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Delphi methods as an approach in architecture research: Opportunities and pitfalls

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ABSTRACT

Participatory approaches hold significant relevance within complex architectural research, serving as a vital link between theoretical inquiry and practical implementation. Among the prominent methods within this paradigm is the Delphi method, a systematic and iterative procedure that employs anonymous expert insights to cultivate collective agreement. While it has long been acknowledged for its strength in producing consensus, forecasting emerging tendencies, filtering conceptual propositions, and assessing issues that demand informed collective judgment, its utilization in architectural research remains comparatively limited. This study seeks to examine the Delphi method's capabilities, delineate its strengths and constraints, and underscore its prospective contributions to architectural research practices. Employing a qualitative strategy through an integrative review of literature, data were gathered from 54 selected publications issued between 2000 and 2025. These data were subsequently interpreted using thematic content analysis. The results affirmed the Delphi method's proficiency in generating impartial, multidisciplinary concurrence, its versatility in synthesizing diverse bodies of knowledge, and its particular relevance for navigating complex and future-oriented architectural challenges. Nevertheless, it also encounters obstacles such as participant withdrawal, the possibility of producing manufactured consensus, and inherent limitations in representing real-time social interactions. The methodological potential of the Delphi technique to broaden the boundaries of architectural research becomes even more substantial when combined with approaches such as the Analytic Hierarchy Process, Focus Group Discussions, or Q-Methodology.

Introduction

In contemporary architectural research which continues to evolve in complexity, depth, and multidimensionality the participatory approach has become increasingly significant (ALwaer and Clements-Croome 2010; Sudradjat 2020; Widodo 2019). This paradigm helps narrow the long-standing divide between theoretical knowledge and applied practice by directly engaging diverse stakeholders in the investigative process. It facilitates the articulation of varied viewpoints (Sanoff 2000) and simultaneously promotes outcomes that are more contextualized, inclusive,

and applicable. Among the various participatory methodologies, such as Participatory Action Research (PAR), Focus Group Discussions (FGD), the Nominal Group Technique (NGT), the Analytical Hierarchy Process (AHP), and other comparable strategies, the Delphi method emerges as particularly distinguished due to its effectiveness in structuring collective decision-making (Okoli and Pawlowski 2004; Hsu and Sandford 2007).

By employing a systematic structure and a cyclical procedure for refining expert contributions (Hsu and Sandford 2007), the Delphi technique offers a robust methodological foundation for addressing complex, multidimensional, and forward-oriented architectural questions (Donohoe, Stellefson, and Tennant 2012). Its iterative extraction of expert insights enables the building of consensus while preserving core features such as anonymity, a clearly defined framework, and reduced individual dominance (Melnikovas 2018); furthermore, the method is anchored in rational and reflective argumentation (J. Skulmoski, T. Hartman, and Krahn 2007). The strength of Delphi lies in its capacity to consolidate dispersed forms of knowledge (Landeta 2006), filter conceptual propositions, and establish priorities through repetitive cycles of reflection (Arisman, Sudradjat, and Widiastuti 2024). These characteristics collectively reinforce its value as a participatory approach capable of addressing intricate issues through multidisciplinary collaboration (Okoli and Pawlowski 2004).

Despite its success across numerous disciplines, the implementation of Delphi within architectural research remains relatively modest and has yet to become standard practice. Because architecture integrates technical, social, cultural, and emotional dimensions, it requires methodologies that systematically and reflectively incorporate diverse perspectives (Groat and Wang 2013). In this regard, Delphi holds considerable promise as a consensus-forming mechanism, particularly for developing design indicators, assessing building performance, and examining user perceptions and behaviors (Okoli and Pawlowski 2004; Bolger and Wright 2011). Nevertheless, certain obstacles persist, including limited methodological literacy among architectural scholars, difficulties in selecting suitably qualified and representative panelists, and the challenges associated with managing the iterative nature of the process (Hsu and Sandford 2007; Salura and Clarissa 2024; 2025).

