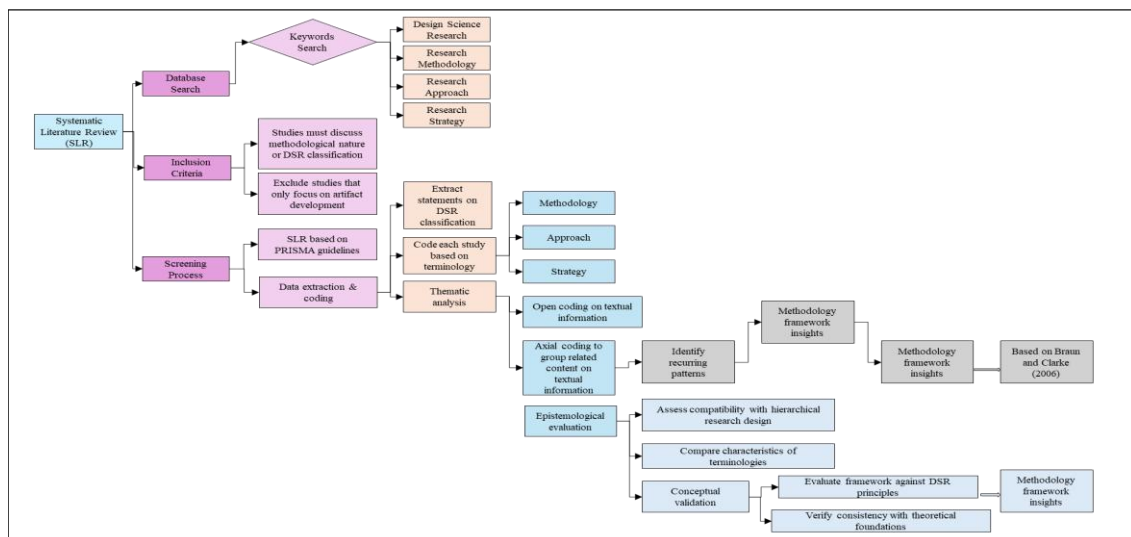


Figure 1: Research process

The approach to conducting this research was a SLR since it was not the aim of this research to empirically test anything, yet rather to perform conceptual synthesis (Tarhan et al., 2016). The SLR approach facilitates clear and structured extraction of concepts, classifications, and controversies in existing literature (Vilches et al., 2017). As the study is focused on understanding the place that DSR occupies in methodological taxonomies, the systematic review approach appeared to be appropriate.

3.2 CONCEPTUAL VALIDATION

To ensure conceptual coherence, the resulting framework was evaluated against established design science principles articulated by Shirley Gregor and Alan R. Hevner. This step verified that the proposed positioning of DSR remains consistent with the theoretical foundations of design science while aligning with established research design frameworks.

3.3 DESCRIPTIVE MAPPING

This study conducted a SLR to identify and classify scholarly discussions on DSR as a research methodology, strategy, or approach. The review used a structured search string: <Title ABS key> “Design Science Research” AND (methodology OR strategy OR approach OR paradigm), along with variations such as “Design Science Research methodology,” “Design Science Research approach,” and “Design Science Research strategy.” Searches were performed in Scopus and Web of Science, yielding 282 and 44 records, respectively. Only peer-reviewed journal articles and conference papers published in English were included. Following duplicate removal and screening of titles, abstracts, and full texts against inclusion criteria, the final dataset was prepared for analysis. The screening process is illustrated in a PRISMA diagram. This SLR provides a rigorous, transparent, and reproducible foundation for the subsequent thematic analysis and epistemological evaluation. The Scopus and Web of Science databases were chosen since they have been established as two of the most comprehensive and trustworthy multidisciplinary citation databases (Mongeon & Paul-Hus, 2016). They provide extensive access to peer-reviewed literature relevant to DSR and methodology.

