

01-047 – Contract modifications and their relationship with awarding criteria: an analysis of Spanish public procurement data – Las modificaciones contractuales y su relación con los criterios de adjudicación: análisis de datos de licitaciones públicas españolas.

Alonso Iglesias, Guillermo¹; Ortega Fernández, Francisco¹; Rodríguez Montequín, Vicente¹;
Alonso Álvarez, Cristina¹
(1) Universidad de Oviedo

 Spanish  Spanish

Public procurement is a pivotal mechanism for managing state resources and a major driver of economic activity. Nevertheless, modifications introduced after contract award are a recurring issue that often leads to inefficiencies and cost overruns. Such changes may stem from various factors, including the inadequate selection of the most suitable offer. Given that price frequently serves as the predominant criterion in Spanish tenders, it is relevant to investigate how this focus influences the likelihood of incurring modifications and, consequently, compromises project efficiency. This study is based on an extensive dataset of Spanish public procurement processes, collected between 2015 and 2024, encompassing over 500,000 cases from different productive sectors. Drawing on this empirical evidence, we compare various award criteria—whether economic, technical, or otherwise—with the frequency and impact of the resulting contract modifications. The principal aim is to identify how the nature of these criteria affects the incidence of deviations in both works and service contracts, while accounting for differences across sectors. The findings provide valuable insights for improving planning and decision-making in future procurement processes.

Keywords: *Public procurement; Contract modifications; Awarding criteria*

Las licitaciones públicas son un elemento crucial en la gestión de recursos estatales, así como uno de los principales motores de la economía. Sin embargo, la aparición de modificaciones tras la adjudicación constituye un problema recurrente que conlleva habitualmente ineficiencias y sobrecostes. Estas alteraciones pueden responder a múltiples factores, como la inadecuada elección de la mejor oferta. Dado que el precio suele ser el criterio preponderante en los concursos españoles, resulta pertinente examinar cómo este enfoque afecta la probabilidad de generar modificaciones y, por tanto, comprometer la eficacia de los proyectos. El presente estudio se sustenta en el análisis de una extensa base de datos de licitaciones públicas en España, recopilada entre 2015 y 2024, abarcando más de 500.000 casos de diferentes sectores productivos. A partir de esta evidencia empírica, se comparan criterios de adjudicación (ya sean económicos, técnicos u otros) con la frecuencia e impacto de las modificaciones. El objetivo principal radica en identificar cómo la naturaleza de los criterios influye en la aparición de desviaciones en contratos de obra y servicio, estudiando las diferencias entre sectores productivos. Estos resultados aportan gran valor de cara a la planificación y adjudicación de futuras licitaciones.

Palabras claves: *Contratación pública; Modificaciones contractuales; Criterios de adjudicación*

Acknowledgments:

Investigación apoyada por el proyecto: Bid rigging detection in public tenders using Machine Learning and Artificial Intelligence - SmartBidRigging - PID2023-146244OB-I00



©2025 by the authors. Licensee AEIPRO, Spain. This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The public procurement sector plays a critical role in the global economy, accounting for an average of 13% of the Gross Domestic Product (GDP) in OECD countries (Public Procurement Performance, 2023). This figure underscores the significance of procurement not only as a mechanism for the acquisition of goods and services by the public sector, but also as a key driver of economic growth and sustainable development.

Public procurement has a direct impact on various sectors, such as construction, healthcare, transportation, and infrastructure development. It stimulates economic growth by creating business opportunities for suppliers and contractors, generating employment, and fostering innovation (Rhode, 2019).

Award criteria in public tenders are essential in shaping the efficiency, transparency, and fairness of the procurement process (Tavares et al., 2022). Generally, these criteria are divided into objective criteria—measurable through objective formulas—and subjective criteria, based on value judgments. Of these two types, the cost or price criterion has historically been dominant in award decisions (Alonso-Iglesias et al., 2023).

However, this approach is being revised toward a more holistic balance that includes quality, innovation, and sustainability (Fregonara et al., 2022). The inclusion of social and environmental criteria in public works tenders has thus far been limited, representing an area of improvement for aligning procurement practices with sustainable development goals (Fuentes-Bargues et al., 2017).

