

From Literature Evidence to Method Selection: A Two-Layer MCDA Framework for Project Alternative Evaluation in Public Procurement

Debora Anelli[1(✉)], Francesco Tajani[1], Pierluigi Morano[2], João Zambujal-Oliveira[3], and Maria Rosaria Guarini[1]

[1] Department of Architecture and Design, "Sapienza" University of Rome, 00196 Rome, Italy
{debora.anelli,francesco.tajani,
mariarosaria.guarini}@uniroma1.it
[2] Department of Civil, Environmental, Land, Building Engineering and Chemistry (DICATECh), Polytechnic University of Bari, 70126 Bari, Italy
pierluigi.morano@poliba.it
[3] NOVA LINCS (FCT), University of Madeira (FCS), Funchal, Portugal
joliveira@staff.uma.pt

Abstract. Multi-criteria decision-aiding (MCDA) methods are increasingly used in public procurement to compare project alternatives when evaluation depends on technical, environmental, social, and economic criteria. Yet method selection is often treated as a purely analytical matter, whereas in regulated procurement it is also constrained by requirements of transparency, ex ante definability, auditability, and effective competition. Building on prior review evidence on MCDA applications in public procurement, this paper proposes a two-layer framework for method selection. The first layer assesses normative compatibility, filtering out methods whose inferential structure is difficult to predefine, explain, or verify within award procedures. The second layer assesses methodological adequacy in relation to the decision problem, considering weighting needs, compensatory logic, uncertainty, criteria interdependence, and robustness of the final ranking. The framework is then translated into an operational selection matrix linking recurrent procurement settings to coherent method families and modular configurations. The contribution is both conceptual and practical: it shows that MCDA method choice in public procurement is not method-neutral, but a design decision at the intersection of decision theory, procurement regulation, and evaluation practice.

Keywords: public procurement · MCDA · method selection · normative compatibility · decision framework · project alternative evaluation

1 Introduction

Public procurement increasingly relies on evaluation settings in which economic, technical, environmental, and social criteria must be assessed jointly. This is especially evident when project alternatives are selected under the logic of the *best quality/price ratio*, where

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the decision problem cannot be reduced to a single monetary metric. In such contexts, MCDA methods offer a structured way to support bid comparison, weight elicitation, and final ranking. Yet the growing diffusion of MCDA in procurement has not resolved a crucial issue: the choice of the method itself is often treated as implicit, conventional, or merely technical, rather than as a design decision that directly affects the transparency, traceability, and defensibility of the award procedure. More broadly, recent MCDA literature has moved away from the idea of a universally superior technique and has increasingly emphasized the context-dependence of method selection, especially with respect to the nature of the decision problem, the structure of the available information, and the type of output required [1–3].

The need for a more explicit rationale in method selection emerges clearly from the recent review by Anelli et al. [1], which analyzed 74 peer-reviewed studies published between 1998 and 2023 on the use of MCDA in public procurement in construction and infrastructure. That review showed, on the one hand, the persistent centrality of AHP and, on the other, the gradual emergence of techniques such as BWM, EDAS, MABAC, DEA, and more advanced hybrid configurations. At the same time, it highlighted three recurring weaknesses: the absence of a systematic reading of procurement dynamics by stages, the limited reporting of robustness checks and sensitivity analysis, and the still incomplete operationalization of environmental and social criteria. The same review also made explicit that method choice in procurement depends on properties required by practice, such as consistency of weights, transparency, computational burden, and stakeholder acceptance. These results suggest that the real gap in the literature is no longer the mere documentation of MCDA applications, but the lack of a structured device for selecting methods in relation to the characteristics of the procurement setting.

This gap becomes even more relevant when the regulatory context is taken seriously. In EU procurement law, award criteria must be linked to the subject matter of the contract, must allow effective competition, and—except where price or cost alone is used—must be accompanied by their relative weighting; more generally, the design of the procedure must make the evaluation architecture sufficiently clear and verifiable [4]. Within the Italian context, both the current public contracts framework and ANAC guidance reinforce the importance of transparency, ex ante definition of criteria and weights, and intelligibility of the scoring rules [5, 6]. For this reason, in regulated procurement settings, method selection cannot be based exclusively on analytical elegance or computational sophistication. It must also be aligned with procedural requirements such as explainability, pre-definability, auditability, and control of administrative discretion.