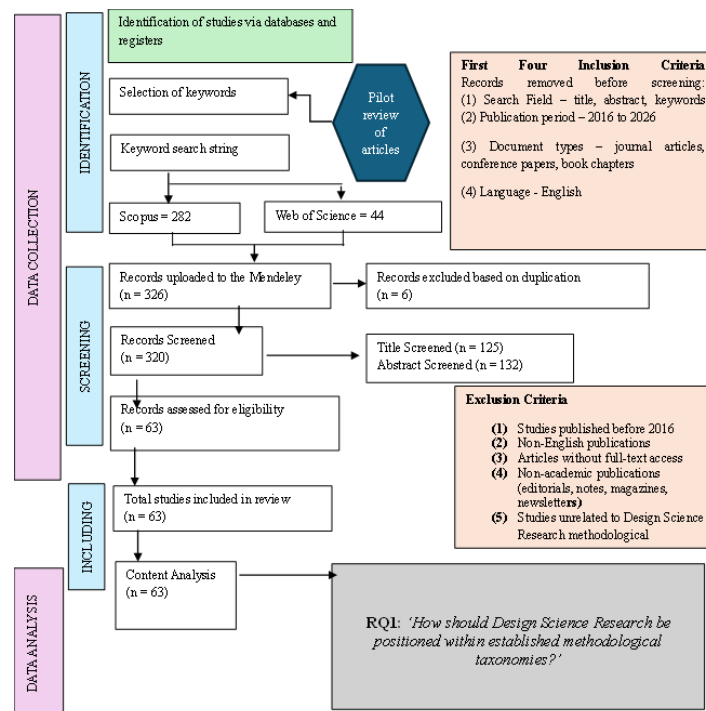


Figure 2: PRISMA Standard mapping for the SLR to identify the studies that are related to the search string, and the studies that lead to thematic findings and epistemological evaluation

3.3.1 Data Representation

The next step was to synthesise the results from the selected studies using a qualitative content analysis method (Briner & Denyer, 2012). This method is particularly relevant for analysis because it provides a systematic means for interpreting texts based on patterns, themes, or relationships that exist between them. The analysis was undertaken manually without the help of any computer program for qualitative data analysis. This was particularly relevant for ensuring a deeper level of analysis that could filter out any weaker conceptual or methodological work in favour of high-quality insights (Toyin et al., 2025). The studies selected for analysis were coded based on different dimensions, such as the research taxonomy for studies as a foundation, research methodology, research strategy, and research approach to understanding.

4. FINDINGS

The section presented the findings and analysis of SLR, thematic analysis, and the epistemological findings.

4.1 OVERVIEW OF THE INCLUDED STUDIES

The last set included studies consisting of peer-reviewed journal articles, review articles, conference publications, and book chapters published between 2002 and 2026, reflecting the increased interest in biomimicry-based building materials and innovation in sustainability in the built environment (Pedersen Zari & Hecht, 2020).

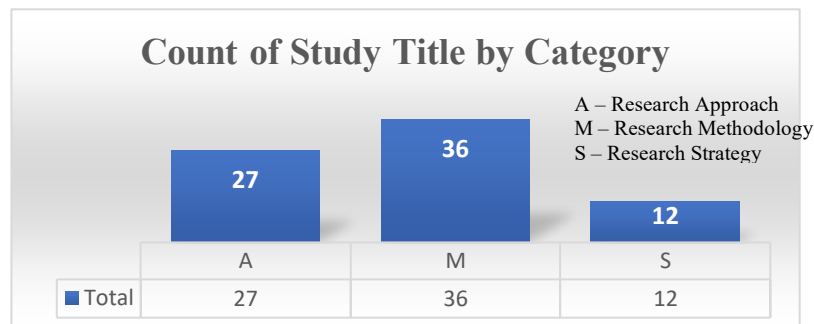


Figure 3: Studies by the term

Note: There is no exclusivity between the categories. Many studies used in the review made reference to DSR employing various categorizations such as methodology, approach, strategy, and paradigm. Thus, the total number is more than that of the reviewed studies.

The studies have been considered based on the term, as shown in Figure 3.