In Spain, legislative efforts have been made, such as the enactment of LCSP 9/2017 (Ley 9/2017, de 8 de noviembre, de Contratos del Sector Público, por la que se transponen al ordenamiento jurídico español las Directivas del Parlamento Europeo y del Consejo 2014/23/UE y 2014/24/UE, de 26 de febrero de 2014., 2018). One of its primary goals is to promote a balanced approach between qualitative and economic criteria, aiming for the best value for money rather than merely the cheapest bid. Nevertheless, cost remains by far the most decisive factor in many award processes. This suggests that, although legislative and regulatory progress has been made, the effective practice of incorporating broader criteria into public tenders continues to be a challenge requiring ongoing attention, as is also observed in other countries (Zadawa et al., 2015).

Recent studies on public procurement award criteria generally fall into three main areas of research:

- Development of selection or evaluation methodologies to determine the best criteria for a specific project portfolio (Niewerth et al., 2022).
- Integration of environmental and social criteria into public procurement (Fuentes-Bargues et al., 2021).
- Innovation in public procurement and its role as a driver (Obwegeser & Müller, 2015).

However, few studies analyze award criteria from a data science perspective, leveraging large databases of projects. This is primarily due to the significant difficulty, until now, of compiling such databases.

Another widely studied global issue in public procurement projects is cost overruns (Flyvbjerg et al., 2002). One of the main causes of cost overruns in civil engineering projects is so-called “change orders,” initiated or accepted by the public administrations sponsoring the projects.

These change orders give rise to conflicts, delays, legal disputes, reduced productivity, and consequently, project cost overruns (Salazar et al., 2024).

Project change orders have been defined in the literature as tasks or work added to or removed from the initial scope of a contract, thereby altering the original contract budget and/or timeline (Love & Ika, 2021). Research on change orders can be divided into two main lines: the development of processes to mitigate their effects (Du et al., 2019) and the study of their causes and impacts (Naji et al., 2022). Within the line of process or methodology development for mitigating these effects, the applicable legal framework emerges as a critical factor.

Over the past decades, Spain's public procurement legal framework has been reformed to limit abusive practices involving change orders and cost overruns in public contracts, wherein winning bidders submit extremely low bids and plan to recoup profits through these change orders (Pedro Mediavilla, 2015). Under RD 2/2000, the contract amount could be increased up to 20% of the tender budget, facilitating significant abuses. Consequently, the European Commission initiated an infringement procedure against Spain in 2008. To address this, Law 2/2011 on Sustainable Economy and RD 3/2011 set a 10% limit for unforeseen change orders. Although these measures helped to control cost overruns, Directive 2014/24/EU was approved in 2014, and eventually, Law 9/2017 on Public Sector Contracts introduced new thresholds for anticipated change orders (up to 20% of the initial price) and unforeseen change orders (up to 50%). The inability to terminate the contract without incurring greater losses for the Administration also encourages acceptance of these changes, leading to the execution of projects with significant cost overruns. Moreover, extraordinary no substantial change orders are allowed, with limits of 15% for works and 10% for other contracts.

Although Law 9/2017 was drafted with the objective of strengthening competitive tendering and transparency, the permissiveness of the European Directive contrasts with Spain's intention to curb abuses. In addition, aspects such as price review or contradictory prices are excluded from these considerations, each governed by its own regulations.

This study aims to investigate possible relationships between public procurement award criteria and subsequent change orders, examining both their occurrence rate and their relative amount (expressed as a percentage). This analysis is conducted from a large-scale data perspective by constructing a database of actual public procurement projects.

2. Objectives

The primary objective of this study is to examine the potential relationships between award criteria and the use of change orders in Spanish public tenders. A large database of real public procurement projects is used to conduct this analysis, focusing specifically on time trends, productive sectors, and the various types of award criteria.