Starting from these premises, this paper aims to develop a normatively informed framework for MCDA method selection in public procurement, with specific reference to the evaluation of project alternatives. Its objective is specific: to transform the evidence already consolidated in the literature into a two-layer selection framework. The first layer concerns normative compatibility and operates as a preliminary filter, identifying the set of methods that are coherent with the procedural requirements of regulated procurement. The second layer concerns methodological adequacy and selects, within that feasible set, the methods—or methodological configurations—most appropriate to the actual structure of the decision problem, considering weighting needs, compensation logic, uncertainty, interdependence of criteria, and robustness of the final ranking.

Accordingly, the paper addresses the following research question: how can MCDA method selection in public procurement be structured so that it is both normatively defensible and methodologically coherent? The underlying argument is that, in public procurement, what must be designed is rarely a single isolated technique; rather, it is a methodological configuration capable of combining weighting, ranking, screening, and robustness checks in a context-sensitive and procedurally auditable way.

The reminder of the paper is: Sect. 2 explains the methodological framework evidences given by the literature review; Sect. 3 describes the two-layer structure of the framework; in Sect. 4 discussion and conclusions of the proposed methodological framework are reported.

2 From Review Evidence to Method Selection Properties

This contribution takes as its starting point the empirical basis built in the review published by Anelli et al. 2025 [1] which examined 74 studies that appeared between 1998 and 2023 on the use of MCDAs in public procurement, with particular reference to the public works sector and the logic of the *Most Economically Advantageous Tender* (MEAT). This review shows the centrality of AHP, the growth of emerging techniques such as BWM, EDAS, MABAC, DEA and advanced TOPSIS, the lack of standardization in the operationalization of environmental and social criteria, and the limited diffusion of sensitivity analysis and structured procedures for aggregating judgments. The same work, moreover, explicitly identifies among its objectives the analysis of the main advantages and limitations of the techniques used and proposes an operational framework oriented to link the choice of criteria, method selection, robustness checks and minimum reporting. These elements make it possible to process the results obtained, aimed at identifying the properties that guide their selection in the competition contexts.

In public procurement, the choice of method is intertwined with the needs of transparency, traceability, comparability of offers, controllability of discretion and organizational sustainability of the procedure. In this framework, MCDA techniques are no longer viewed as equivalent tools. Instead, they are regarded as differentiated evaluation devices, each characterised by a specific combination of properties. These properties include the degree of explainability of the inferential process, the compensatory structure of aggregation, the ability to process uncertain or mixed data, the aptitude to represent hierarchical or interdependent relationships, and the computational load required for administration. From this derives a methodologically important conclusion: the appropriateness of a technique also depends on its degree of incorporation into the administrative structure.

After careful consideration, the evidence from the review clearly shows that there are five key properties that are vital for selecting the most appropriate method. These include transparency and the ability to easily rebuild the procedure; a compensatory structure for aggregation; the ability to effectively handle uncertainty and mixed data; the ability to address hierarchical or interdependent problems; and the operational sustainability of the implementation. This recording is the foundation of the framework proposed in the following sections. Once the salient methodological properties have been isolated, it is possible to assess their consistency with the regulatory constraints of public procurement. On this basis, a more rigorous and more defensible criterion for choosing methods can be built.

3 Methodological Framework

3.1 The First Layer of the Framework: Regulatory Compatibility as an Eligibility Filter

The first layer of the framework concerns the regulatory compatibility of the MCDA method in the regulated context of public procurement. Its function is to act as an admissibility filter: before selecting the most appropriate technique with respect to the structure of the decision-making problem, it is necessary to circumscribe the set of methods that can be incorporated into an award procedure built according to the requirements of transparency, predetermination, verifiability and protection of competition. In this perspective, normative compatibility enters into the selection of the method as a set of constraints that define the space of viable methodological solutions. Table 1 shows the regulatory framework regarding the use of MCDAs in national Public Procurement.