4.2 DOMINANT POSITIONING OF DSR AS A RESEARCH METHODOLOGY IN THE RESEARCH ONION

The systematic literature review reveals that the majority of studies conceptualise DSR as a research methodology. Out of the analysed studies, 36 publications position DSR as a methodological framework, highlighting its structured process for designing and evaluating artefacts. Foundational and subsequent studies emphasise that DSR provides systematic procedures for conducting design-oriented research, including artefact development, demonstration, and evaluation stages. For example, a study by Peffers et al. (2007), explicitly refers to DSR as a methodological framework guiding the research

process. Similarly, several studies emphasise the methodological rigor embedded in DSR through structured design cycles and evaluation mechanisms, considering the research onion. Researchers such as Goecks et al., (2021) and Tommelein (2020), highlight the systematic research procedures that characterise DSR. These studies collectively demonstrate that DSR provides a structured methodological pathway for developing and evaluating artefacts, which aligns with the defining characteristics of a research methodology at the point of Saunders' research onion. The predominance of methodological interpretations in the reviewed literature suggests that researchers widely recognise DSR as more than a general research orientation. Instead, it functions as a comprehensive methodological framework capable of guiding the entire research lifecycle, from problem identification to artefact evaluation and knowledge contribution.

4.3 DSR AS A DESIGN-ORIENTED PROBLEM-SOLVING METHODOLOGY

One of the primary reasons for the strong positioning of DSR as a research methodology is its explicit focus on problem-solving through artefact creation. Many studies highlight that DSR enables researchers to address complex organizational and technological problems by designing innovative solutions such as models, systems, frameworks, and methods. For instance, studies by such as Diaz Schery et al., (2025) illustrate how DSR is applied to develop practical artefacts that address real-world challenges. Similarly, research such as Tommelein (2020) demonstrates how DSR facilitates the development of technological solutions in industry contexts. These studies collectively emphasise that DSR provides a systematic methodological framework for generating practical solutions, reinforcing its positioning as a research methodology rather than merely a research approach or strategy.

4.4 STRUCTURED RESEARCH PROCESSES AND EVALUATION MECHANISMS

Another factor supporting the classification of DSR as a research methodology is its structured research process and evaluation mechanisms. Numerous studies emphasise that DSR incorporates clearly defined stages that guide the development and validation of artefacts. Researchers such as Aparicio et al. (2023), Gomera and Mramba (2023), and Muntean and Militaru (2022) highlight the importance of evaluation within the DSR process. These studies describe how artefacts developed through DSR must be rigorously assessed to ensure their effectiveness and relevance. Furthermore, studies such as *On Experiments in Design Science Research and Theory Development: A Literature Review* and *Design Science Research Evaluation* emphasise that the evaluation phase plays a critical role in validating the artefacts produced through the research process. The presence of these systematic evaluation mechanisms further reinforces the methodological nature of DSR. Overall, the findings of the systematic literature review indicate that Design Science Research demonstrates the strongest conceptual alignment with the characteristics of a research methodology for the research onion. While several studies frame DSR as a research approach and a smaller subset conceptualises it as a research strategy, the predominance of methodological interpretations suggests that DSR provides the most value when positioned as a structured research methodology. This conclusion is supported not only by the frequency of studies identifying DSR as a methodology, yet by the methodological characteristics consistently highlighted in the literature, including structured research stages, artefact development processes, and rigorous evaluation mechanisms.

4.5 THEMATIC ANALYSIS

The findings of this study were derived through a two-stage analytical process consisting of a SLR followed by thematic analysis. The SLR systematically identified and collected relevant scholarly publications on the methodological positioning of DSR. Through database searches, screening procedures, and eligibility assessment, studies that explicitly discussed the classification or conceptual role of DSR within research design were selected for further analysis. While the SLR provided a structured process for identifying the relevant body of literature, it did not by itself reveal how DSR is conceptually interpreted. To address this, the textual statements extracted from the selected studies were analysed thematically, following the procedures proposed by Braun and Clarke (2006, 2012). In this stage, statements describing the role, function, or classification of DSR were coded and grouped into conceptual categories. Open coding was first applied to identify key terms and descriptions used by authors. These codes were subsequently consolidated through axial coding to identify recurring patterns across the literature. Through this process, three dominant interpretations of DSR emerged from the analysed studies: DSR as a research methodology, DSR as a research strategy, and DSR as a research approach.