To achieve this main objective, the following secondary objectives are established, enabling a more detailed and specific understanding of the various dimensions of the study:

- Create a detailed tender database that serves as the foundation for the analysis.
- Study the relationships both in terms of the incidence rate of contractual change orders and their relative size.
- Analyze these relationships according to their temporal evolution, the productive sector, and the predominant award criterion.

This work aligns with Sustainable Development Goal (SDG) 9, which promotes industry, innovation, and infrastructure. By examining how procurement procedures can foster more equitable, transparent, and sustainable public contracting practices, this research contributes

to the debate on improving infrastructure and promoting inclusive and sustainable industrialization. In the long term, the effective implementation of award criteria that balance cost with quality, innovation, and sustainability, while minimizing future change orders that reduce project efficiency, could positively affect the development of resilient infrastructure and promote innovation in the public sector.

Attaining these objectives will not only provide a thorough analysis of the current state of award criteria and change orders in Spain but will also make a significant contribution to the debate on how procurement procedures can be optimized to better reflect the values of transparency, efficiency, and sustainability demanded by society.

3. Methodology and Tools

The methodology used in this research can be divided into several processes. First, a literature review was carried out to identify the state of the art in public procurement analysis, with special emphasis on valuation and award processes.

Next, tasks related to the development of the study database were conducted, which can in turn be divided into those related to the acquisition of raw data and those related to the filtering and processing of the acquired data.

Finally, data analysis tasks were carried out, primarily using descriptive statistical methods and variables, leading to the results and conclusions of this research.

3.1 PLACSP and Data Acquisition

Public administrations in Spain have devoted efforts to modernizing and digitizing public procurement and tendering processes, focusing on improved transparency and data accessibility.

Article 347 of the LCSP (*Ley de Contratos del Sector Público*, translated as Public Sector Procurement Law) defines PLACSP (*Plataforma de Contratación del Sector Público*, translated as Public Sector Procurement Platform) as an “electronic platform that enables the online publication of contractor profiles, as well as other services related to the digital processing of such information.” It serves as the centralized platform where state, regional, and local administrations must publish their tender data, whether directly or through aggregation in cases where autonomous communities have their own platforms. Since the implementation of the LCSP in 2018, there has been a substantial increase in the number of tenders published on PLACSP.

The open data sets available on PLACSP are provided in *.atom* format (structured and tagged XML files) and are updated daily. These data sets are continuously updated and refined according to a standard format known as CODICE. The available information includes bidding or awarded prices, number of bidders, the contracting administration, the contract’s CPV code, dates, required guarantees, and recorded change orders, among others.

There are two ways to access PLACSP data. The first involves downloading the *.atom* files directly, then examining and extracting the data programmatically in XML, and finally incorporating them into a private database. Alternatively, in 2021, the Sub-Directorate for Coordination of Electronic Procurement introduced OpenPLACSP, which allows users to conveniently extract data from *.atom* files into Excel format. However, while users can select

up to 25 different fields with this application, certain fields—such as mandatory guarantees, recorded modifications for a project, or award criteria—cannot be chosen.

As a result, this study employs a mixed methodology for data retrieval. On the one hand, all available cases and fields are obtained using the OpenPLACSP application. On the other hand, a custom XML script was developed to retrieve fields related to award criteria from the .atom files, then integrate them into the previously generated database from OpenPLACSP. It is important to note that only cases uploaded directly to PLACSP profiles (and not from aggregated platforms) include data on award criteria and change orders, which limits the scope of the database.

A major challenge in using PLACSP data is data quality. Despite the large volume of retrievable information, the lack of validation systems or processes within PLACSP leads to frequent cases with empty fields, formatting errors, and incorrect values. Examples include inconsistently formatted tax identification numbers (NIF), numeric values with incorrect decimals, and the main inconsistency: the handling of contract divisions into multiple lots.

Therefore, processing, selecting, and cleaning data have been crucial in preparing the final database for this study, resulting in a refined database with improved data quality.

3.2 Data Processing and Filtering

From the initial data retrieval, using the XML .atom file-reading script, more than 500,000 different projects were obtained, each with their respective award criteria. These criteria are presented in three variables: “contractID” (the project identifier), “WeightNumeric” (the percentage weight of the criterion), and “Description” (a text description of the criterion used).