Given the intricate interconnections within architectural research, Delphi should be regarded as a strategic participatory methodology capable of supporting informed, knowledge-driven decision-making. Its successful application depends on a thorough comprehension of its methodological structure from designing instruments and selecting panelists to carefully directing each iterative cycle (Hsu and Sandford 2007). Accordingly, this study seeks to investigate the potential of Delphi within the architectural domain and to identify both the challenges and opportunities associated with its use. Through an integrative literature review supported by relevant scholarship and reflective, cross-disciplinary insights, this study aims to strengthen methodological discourse in architecture and contribute to the advancement of more participatory, reflective, and transdisciplinary approaches for addressing contemporary architectural issues.

Methods

This study adopts a qualitative approach through an integrative literature review to construct a comprehensive conceptual understanding of the Delphi method. The data collection process was undertaken through systematic searches across reputable academic databases, including Scopus, Web of Science, and Google Scholar. Searches were conducted using the Publish or Perish (PoP) software with the primary keywords “Delphi methods,” “expert consensus,” “iterative survey,” and “participatory research” arranged in Boolean combinations. The literature selection was limited to English-language, peer-reviewed publications published between 2000 and 2024. From an initial pool of more than 200 studies, 54 articles were purposively chosen based on the following criteria: (a) explicit explanation of the foundational procedures and principles of Delphi, (b) discussion of its advantages and limitations, and (c) presentation of insights applicable to various research contexts. The data were analyzed using thematic content analysis, beginning with an open-coding process to identify key themes within each source, such as procedural stages, expert panel roles, forms of iteration, consensus-building techniques, and issues of validity and

reliability. Subsequent axial coding was employed to cluster related themes and establish conceptual linkages. The synthesis was conducted in a narrative-interpretive manner by comparing and contrasting descriptions from multiple sources to underscore the convergences, divergences, and theoretical contributions of each study. The final outcome is a conceptual framework that articulates the defining characteristics and methodological dynamics of the Delphi technique across disciplines.