These themes represent the different ways in which researchers conceptualise the methodological nature of design-oriented inquiry. The first theme interprets DSR as a research methodology. In this interpretation, DSR is described as a structured methodological framework that guides the systematic design, development, and evaluation of artefacts. Studies adopting this perspective typically emphasise methodological principles and procedural guidance for conducting design-oriented research. Such interpretations frequently reference the design science guidelines proposed by Hevner et al. (2004), which outline principles for rigorous artefact creation and evaluation. The second theme conceptualises DSR as a research strategy. Within this interpretation, DSR functions as a structured plan that organises research activities around the iterative design and evaluation of artefacts intended to address practical problems. Authors adopting this perspective emphasise the role of DSR in structuring the research process rather than prescribing specific research techniques. This interpretation often reflects the process-oriented model proposed by Peffers et al. (2018), where DSR is presented as a sequence of research activities including problem identification, artefact design, demonstration, and evaluation. The third theme interprets DSR as a research approach. In this view, DSR is treated as a broader orientation toward knowledge generation that prioritizes constructive problem solving through artefact creation. This interpretation reflects the philosophical foundations of design-oriented inquiry originally articulated by Simon (2019), who distinguished between explanatory sciences and sciences concerned with the design of artificial artefacts. The identification of these three themes demonstrates that the literature does not consistently classify DSR within a single layer of research design. Instead, scholars emphasise different aspects of design-oriented research, leading to multiple interpretations of its methodological status.

5. PHILOSOPHICAL REFLECTION

To further examine the methodological positioning of DSR, an epistemological evaluation was conducted based on the classifications identified through the systematic literature review. While the SLR provided a descriptive mapping of how DSR is labelled across studies, the epistemological evaluation aims to interpret these classifications

within the broader hierarchy of research design. The SLR results indicate considerable variation in how DSR is positioned within the research design structure. As illustrated in Figure 4, the majority of studies (36) describe DSR as a research methodology, while a substantial number of studies (27) interpret it as a research approach. Only a limited number of studies positions DSR as a research strategy (12), while very few studies conceptualise DSR at higher epistemological levels, such as research philosophy (2) or research paradigm (2). These findings demonstrate that the literature predominantly emphasises the methodological and procedural characteristics of DSR, particularly its structured frameworks for artefact design and evaluation. At the same time, the presence of approach-level interpretations suggests that some scholars view DSR more broadly as a mode of inquiry oriented toward design-based knowledge generation. The epistemological evaluation, therefore, highlights the conceptual diversity in the methodological positioning of DSR within the literature, indicating that scholars interpret the role of DSR at multiple levels of the research design hierarchy.

There have been different interpretations of the epistemological foundations of DSR, particularly concerning the relationship between pragmatism and design science epistemology. Goldkuhl (2020), argues that pragmatism provides an important foundation for DSR, whereby knowledge is judged according to its practical consequences and usefulness in addressing real-world problems. In contrast, design science epistemology places greater emphasis on the purposeful creation and evaluation of artefacts to generate prescriptive knowledge. Thus, while pragmatism primarily focuses on the utility of knowledge, design science epistemology highlights the processes of design, intervention, and artefact evaluation as mechanisms for knowledge generation. Furthermore, Iivari (2015) distinguishes between theory-oriented and problem-solving-oriented forms of DSR, demonstrating that the nature of knowledge produced and the criteria used for its validation may vary depending on the objectives of the inquiry.