On a conceptual level, public procurement law does not identify a specific evaluation algorithm; instead, it defines the conditions within which a decision support technique can be used in a legitimate and defensible way. In the European framework, the award criteria must be linked to the subject matter of the contract, must allow for an effective competitive comparison and must be accompanied by specifications such as to make the information provided by the tenderers verifiable. Where price is not the only criterion, the relative weighting of the criteria must also be made explicit in the procurement documents. Translated into methodological terms, these requirements imply that the evaluation model must possess an inferential logic that can be understood and formalized ex ante and reconstructed ex post.

In the Italian context, this approach is further clarified by Legislative Decree no. 36/2023, which places the contractual action within the principle of the result, to be pursued according to legality, transparency and competition, and attributes to transparency a function closely linked to the full verifiability of the procedure. Art. 108 also confirms the centrality of the most economically advantageous offer and, in labour-intensive contracts, limits the weight of the economic component, so as to preserve the substantial importance of technical quality. ANAC's interpretative indications also insist on the need for criteria, formulas and rules for awarding scores to be consistent with the subject matter of the contract, justifiable, intelligible and free of discriminatory effects. In terms of method selection, this means that a technique is normatively compatible when it can be included in a predetermined, controllable and rationally contestable decision-making structure.

Hence a significant methodological consequence: in public procurement, MCDAs participate directly in the construction of the evaluation rule. The choice of technique affects the form of the comparison between offers, the treatment of the compensations between criteria, the degree of traceability of the judgment and the defensibility of the final outcome. A method based on transformations that are difficult to read, on parameters that are difficult to predetermine or on poorly verifiable passages produces critical issues already at the level of its procedural incorporation. A method characterized by explicit steps, formalizable aggregation criteria and replicable results, on the other hand, presents greater consistency with the institutional structure of the award. The first layer of the

Table 1. Summary of regulatory framework of MCDA into Public Procurement

No.	Government	Reference to law/standards and/or dispositions and regulations
1	United States of America	Competition in Contracting Act of 1984, Federal Acquisition Reform Act of 1984
2	Australia	Commonwealth Procurement Rules (CPRs) commenced on 1 July 2022 (division 1-Section 4)
3	Italy	New Code of Contracts Legislative Decree no. 36/2023 + ANAC Guidelines no. 2+ Guidelines of the Ministry for Infrastructure and Sustainable Mobility for the drafting of the technical and economic feasibility project to be used as the basis for the awarding of public works contracts under the PNRR
4	Spain	Real Decreto Legislativo 3/2011, de 14 de Noviembre
5	France	Ordonnance n.2015-899 du 23 Juillet 2015
6	Belgium	Loi sur les marchés publics du 17 juin 2016 art. 81
7	United Kingdom	Public Contracts Regulations 2015 in England and Wales Public Contracts Regulations 2015 in Scotland, as well as the Utilities Contracts Regulation 2016 in England and Wales (the "UCR 2016" together with the PCR 2015, the "UK Regulations") and the Utilities Contracts Regulations 2016 in Scotland
8	Czech Republic	Zákon č. 134/2016 o veřejných zakázkách (§ 116)
9	Canada	Government Contract Regulations (Introduction section)
10	Germany	Gesetz gegen Wettbewerbsbeschränkungen + Verordnung über die Vergabe öffentlicher Aufträge + Vergabeverordnung für öffentliche Bauleistungen, Abschnitt 2
11	Chile	Law of Bases of Administrative Contracts for supply and services, No. 19.886 (the Chilean Public Procurement Law, "PPL") and its regulation (Supreme Decree No. 250 of 2004, the Ministry of Finance; "PPL Regulation")

framework is therefore used to identify the set of methods that meet this preliminary threshold of admissibility.

Operationally, the regulatory compatibility filter is divided into five requirements. The first is the transparency and explicability of the procedure, i.e. the possibility of making intelligible the way in which criteria, weights, parameters and rules of aggregation lead to the final result. The second is the predeterminability of the evaluation rules, which requires the ex ante definition of the essential elements of the model in the tender documents. The third is the verifiability and auditability of the outcome, understood as the possibility of reconstructing the decision-making process and replicating the result starting from the same inputs. The fourth is the controllability of administrative discretion, which admits the use of expert judgment within a methodological

structure capable of making its assumptions, limits and consequences visible. The fifth is the ability to sustain an effective competitive comparison, i.e. the ability of the method to produce a meaningful comparison between offers without opaquely altering the relationship between quality and price or absorbing insufficient performance through poorly manageable compensations.