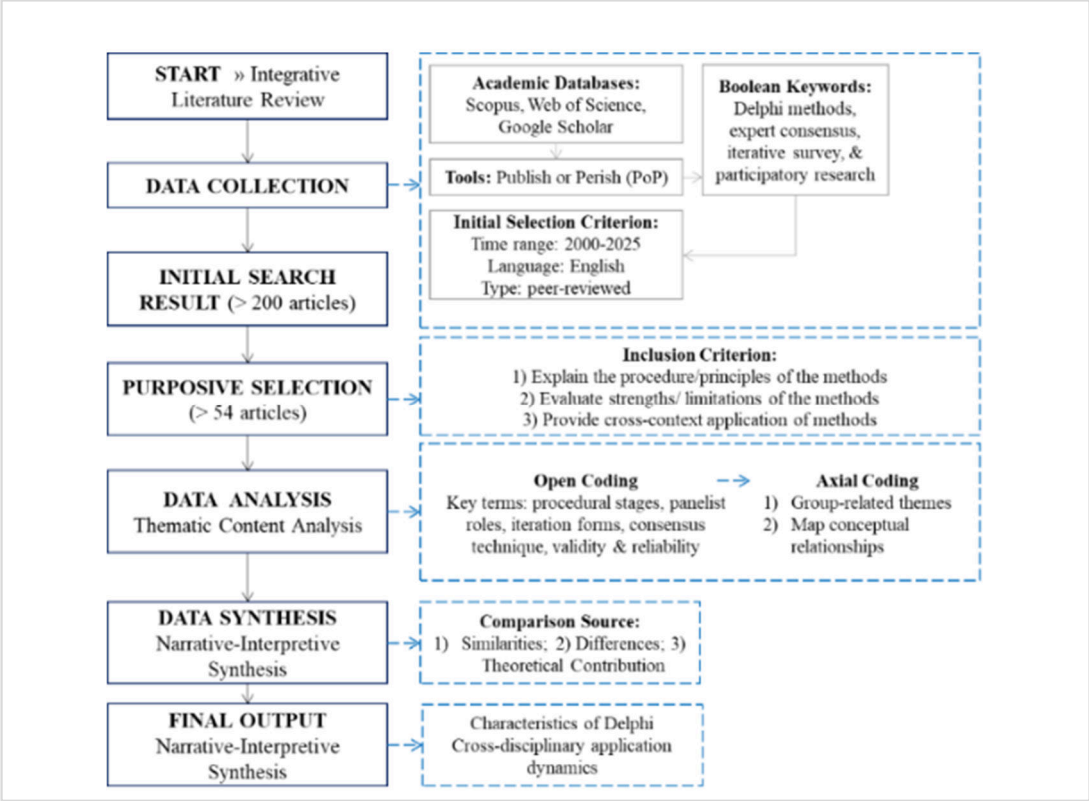

Figure 1. Research flow chart

Results and discussion

Delphi method: An overview

The Delphi method constitutes a qualitative research technique designed to derive consensus from a group of experts through a sequence of iterative surveys or questionnaires (Hsu and Sandford 2007). Originating at the RAND Corporation in the 1950s, it was initially developed to address complex issues lacking singular solutions and requiring informed collective judgment (Linstone and Turoff 2002). Its defining features include iteration, anonymity of expert participants, structured feedback, and consensus development (Okoli and Pawlowski 2004). Anonymity serves to minimize dominance, prevent argumentative exchanges, and promote a more objective deliberative environment. At each stage, aggregated responses or summaries from the previous round are fed back to the experts, enabling reconsideration, refinement of viewpoints, and gradual convergence towards consensus (Hsu and Sandford 2007). Its principal strengths lie in its flexibility across disciplines and its capacity to integrate both explicit and tacit forms of expert knowledge (Okoli and Pawlowski 2004). Nevertheless, challenges remain, such as potential bias in expert selection, declining participation across rounds, and the substantial time and resources required to sustain process consistency (J. Skulmoski, T. Hartman, and Krahn 2007).

The Delphi process begins with identifying a central topic, problem, or research issue. This is

followed by the recruitment of an expert panel based on established criteria such as expertise, representativeness, and an appropriate number of participants (Rowe, Wright, and Bolger 1991; Chan 2022). Subsequently, an initial questionnaire either open-ended or structured using a Likert scale is developed to gather preliminary expert opinions. The results of this first round are analyzed to construct the questionnaire for the next round, aimed at deepening, clarifying, or refining the panelists' views. This iterative cycle continues until a consensus or the desired level of agreement is attained. The concluding phase synthesizes the cumulative results and formulates design recommendations or implementation strategies. This iterative, reflective progression enables the filtration and maturation of expert perspectives, establishing Delphi as a robust method for consensus-based decision-making (Linstone and Turoff 2002; Hsu and Sandford 2007). Figure 2 illustrates the procedural stages of the Delphi problem-solving approach.

Figure 2. Research steps through a Delphi approach
Source: Developed from Chan (2022)

Delphiand other participation methods

The Delphi method possesses distinctive features that set it apart from other problem-solving and participatory approaches, particularly its emphasis on achieving consensus through a structured, multi-round iterative process. This characteristic differentiates Delphi from techniques such as the Nominal Group Technique (Vahedian-Shahroodi et al. 2023) and *Consensus Workshop* (Cameron and Hynes 2024) which, despite emphasizing collective decision-making, do not incorporate repeated rounds of refinement (Islam 2010). In contrast, Delphi employs controlled feedback and anonymity among panelists to progressively filter and refine expert opinions. These mechanisms are designed to minimize individual dominance, reduce argument-based bias, and encourage more balanced decision-making (Hsu and Sandford 2007). While methods such as the *Expert Panel* (Dixon and Lazenby 2023) or *Focus Group Discussion* (Afiyanti 2008) typically rely on a single face-to-face session or non-iterative dialogue and do not prioritize quantitative measures of consensus. Delphi, however, combines qualitative insights with quantitative elements, for example, utilizing Likert-scale assessments to measure consensus levels (Goodman 1987). This methodological distinction makes Delphi particularly well-suited for addressing complex problems that require convergence of expert perspectives, unlike Scenario Planning, which aims to explore possible futures without involving iterative cycles or consensus-building (Charlton 2018).