In the first stage of variable processing, the goal is to transform the variables related to the description of criteria—“WeightNumeric” (the percentage weight of the criterion) and “Description” (the text description)—into three specific variables:

- Price/Cost criteria: corresponds to the percentage weight of the project’s cost criterion.
- Other objective criteria: corresponds to the percentage weight of other objectively measurable criteria, excluding price or cost, such as execution timelines or warranties.
- Value Judgment criteria: corresponds to the percentage weight of nonobjective, value-judgment-based criteria.

To create these variables, text analysis models in R software are applied. By analyzing the “Description” field for each criterion, the criterion is classified into one of the three final variables, assigning it the corresponding percentage weight (“WeightNumeric”). Notably, there are often multiple criteria encompassed within one of the three final categories, which are then summed to obtain an aggregate value. For example, if multiple economic criteria appear separately (e.g., personnel cost and materials cost), they are consolidated and summed under the final variable “Price/Cost criteria.”

Thanks to this transformation, instead of having one case per criterion per project, each project becomes a single case in which the three new variables capture its award criteria. Subsequently, the newly obtained award criteria database is merged with the database of project characteristics obtained through OpenPLACSP (using the common, unique identifying variable “entryID”), producing the final procurement award database for this study.

However, as previously noted, data quality is low, making it necessary to apply a set of data processing and filtering steps to ensure the quality of the final database, ultimately reducing

the total number of projects in the award database to 363,878. Among the primary cleaning filters are:

- Elimination of duplicated cases, selecting the most recent entry.
- Elimination of cases where the sum of the percentage weights of their criteria does not equal 100%.
- Elimination of cases where the awarded contract amount is less than €5,000.

From the second data retrieval using the XML .atom file-reading script, a change-order database was obtained, containing 29,011 different cases (including different lots for the same project). Cross-referencing these with the award database shows that 18,255 cases (5.01%) out of 363,878 included contract modifications. This again reflects poor data quality, as not all recorded cases contain complete information or variables, leading to situations where modification data exist but not the award criteria used.

Following the cleaning and processing steps for this second database on modifications, 13,187 cases remain. Key operations include:

- Elimination of duplicate cases or cases sharing values in the studied variables, selecting the most recent entry.
- Elimination of cases where the awarded contract amount is less than €5,000.
- Elimination of cases in which the final amount after modification is €0, indicating project cancellation.
- Calculation of additional variables such as Percentage of bid reduction, Percentage of modification, etc.
- Removal of 785 outliers using the interquartile range (IQR) criterion for the Percentage of modification variable.

4. Results and Discussion

4.1 Databases

As a result of the data acquisition, cleaning, and processing procedures, two databases were generated: one related to award criteria, called the Awarding_DB (with a total of 363,878 cases), and another related to contract modifications (Modification_DB), containing 13,983 cases.

In addition to the three variables concerning the percentage weights of award criteria mentioned previously for Awarding_DB, Table 1 lists the other fields or variables utilized. For the categorical variables, the number of observations in each category is shown in parentheses.

It is worth noting the CPV (Common Procurement Vocabulary) variable, which refers to a standardized classification system for the economic sector covered by the project, using a unique 9-digit code for each economic activity. For instance, cases where the CPV code begins with “45*” correspond to construction projects. For the purposes of this study, these CPV codes have been truncated to only the first two digits of the code.

Table 1: Awarding_DB dataset variables description.