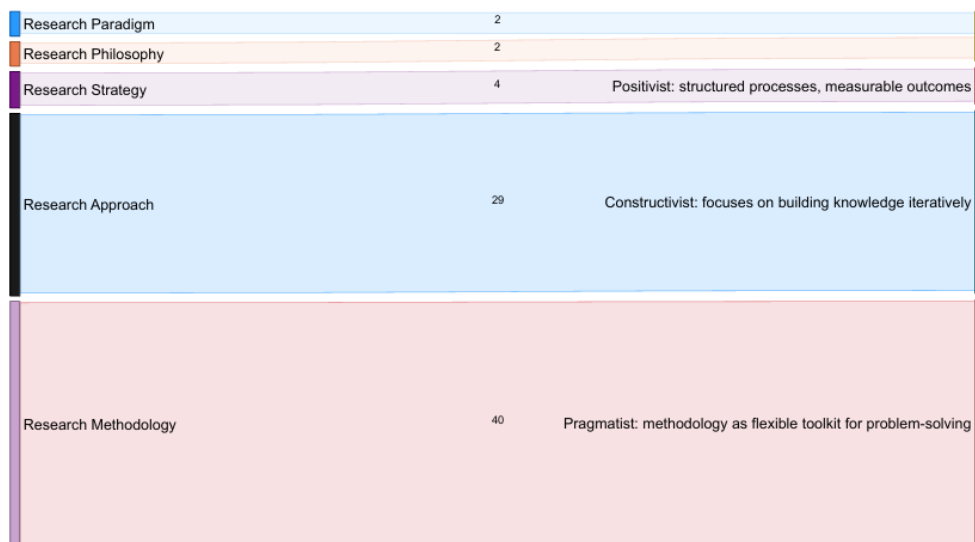


Figure 4: SLR findings directed towards Epistemological evaluation

Note: There is no exclusivity between the categories. Many studies used in the review referred to DSR employing various categorizations such as methodology, approach, strategy, and paradigm. Thus, the total number is more than that of the reviewed studies.

This plurality of epistemological assumptions suggests that DSR does not prescribe a single form of knowledge generation but rather provides a flexible framework through which knowledge can be created and evaluated. Consequently, these epistemological characteristics support the positioning of DSR as a methodological choice, as its underlying assumptions inform how artefacts are designed, evaluated, and used to produce scientifically rigorous and practically relevant knowledge.

6. POSITIONING DESIGN SCIENCE RESEARCH WITHIN THE EXTENDED RESEARCH ONION

The systematic literature review and epistemological evaluation conducted in this study demonstrate that DSR functions as a research methodology rather than merely a research strategy or approach. To conceptually position this finding within established methodological frameworks, this study introduces an extended version of the research onion model, incorporating Design Science Research at the research methodology layer. The research onion, developed by Mark Saunders, Philip Lewis, and Adrian Thornhill, is widely used to explain the hierarchical structure of research design (Saunders et al., 2019). The framework conceptualises methodological decision-making as a set of layered choices through which researchers move from philosophical assumptions toward specific research techniques. These layers typically include research philosophy, research approach, research strategy, method choice, time horizon, and techniques and procedures.

Despite its extensive adoption in management, information systems, and construction research, the original research onion does not explicitly include Design Science Research. This omission reflects the historical development of methodological frameworks, which primarily emphasise explanatory research traditions such as experiments, surveys, and case studies. In contrast, design-oriented research approaches have developed more prominently within engineering and information systems disciplines. The intellectual origins of design-oriented inquiry can be traced to the work of Simon (2019), who introduced the concept of the sciences of the artificial, emphasising research aimed at creating artefacts that address real-world problems (Simon, 2023). Building on this perspective, Hevner et al. (2004), formalised DSR as a paradigm focused on the development and evaluation of artefacts that generate practical and theoretical knowledge (Hevner et al., 2004). Later, Peffers et al. (2018), proposed a structured Design Science Research Methodology (DSRM) consisting of stages, including problem identification, artefact design, demonstration, evaluation, and communication (Peffers, 2006).

Based on these foundations and the findings of the systematic literature review, this study proposes an extended methodological research onion that explicitly incorporates DSR as a research methodology. The structure of the extended model is illustrated in Figure 5. Positioning DSR at the methodology layer reflects its ability to structure the entire research process while integrating multiple research strategies and empirical methods. Unlike conventional explanatory methodologies, DSR generates prescriptive knowledge through the design and evaluation of artefacts such as models, frameworks, systems, and decision-support tools. As noted by Gregor and Hevner (2013), the outputs of DSR include technological artefacts and design principles that contribute to both theoretical advancement and practical innovation (Gregor & Hevner, 2013). Consequently, the extended research onion proposed in this study provides a clearer methodological structure for positioning design-oriented research, particularly in applied disciplines such as construction management, information systems, and engineering.