The first layer does not yet select the most appropriate method in an analytical sense. It delimits the set of methods that can be used in a manner consistent with the procedural rationality of procurement. Only within this set does it become possible to activate the second layer of the framework, dedicated to methodological adequacy with respect to the structure of the decision problem, the type of data available and the form of the result required by the procedure.

3.2 The Second Layer of the Framework: Methodological Adequacy

Once the set of methods compatible with the constraints of public procurement has been delimited, through the first layer, the selection requires a second step, dedicated to methodological adequacy. In this phase, the guiding criterion is the consistency between the structure of the decision problem and the logic of operation of the method. The recent literature on MCDA clearly shows that the choice of technique depends on the nature of the decision, the form of information available, the type of aggregation required and the configuration of the expected output. In the context of public procurement, this verification is of particular importance, since the evaluation is rarely limited to a simple final ranking and is more often divided into a sequence of distinct functions: structuring of criteria, determination of weights, processing of qualitative and quantitative data, possible screening of tenders and final summary [7].

The review referred to [1] provides, from this point of view, a methodologically important indication. The widespread presence of hybrid configurations signals that adequacy should not be attributed to the method in the abstract, but to its placement within the evaluation pipeline. A technique may be particularly suitable in the weighing phase and less effective in the ranking phase, or show the inverse relationship. Consequently, the second layer does not aim to identify a universally preferable technique, but to verify which method, or which combination of methods, is most consistent with the decision-making function to be performed in each segment of the procedure.

The first dimension of analysis concerns the prevailing evaluative function. In some contexts, the main problem consists in the construction and legitimization of weights; in others, the criticality is concentrated in the final ranking; in still others, the procedure requires a clear separation between the weighing phase and the ranking phase. This distinction is crucial, as different techniques respond to different needs: some methods offer a more structured representation of preferences, others provide greater speed and readability in the final synthesis, and still others are more effective when the problem requires modular configurations. Methodological adequacy therefore depends, first of all, on the correspondence between the function assigned to the method and the role it is called upon to play in the overall design of the evaluation [8, 9].

A second dimension concerns the compensatory structure of aggregation. Each method incorporates a particular logic of compensation between criteria, and this logic must be consistent with the substantive meaning of the decision. In contexts where the

administration accepts a strong synthesis between heterogeneous services, methods with a predominantly additive or proximity character are appropriate. In cases where some deficiencies should not be fully absorbed by high performance on other criteria, partially compensatory approaches, configurations with thresholds or outranking methods acquire greater methodological consistency. In this perspective, the second layer tests whether the selected technique adequately reflects the level of compensation that the decision problem allows or requires.

A third dimension concerns the nature of the data and the treatment of uncertainty. In procurement problems, especially when environmental, social or qualitative criteria come into play, the information base may be heterogeneous, incomplete, linguistic or poorly standardised. Under these conditions, the use of fuzzy extensions or hybrid configurations finds a solid methodological justification when it allows the epistemic structure of the problem to be represented more faithfully. The greater representative capacity, however, must be accompanied by a corresponding increase in methodological clarity, documentation of assumptions and robustness checks. The second layer therefore requires verifying whether the complexity of the method is proportionate to the quality and form of the information actually available [10].

A fourth dimension concerns the relational morphology of the problem, i.e. the degree of independence or interdependence between criteria and sub-criteria. When the problem can be represented in hierarchical form, methods based on linear structures are usually sufficient. When, on the other hand, the criteria interact in a relevant way, influence each other or produce feedback effects, models capable of representing these interactions explicitly become more appropriate. The choice of method, in this case, depends on the ability to grasp the real architecture of the problem without introducing levels of complexity disproportionate to the information benefit obtained. Also from this point of view, methodological adequacy is measured in terms of congruence between the properties of the problem and the inferential structure of the method [11].