In terms of analytical depth and methodological flexibility, Delphi offers advantages by enabling the involvement of diverse experts through online or hybrid data-collection modes. Conversely, techniques such as the Nominal Group Technique or Participatory Action Research (Kindon, Pain, and Kesby 2007)

depend heavily on face-to-face interactions, which restrict participation and limit broader expert engagement (Vahedian-Shahroodi et al. 2023). Although more time-intensive than the Analytic Hierarchy Process, an approach designed for rapid hierarchical decisions (Saaty and Vargas 2012; Saaty 2008), Delphi provides richer, multidisciplinary insights grounded in iterative consensus formation (J. Skulmoski, T. Hartman, and Krahn 2007). Other methods, such as Cross-Impact Analysis (Weimer-Jehle 2006) or Q-Methodology, may offer deep causal or subjectivity-oriented analysis (Damio 2016), yet they lack the component of collective expert participation (Fang and Chen 2018). For these reasons, Delphi remains one of the most reliable methodologies for research prioritizing the validity and rigor of expert consensus, although it is less suitable for rapid decision-making or community-driven social transformation efforts, such as those pursued in Participatory Action Research (Puri 2023). Table 1 provides a comparative summary of how Delphi differs from related problem-solving methods.

Application of Delphi in interdisciplinary research

Table 2 presents the breadth of Delphi applications across multiple disciplines, highlighting its central role in interdisciplinary inquiry. In the fields of health and nursing, Delphi is extensively used to formulate clinical guidelines, develop service-quality indicators, and establish research priorities requiring the input of multidisciplinary expert groups. For example, the study by Boulkedid et al. demonstrated Delphi's effectiveness in selecting healthcare quality indicators through anonymous, iterative rounds that reduce dominance bias. (Boulkedid et al. 2011). Other research emphasizes the method's utility in addressing ethically complex issues involved in designing evidence-based care protocols (Keeney, Hasson, and McKenna 2011) and formulating public health policies (Shang 2023). This process supports the integration of diverse stakeholder perspectives including physicians, nurses, healthcare managers, and patients, within a structured and holistic framework.

Table 1. Comparison of Delphiand other problem-solving approaches/methods

Methods	Participation (Y/N)	Interview (Y/N)	Iterative (Y/N)	Collective approach (Y/N)	Consensus approach (Y/N)	Quantification (Y/N)	Data collection technique	Time	Main aims
Delphi Methods	Y	Y	Y	Y	Y	Y	Online/ email/ hybrid	Take time	Consensus of experts
Fussy Delphi Methods	Y	Y	Y	Y	Y	Y	Online, digital, software	Moderate	Consensus, assessment
Nominal Group Technique	Y	Y	N	Y	Y	Y	Face-to-face/hybrid	Short	Idea ranking
Focus Group Discussion	Y	Y	N	Y	N	N	Face-to-face/hybrid	Short	Exploration idea & opinion
Expert Panel	Y	Y	N	N	N	N	Face-to-face/online	Moderate	Experts' consolidatior
Cross-Impact Analysis	N	N	N	N	N	Y	Digital/ computational	Moderate	Causality prediction
Scenario Planning	Y	N	N		N	N	Face-to-face/hybrid	Take time	Future prediction
Analytic Hierarchy Process	Y	N	N	N	Y	Y	Digital/hybrid/manual	Moderate	Decision-making
Q-Methodology	Y	N	N	Y	N	Y	Questionnaire, sorting card, online	Moderate	Subjectivity & clustering
Participatory Action Research	Y	Y	Y	Y	N	N	Field observation, face-to-face	Take time	Social transformation
Consensus Workshop	Y	Y	N	Y	Y	N	Face-to-face/direct facilitation	Moderate	Collective consensus

In the fields of education and technology, the Delphi method serves as a strategic mechanism for identifying emerging edtech trajectories and anticipating future developments. Wang's study demonstrates how educational technology research priorities can be systematically mapped

through consensus-building among academics and practitioners (Wang et al. 2022). In parallel, Delphi-based procedures have been consistently employed to design innovative curricula and inform evidence-driven educational policies (Green 2014). Within social science research, Delphi functions as a robust validation tool for social prognostic instruments related to public policy formation, cultural dynamics, and long-term societal shifts (Landeta 2006). Complementary research further broadens its utility by applying Delphi to support processes of social transformation, enabling consensus among heterogeneous stakeholders through iterative interactions that help manage complex group dynamics and conflicting viewpoints (KOZAK and FRĄCZKIEWICZ-WRONKA 2023).