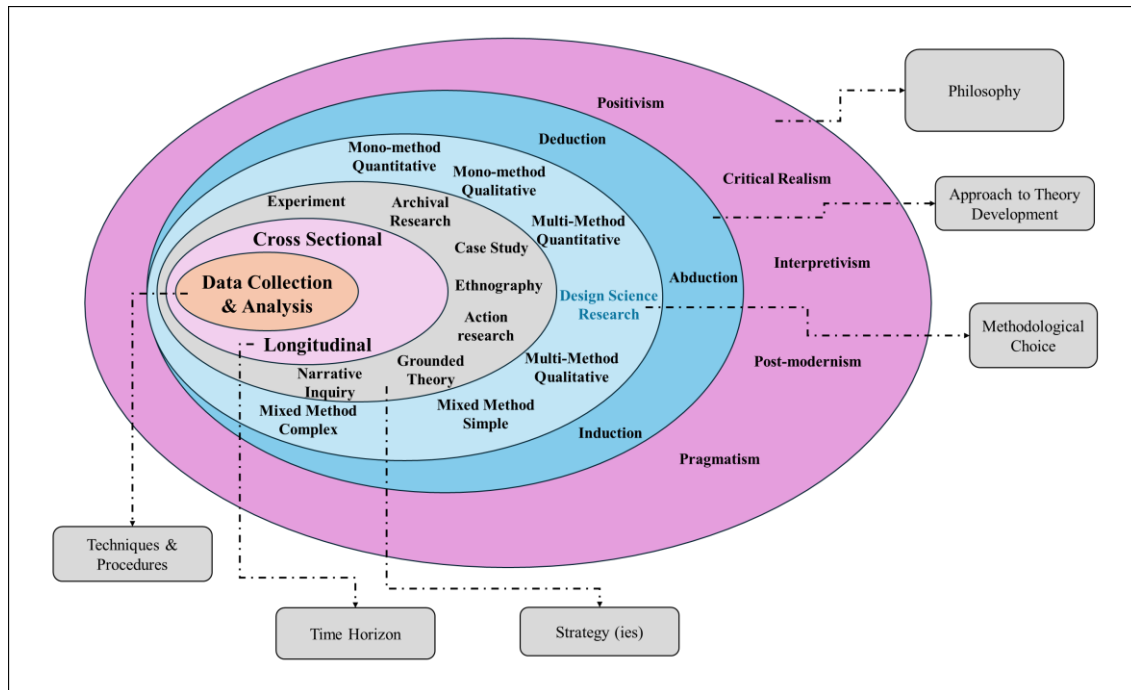


Figure 5: Extended research onion

Source – Author's own work - Devised the research onion by (Saunders et al., 2019)

DSR is appropriately conceptualised as a research methodology because it provides a structured framework that guides the overall research process, including the design, development, and evaluation of artefacts. By facilitating the integration of appropriate methods and techniques within a coherent process, DSR enables the generation of both rigorous and practically relevant knowledge (Abutabenjeh & Jaradat, 2018; Saunders et al., 2019).

7. LIMITATIONS AND FUTURE RESEARCH

Despite its contributions, this study has several limitations that should be acknowledged. First, the study relies on interpretive analysis of conceptual descriptions within the literature. Although systematic review procedures were used to minimise bias, the classification of studies inevitably involves a degree of interpretive judgement. Second, the scope of the literature review is limited to publications identified through the selected academic databases. While these databases provide extensive coverage of relevant journals, additional studies discussing Design Science Research may exist outside the search scope. Third, the extended research onion framework proposed in this study represents a conceptual model rather than an empirically validated framework. Future research could examine the applicability of the model by analysing how Design Science Research is employed in empirical studies across different disciplines. Further research may also explore how Design Science Research interacts with different research philosophies and methodological approaches within interdisciplinary contexts.

8. CONCLUSIONS

This study sought to clarify the methodological positioning of DSR within the hierarchy of research methodologies. Through a systematic literature review, thematic analysis, and epistemological evaluation, the study examined how DSR has been conceptualised across

the academic literature. The results show that DSR is mainly considered a research methodology in prior literature. According to the research onion, DSR can be classified as a research methodology. This conceptual framework provides a clearer methodological structure for design-oriented research and helps address longstanding ambiguity surrounding the classification of DSR. By clarifying the methodological status of Design Science Research, this study enhances research design transparency and supports the integration of design-oriented inquiry into established methodological frameworks from the perspective of Saunders' research onion.

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