The fifth dimension concerns the robustness of the ranking and the operational sustainability of the implementation. In public procurement, the quality of the final ranking also depends on its stability to plausible variations in weights, parameters, thresholds and basic assumptions. For this reason, robustness does not constitute an ancillary control, but a component of the judgment of methodological adequacy. Linked to this is the operational sustainability of the method: availability of calculation tools, replicability of operations, ease of audit, documentary burden and cognitive cost required of the commission. A method that is theoretically consistent with the structure of the problem may be inadequate when it requires a level of implementation that is not compatible with the organizational resources of the procedure [12]. The second layer therefore also incorporates a feasibility test, understood as the ability of the method to produce a robust result within realistic conditions of administrative use.

In the light of these considerations, the second layer of the framework can be formalized as a verification of congruence between five profiles of the decision-making problem: evaluative function, compensatory logic, data form, relational structure of criteria and expected operational robustness. In summary terms, the selection of the method can be guided by five ordering questions: the problem mainly requires a weighing phase, a ranking phase or a combination thereof; the compensation between criteria is either

fully acceptable or must be contained; the data are either stable and numerical or heterogeneous, uncertain and linguistic; the criteria are substantially independent or interact in a material way; Does the result remain stable under plausible changes in the basic assumptions? The joint answer to these questions allows to select, within the subset defined by the first layer, the methods or methodological configurations that are actually consistent with the cognitive, informational and operational structure of the problem.

In this perspective, the second layer completes the first and develops its logic on a properly methodological level. The first layer defines the set of methods admissible in the regulated context of the tender; the second identifies, within this set, those most congruent with the way in which the decision-making problem is constructed, with the type of information available and with the form of the result that the procedure requires. The point of arrival does not necessarily coincide with the selection of an isolated technique. In many cases, the most methodologically coherent solution takes the form of a modular configuration, in which different methods oversee different functions of the evaluation process. Table 2 shows the main MCDA techniques found in the field of Public Procurement and the relative pros and cons highlighted by the authors.

Rather than treating each technique as an isolated option, the literature suggests recurring methodological families characterized by distinct strengths and limitations in terms of transparency, compensation logic, uncertainty handling, and operational implementability.

Table 2. Strengths and limitations of MCDA families

MCDA family	Representative techniques	Main strengths	Main limitations
Additive value/score-based methods	SAW, MAVT, MAUT, UF, SCORE	Simple structure; transparent aggregation; easy implementation and communication; suitable for combining multiple criteria into a synthetic score [8, 9]	Strong compensatory logic; sensitivity to weighting assumptions; possible difficulty in eliciting utilities or trade-offs; limited ability to represent uncertainty unless extended [13]
Pairwise comparison and weighting methods	AHP, FAHP, ANP, BWM, MACBETH, DEMATEL	Effective for structuring criteria and eliciting preferences; useful in group decision-making; consistency support in some methods; suitable for deriving weights and modelling interdependencies [10]	Dependence on expert judgement; cognitive burden when comparisons increase; possible inconsistency or rank reversal; higher complexity in network-based models [13, 14]

(*continued*)

Table 2. (*continued*)

MCDA family	Representative techniques	Main strengths	Main limitations
Distance- and utility-based ranking methods	TOPSIS, FTOPSIS, COPRAS, COPRAS-G, MABAC	Intuitive ranking logic; ability to handle benefit and cost criteria jointly; suitable for comparing alternatives across multiple attributes; some variants manage uncertainty better [15–18]	Results depend heavily on weighting and normalization choices; limited consistency control in weight elicitation; some variants require higher computational effort [12–15]
Outranking methods	PROMETHEE, F-PROMETHEE II, ELECTRE	Reduced full compensation among criteria; explicit use of preference/indifference thresholds; good stability of rankings; suitable when unacceptable performances should not be offset entirely [14–17]	Greater methodological complexity; more demanding parameter setting; lower immediacy for non-expert users; some methods do not provide easily interpretable final scores [11–13]
Efficiency-based methods	DEA, DEA-BoD	Relative efficiency assessment based on observed performance; benchmarking capability; reduced need for predefined utility functions; useful for comparing suppliers/entities on multiple criteria [10–13]	Sensitive to sample size and model specification; requires technical expertise; weaker suitability when a direct final award ranking is needed; interpretation may be less intuitive for procurement practice [14–17]
AI-based and learning methods	ANN, FNN	Adaptive capability; useful for pattern recognition and prediction; suitable when historical data are available; potential integration with other decision-support tools [16–19]	Limited transparency and explainability; higher modelling and validation requirements; weaker procedural intelligibility in regulated evaluation settings [15]