In ecological and environmental disciplines, the Delphi method has become central to constructing sustainability indicators and informing conservation-oriented policy frameworks. Applications include reducing scientific uncertainty by facilitating transdisciplinary expert agreement on biodiversity risk assessment (Mukherjee et al. 2015), developing indicators of urban environmental well-being that synthesize perspectives from environmental scientists, urban planners, and local communities (Musa et al. 2015), and forecasting the ecological implications of emerging technologies (Sossa et al. 2020). In economics and political studies, Delphi contributes significantly to strategic planning and complex policy analysis, particularly in identifying the critical drivers of socio-economic transformation in the context of digitalization by integrating viewpoints from economists, sociologists, and political analysts (Gordon 1994). Beyond this, Delphi supports the projection of macroeconomic and geopolitical scenarios (Gordon 1994), and enhances cross-sector public policy research by generating transparent, well-referenced recommendations even when underlying data conditions are uneven or fragmented (Niederberger et al. 2024).

Table 2. Synthesizes the breadth of Delphi's application across interdisciplinary domains

Research fields	Main aims and functions	Specific application	Certain considerations
Health & nursing (Shang 2023)(Keeney, Hasson, and Mckenna 2011)(Boulkedid et al. 2011)	Develop clinical guidelines, service quality indicators, and health policies.	Selection of health quality indicators, evidence-based health protocols, and resolution of complex ethical issues;	Multidisciplinary integration (clinical-manager-patient); mitigation of dominance bias through anonymity
Environment & ecology (Sossa et al. 2020)(Musa et al. 2015)(Mukherjee et al. 2015)	Develop sustainability indicators, conservation policies, risk foresight, & innovation.	Development of urban environmental well-being indicators; projection of the impact of new technologies on the environment;	Transdisciplinary collaboration (ecologist-urban planner-community); handling data uncertainty;
Education & technology **[34] [35]**	Identify edtech trends, curriculum development & competency standards	Educational technology trend mapping, innovative curriculum policy development;	Academic-practitioner consensus; adaptation to rapid changes in technology;
Social humanity (Kozak and Frączkiewicz-Wronka 2023)(Landeta 2006)(Rowe, Wright, and Bolger 1991)	Reconcile normative values, social change implementation, and cultural transformation	Identification of key factors of post-capital social change; institutional transformation planning	Management of multidimensional stakeholder dynamics (sociologists, activists, bureaucrats)
Economy & politics (Gordon 1994)(Kozak and Frączkiewicz-Wronka 2023)(Niederberger et al. 2024)	Develop strategic planning, public policy analysis, and macroeconomic projections.	Formulation of public policy recommendations; identification of post-crisis socioeconomic change factors	Standardization of reporting across sectors; synthesis of economics, politics, and sociology expert perspectives

DelphiPitfalls: Expert attrition and anonymity bias

A central limitation of the Delphi method lies in its vulnerability to participant fatigue and expert withdrawal, particularly because of its multi-round, iterative structure. Prior research reports that in complex studies, attrition rates may reach 20–30% by the third round, a condition that can compromise consensus validity (Powell 2003). Furthermore, although anonymity is intended to reduce dominance bias, it simultaneously removes contextual nuances and the dynamic interpersonal processes that characterize participatory methods (de Meyrick

2003), such as Participatory Action Research or Focus Group Discussion (Shabina, Amit, and Eram 2024; Puri 2023). When dealing with sensitive social themes such as ethnicity Delphi is unable to capture emotional intensification or real-time negotiation, both of which are strengths of Participatory Action Research (Rahmat and Mirnawati 2020). Additionally, reliance on quantitative measures, including Likert scales, often compresses rich multidimensional qualitative arguments, whereas Q-Methodology retains the complexity of subjectivity through factor-analytic interpretation (Watts and Stenner 2012).

It is also important to acknowledge that Delphi is less adaptable for urgent decision-making due to its time-intensive nature. For instance, disaster management research demonstrates that Scenario Planning and Nominal Group Discussion can generate recommendations within 48 hours through intensive workshops (Dinnesen et al. 2020; Vahedian-Shahroodi et al. 2023), while Delphi requires 2-3 months (Landeta 2006). Another methodological challenge is the risk of producing an artificial consensus, whereby pressure to align with mean scores diminishes minority or outlier perspectives. In contrast, the Analytic Hierarchy Process addresses such issues through a structured, weighted-priority system (Saaty 2008). Within innovation studies, Delphi is also limited in its capacity to trace non-linear causal mechanisms, unlike Cross-Impact Analysis, which models variable interdependencies through computational simulation (Brown 2015). Finally, Delphi tends to be weak in fostering implementation commitment because its anonymity and lack of direct interaction cannot emulate the collaborative engagement found in the Consensus Workshop model (Charlton 2018).

The Delphi method presents substantial potential for broader application in architectural research, particularly in studies requiring collaborative, exploratory, and speculative orientations. Architectural inquiry extends beyond the question of form to encompass the interplay of space, user experience, contextual conditions, and socio-ecological values. In this regard, Delphi serves as an effective reflective instrument for synthesizing expert perspectives on architectural problems that lack established consensus or standardized frameworks. Drawing on earlier research, Delphi is particularly significant for speculative or forward-looking investigations, such as post-pandemic architectural design, building-level energy transitions, or the development of sponge cities.

The method is also advantageous for research requiring geographically distributed expert input, such as determining public space quality indices, developing sustainability indicators, or constructing spatial comfort measurement tools for tropical architectural contexts. Likewise, Delphi is well suited for formulating conceptual frameworks or developing design parameters in fields such as biophilic design, inclusive design, and culturally rooted architectural practices.

Opportunities for the Delphi in architectural research

Table 3. Comparative analysis of the weaknesses of the Delphi method and its alternative solutions

***Delphi* weakness**	**Impacts**	**Other superior methods**	**Reasons**
High expert attrition (Catherine 2003)(Keeney, Hasson, and Mckenna 2011)	Complex iterations 20-30% drop-out; weak consensus validity	*Nominal Group Technique* (Varga-Atkins et al. 2011)(Vahedian-Shahroodi et al. 2023)	Single-session design maintains full participation via focused discussion
Loss of group dynamics (Green 2014)(Watts and Stenner 2012)	Ignores emotional escalation & real-time negotiation process	*Participatory Action Research* (Puri 2023)(Chevalier and Buckles 2020)	Field observation and participatory dialogue provide holistic socio-cultural insights
Artificial consensus (Landeta 2006)(Saaty 2008)	Outliers urged to be 'average', leading to biased recommendations	*Analytic Hierarchy Process* (Vaidya and Kumar 2006)	The weighted hierarchy of priorities seeks to preserve minority views through pairwise comparison matrices
Excessive data quantification (Watts and Stenner 2012)	Simplifies multidimensional arguments, losing subjective nuance	*Q-Methodology* [21][44]	Factor analysis quantifies subjectivity without complexity reduction

***Delphi* weakness**	**Impacts**	**Other superior methods**	**Reasons**
Ignore complex interdependencies (Gordon 1994)	Fails to identify non-linear causality, resulting in inaccurate risk projections	*Cross-Impact Analysis* [25][50]	Computational modeling simulates 'what-if' scenarios based on variable dependency matrices
Take time and long duration (Landeta 2006)(Goodman 1987)	Unsuitable for rapid or urgent decisions	*Scenario Planning* (Charlton 2017)	The intensive workshop generates contingency scenarios in 48 hours through creative exploration
Weakness of implementation commitment (Rowe, Wright, and Bolger 1991)(Donohoe, Stellefson, and Tennant 2012)	Consensus is not followed by action, so recommendations stall at the paperwork stage	*Consensus Workshop* (Kaner et al., n.d.)	Collaborative facilitation, building ownership through psychological bonding & participatory action plans

Opportunities for the Delphi in architectural research

The Delphi method presents considerable potential for broader application in architectural research, particularly in studies that demand collaborative, exploratory, and speculative approaches. Architecture encompasses more than physical form; it involves interactions among space, users, context, and socio-ecological values. Accordingly, Delphi can function as a reflective tool for synthesizing expert perspectives on complex architectural challenges for which no standard consensus exists. Previous studies indicate that Delphi is especially suitable for future-oriented or speculative research topics, including post-pandemic building design, energy transition strategies, and sponge city development. Moreover, this method is effective when consensus is required from geographically dispersed experts, for example, in developing public space quality indices, sustainability indicators, or spatial comfort measurement tools in tropical design. It is also well-suited for the formulation of conceptual frameworks and design parameters, as in biophilic design, inclusive architecture, or culturally contextualized design approaches.