(*continued*)

Table 2. (*continued*)

MCDA family	Representative techniques	Main strengths	Main limitations
Robustness-oriented methods	SMAA	Suitable under uncertain, imprecise, or incomplete preference information; supports identification of robust alternatives [12–14]	Less immediate for practitioners; requires probabilistic or simulation-based interpretation; usually complementary rather than standalone [14–17]
Process-oriented decision support approaches	CBA, PANTURA	Supports collaborative and structured comparison; useful for highlighting advantages and improving process clarity [10–17]	Less standardised than mainstream MCDA methods; limited generalisability; more suitable as a complementary procedural support tool [16–19]

3.3 Operationalization of the Framework: From Selection Logic to Decision Matrix

The two layers of the framework acquire applicative utility when they are translated into a selection matrix capable of linking the properties of the decision problem to the most coherent methodological families. The proposed operationalization has precisely this function: to transform a conceptual framework into a tool to support the design of the evaluation, while maintaining the procedural constraints of public procurement and the properly analytical needs of the decision. In this perspective, the choice of the method takes the form of an orderly selection procedure, in which regulatory compatibility defines the set of admissible methods and methodological adequacy makes it possible to identify, within this set, the configuration most congruent with the specific context [20, 21].

The matrix is the connecting device between the two layers. The first layer definitively introduces selection properties that clearly derive from the regulated structure of the tender. These properties include transparency and explicability of the procedure, predeterminability of criteria, weights and rules of aggregation, verifiability of the outcome, controllability of discretion and ability to sustain an effective competitive comparison. The second layer reorganises the choice based on the methodological properties of the problem. This includes the prevailing evaluation function, the admissible degree of compensation, the form and quality of the data, the possible interdependence between criteria and the expected robustness of the final ranking. The matrix combines these two families of properties and allows the selection of the method to be read as a problem of congruence between procedural requirements and the cognitive structure of the decision.

On the operational level, the framework can be used as a sequence of ordering questions. First, the administration or technical decision-maker identifies which methods are compatible with the required level of ex ante formalisation, intelligibility of the procedure and auditability of the outcome. Secondly, among the methods that exceed this preliminary threshold, consistency with the function that the method must perform in the evaluation pipeline is verified: determination of weights, final ranking, preliminary screening, treatment of uncertain data or robustness verification. Thirdly, the framework orients the choice towards a single technique or towards a modular configuration, when the different phases of the procedure require methodological properties not concentrated in a single method. The underlying logic is therefore sequential and compositional: admissibility filter, congruence check, composition of the evaluation solution.

The matrix shows that the most streamlined and institutionally standardised procedures tend to favour methods characterised by high traceability and easy formalisation. When it comes to the construction of weights, methods that can structure expert judgment with a controlled cognitive load are undeniably more consistent. When the procedure requires a clear separation between weighting and ranking, hybrid configurations are undoubtedly the best option, combining a structured technique for defining weights with a rapid and verifiable method for the final ranking. In contexts where some minimum performance doesn't need to be fully compensated by good results on other criteria, the matrix shows that partially compensatory or outranking approaches are effective. In the pre-qualification or comparative benchmarking phases, methods oriented towards efficiency analysis clearly acquire greater consistency. When linguistic data is incomplete or poorly standardised, the framework allows the use of fuzzy extensions or hybrid configurations. But there are strict rules about how to do this. The additional complexity must be documentable and compatible with the requirements of intelligibility of the procedure. The matrix justifies the use of methods capable of representing the structural relationships of mutual influence.

Overall, the framework can be expressed through five selection rules.

Rule no. 1 - If the priority is the legitimacy of weighing, with a strong need to make explicit the structure of the criteria, comparative judgments and consistency checks, AHP or BWM are preferable. The former maintains an advantage in terms of institutional familiarity and traceability; the second reduces the number of comparisons and cognitive load, being useful in procedures with compressed times or with many criteria [22].

Rule no. 2 - If the final ranking requires speed, simplicity and easily auditable formulas, it is appropriate to combine the weighing phase with a compensatory but traceable ranking method, such as EDAS, MABAC or TOPSIS. This hybrid configuration allows you to separate the construction of preferences from the final synthesis, maintaining readability of the process and containment of the operating cost.

Rule no. 3 - If the procedure requires minimum thresholds, technical filters or explicit compensation control, outranking methods, in particular PROMETHEE or ELECTRE, become more appropriate. These techniques are consistent when some deficiencies do not need to be fully neutralized by high performance on other criteria.

Rule no. 4 - If the problem is located upstream of the award, as in cases of preliminary screening, benchmarking or comparative efficiency analysis between operators, the use

of DEA, possibly combined with AHP or BWM in the subsequent phases, may be appropriate [23].

Rule no. 5 - If the information framework is highly uncertain, linguistic or poorly standardised, the use of fuzzy extensions or hybrid configurations may be justified, provided that it is accompanied by a proportional increase in methodological documentation. The weak standardization of environmental and social criteria and the limited use of sensitivity analysis constitute one of the main points of fragility of MCDA applications in procurement. In such contexts, the increase in the representative capacity of the model must be balanced by more stringent requirements for explainability and robustness [24].

In this perspective, the operational contribution of the framework consists in shifting the focus from the repertoire of available methods to the logic with which they are selected and combined. The matrix allows this logic to be explained in a concise and usable form, and prepares the ground for the illustrative application presented in the following paragraph.

Table 3 operationalizes the proposed framework by integrating the two selection layers into a single decision matrix. Each row links a recurrent selection profile to its procedural relevance in regulated procurement, the corresponding methodological implication, and the MCDA families that appear most coherent in operational terms. In this way, method selection is treated not as the identification of a universally preferable technique, but as the design of a context-sensitive evaluation architecture.

Table 3. Decision matrix of the proposed framework

Selection profile	Procedural relevance in procurement	Methodological implication	Indicative coherent methods/families	Typical use in evaluation design
High transparency and explainability	The evaluation logic must be intelligible, reconstructable, and defensible within the award procedure	Prefer methods with explicit steps, understandable weighting logic, and traceable aggregation rules	AHP, BWM	Weight elicitation in procedures requiring strong institutional readability
Ex ante definability of rules and parameters	Criteria, weights, aggregation rules, and key parameters should be specified in advance in tender documents	Prefer methods whose structure can be formalized ex ante; avoid approaches requiring substantial ex post calibration	AHP, BWM, simple additive or distance-based ranking methods	Tender designs where predetermination and auditability are central

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Table 3. (*continued*)

Selection profile	Procedural relevance in procurement	Methodological implication	Indicative coherent methods/families	Typical use in evaluation design
Rapid and auditable final ranking	The final ranking should remain easy to compute, communicate, and verify	Combine structured weighting with transparent ranking methods	AHP/BWM + TOPSIS, EDAS, MABAC	Two-stage evaluation designs separating weighting from final ranking
Limited compensation across criteria	Weak performance on key criteria should not be fully offset by strong performance on others	Prefer partially compensatory or outranking logics, especially where thresholds or minimum acceptable performances matter	PROMETHEE, ELECTRE	Procedures with technical thresholds, non-compensable criteria, or controlled trade-offs
Preliminary screening or benchmarking	Some stages require comparative efficiency assessment rather than full award ranking	Use efficiency-oriented methods when the decision concerns pre-selection, benchmarking, or comparative performance	DEA	Pre-qualification, shortlist formation, benchmarking across operators or alternatives
Uncertain, mixed, or linguistic data	Environmental, social, and qualitative criteria may be weakly standardized, incomplete, or expressed linguistically	Use fuzzy or hybrid extensions only when the higher modelling burden is justified and remains explainable	Fuzzy MCDA, hybrid configurations	Evaluation settings with imprecise or heterogeneous information bases
Interdependent criteria structure	Technical, economic, environmental, and organizational criteria may influence one another	Use network-based methods only when interdependence is structurally relevant and cannot be reduced to a hierarchy	ANP	Decision problems with feedback effects and reciprocal influence among criteria

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Table 3. (*continued*)