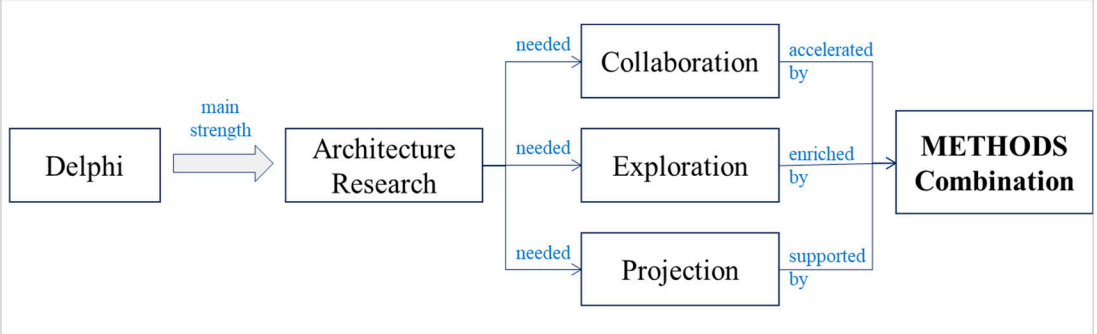

Figure 3. Symbiotic relationship between Delphi and architectural research needs

For the research results to be more comprehensive, the implementation of architectural research should be combined with other methods, including:

1. *Delphi + Focus Group Discussion (FGD)*
   FGDs are effective during the initial exploratory stage to identify key issues and topics from users or stakeholders. Insights gathered from FGDs can then be converted into Delphi questionnaires, making this combination particularly suitable for participatory design projects.
2. *Delphi + Analytic Hierarchy Process*
   Once consensus is reached on indicators via Delphi, AHP can be employed to quantify the relative importance of each criterion. This integrated approach is valuable for prioritizing design decisions, for instance, in evaluating different energy-efficient building typologies (Yu and Hong 2022).
3. *Delphi + Q-Methodology*
   This combination helps capture the subjective perceptions of panelists regarding design issues, making it appropriate for studies on

spatial comfort, aesthetic preferences, or landscape quality.

4. *Delphi + Scenario Planning*
   Together, these methods facilitate exploration of potential future scenarios in urban or built environments. Expert insights collected through Delphi can be projected into alternative scenarios for strategic planning.
5. *Delphi + Fuzzy Delphi Method*
   This approach is suitable when experts provide qualitative responses with inherent uncertainty (Mohamed Yusoff et al. 2021), such as perceptions of daylighting quality, multisensory experiences, or spatial comfort.

Conclusions

The Delphi method constitutes a participatory approach well-suited to addressing the challenges of complex, speculative, and multidisciplinary architectural research. Its strengths include a structured iterative process, panelist anonymity, and the capacity to consolidate diverse expert perspectives within a coherent framework. This study demonstrates that Delphi is particularly relevant for developing design indicators, evaluating spatial quality, and formulating conceptual frameworks related to biophilic design, sustainability, and spatial comfort. The method's effectiveness, however, depends on a rigorous understanding of its procedures and the careful selection of qualified panelists. Despite limitations, such as lengthy duration, risk of participant attrition, and potential oversimplification of nuanced perceptions, Delphi remains highly effective when combined with complementary methods, including Focus Group Discussions, Analytic Hierarchy Process, and Q-Methodology. Consequently, Delphi can significantly strengthen the scientific and participatory foundations of contemporary architectural research.

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Anisza Ratnasari contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

Yohanes Basuki Dwisusanto contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

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