Selection profile	Procedural relevance in procurement	Methodological implication	Indicative coherent methods/families	Typical use in evaluation design
Robustness-sensitive procedures	Rankings should remain stable under plausible variations of weights, thresholds, or assumptions	Support the ranking with sensitivity analysis, robustness checks, or ensemble validation	Hybrid/ensemble configurations, robustness-oriented combinations	Procedures exposed to contestation or requiring stronger ex post defensibility
Need for modular evaluation design	Procurement often includes distinct analytical functions: weighting, ranking, screening, and robustness testing	Prefer methodological configurations rather than a single technique when different stages require different analytical properties	Modular architectures (e.g. AHP/BWM + TOPSIS/EDAS; PROMETHEE for threshold checks; DEA for screening)	Complex evaluation settings requiring differentiated analytical functions

4 Discussion and Conclusions

This paper's contribution definitively clarifies a crucial methodological point: in public procurement, the choice of MCDA technique is integral to the design of the assessment. The method selected influences the form of the comparison between offers, the degree of compensation between criteria, the traceability of the judgment, the robustness of the final ranking and, more generally, the defensibility of the outcome of the procedure. It is crucial to understand that selecting the method is not just an additional technical step. It is a key component of the evaluation design's quality. This approach is in clear continuity with the evidence from the review [1]. This showed the growing diffusion of MCDAs in procurement and the persistence of critical issues. These issues are related to the transparency of methodological choices, the limited use of robustness controls and the incomplete standardisation of environmental and social criteria.

On this basis, the paper proposed a two-layer framework. The first layer operates as a filter of regulatory compatibility and delimits the set of methods that can be incorporated into a procedure that requires predetermination of the rules, intelligibility of the procedure, verifiability of the outcome and control of discretion. The second layer, on the other hand, acts on the level of methodological congruence and allows to select, within the set thus defined, the techniques or configurations of techniques most consistent with the required evaluation function, with the compensatory structure of the problem, with the form of the available data, with the possible interdependence of the criteria and with the expected level of robustness. The most interesting element of the framework therefore lies in having formalized a logic of contextual selection, capable of making explicit steps

that in administrative practice often remain implicit or entrusted to habits that are not fully justified.

A further conceptual result of the work consists in having made clearer the distinction between single method and methodological architecture. The evidence in the literature and the proposed operational matrix converge in showing that, in many tender contexts, the most coherent solution does not coincide with the isolated adoption of a single technique. More often, the quality of the evaluation design depends on the combination of different functions: structured methods for the definition of weights, streamlined and verifiable techniques for the final ranking, possible preliminary screening tools, sensitivity analysis and robustness checks. From this point of view, the framework contributes to shifting the attention from the repertoire of available methods to the design of an evaluation configuration consistent with the decision-making and institutional context.

The work has some limitations. The framework derives from a theoretical-operational reworking of the evidence already consolidated in the literature and, although it has been accompanied by an illustrative application, it has not yet been subjected to extensive validation on real procedures. Furthermore, its formulation is strongly anchored to the context of regulated public procurement, in which the logic of the best quality/price ratio, the ex ante formalization of the evaluation rules and the need to make the procedural outcome controllable and defensible take on particular importance. Finally, the same initial review highlights conditions that may limit the full operation of the framework, in particular the weak standardization of some categories of criteria, especially environmental and social, and the still limited use of structured sensitivity analysis and methodological reporting procedures.

From these limits derive some directions of development. A first line of research concerns the empirical validation of the framework on real cases of selection between design alternatives, so as to verify whether the proposed double filter actually leads to more robust, transparent and better motivated methodological choices. A second line concerns the comparative extension to different institutional and regulatory contexts, useful for understanding the extent to which the regulatory dimension modifies the criteria for selecting techniques. A third line concerns the strengthening of the framework through the systematic integration of robustness checks, sensitivity analysis and minimum reporting protocols, so as to make the use of MCDAs in procurement more controllable, replicable and comparable [25–31].

Overall, the value of the contribution lies in having transformed the evidence in the literature into a more explicit methodological selection device closer to the real needs of public evaluation. The proposed framework does not identify a universally preferable technique. Rather, it offers a conceptual and operational basis for selecting and combining methods in a manner consistent with procedural constraints, with the structure of the decision-making problem and with the quality of the information available. In this sense, the paper argues that, in public procurement, the choice of the MCDA technique should be treated as an evaluative design decision in its own right, and not as a secondary element of the award process.

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