Variable name	Type	Description
Price/Cost criteria	Percentage	Percentage weight of the price/cost criterion
Other objective criteria	Percentage	Percentage weight of other objective criteria (formula-based, excluding price)
Value judgement criteria	Percentage	Percentage weight of value judgement criteria
Contract type	Categorical	Contract type as defined by LCSP 9/2017: Services (152685) – Supplies (136646) – Works (65431) – Private (5155) – Public Service Management (178)
Procurement type	Categorical	Procurement procedure type: Open (163182) – Open simplified (136054) – Negotiated without Advertising (28314) – Derived from Macro Agreement (24686) – Internal Rules (4829) – Restricted (3113) – Negotiated with Advertising (2778)
Urgency	Categorical	Urgency of the process: Ordinary (348657) – Urgent (13146) – Emergency (2075)
CPV	Categorical	CPV division associated with the contract
First published	Date	Year of first publication: 2014 (25) – 2015 (161) – 2016 (2479) – 2017 (9344) – 2018 (24166) – 2019 (36445) – 2020 (37051) – 2021 (49811) – 2022 (60252) – 2023 (67607) – 2024 (71948) – 2025 (4589)
Bid reduction	Percentage	Percentage reduction between base budget and awarded bid
Modified	Binary (Yes/No)	Indicates whether the contract was modified after awarding

The summary statistics for the Awarding_DB dataset reveal a highly heterogeneous distribution of project sizes, as shown in Table 2. Although the average bid reduction is considerable, the wide range from the minimum to the maximum suggests outliers and varied procurement contexts. Evaluation criterion weights show that price dominates most tenders (mean ~66%), while value judgment and other objective criteria remain secondary (mean ~31% and ~2%, respectively). The distribution indicates limited reliance on multidimensional evaluation. These figures reflect a procurement system where cost remains the primary driver, potentially at the expense of qualitative or innovative assessments. The variability underscores the need for segmentation by other fields such as time, CPV, or the predominant criterion.

Table 2: Summary statics of Awarding_DB dataset.

Variable	Min.	Mean	Max.	Median	Q1 (25%)	Q3 (75%)
Price/Cost criteria(%)	0	74.59	100	80	51	100
Other objective criteria (%)	0	3.77	100	0	0	0
Value judgement criteria (%)	0	21.63	98	10	0	44
Tendering Price (€)	0	479,470.1	1.7E+09	56,754.07	23,839.85	16,5157.6
Tenders (n)	1	3.85	615	2	1	4
Awarding Price (€)	5000.1	367,676.4	1.65E+09	48,796.91	21,000	135,000
Bid reduction (%)	0	0	99.99	7.945	0	21.37

Table 3 shows the categorical variables for Modification_DB. Variables such as contract type and procurement authority are well represented across different institutional levels, with a notable concentration in public works. The descriptive summary of evaluation criteria shows that most contracts still emphasize price, while value judgment and objective criteria receive lower weight. The variety in the Last updated variable indicates a long-time span, enabling time-based analysis. This structure allows for segmentation of modification behavior across institutional contexts and evaluation strategies, forming a solid basis for investigating systemic patterns and the effect of contract design on modifications.

Table 3: Modification_DB dataset variables description.

Variable name	Type	Description
Price/Cost criteria	Percentage	Percentage weight of the price/cost criterion
Other objective criteria	Percentage	Percentage weight of other objective criteria (formula-based, excluding price)
Value judgement criteria	Percentage	Percentage weight of value judgement criteria
Contract type	Categorical	Contract type as defined by LCSP 9/2017: Services (152685) – Supplies (136646) – Works (65431) – Private (5155) – Public Service Management (178)
Procurement type	Categorical	Procurement procedure type: Open (163182) – Open simplified (136054) – Negotiated without Advertising (28314) – Derived from Macro Agreement (24686) – Internal Rules (4829) – Restricted (3113) – Negotiated with Advertising (2778)
Urgency	Categorical	Urgency of the process: Ordinary (348657) – Urgent (13146) – Emergency (2075)
CPV	Categorical	CPV division associated with the contract
Last updated	Date	Year of last update: 2017 (52) – 2018 (169) – 2019 (662) – 2020 (1033) – 2021 (1255) – 2022 (2025) – 2023 (3238) – 2024 (3864) – 2025 (865)
Modification	Percentage	Modification cost as percentage of the awarded amount

The descriptive statistics for Modification_DB (shown in Table 4) reveal a wide range of modification cost percentages, with a mean much lower than the maximum, indicating a small number of high-impact cases. After filtering outliers, the distribution becomes more representative of typical project behavior. On average, price remains the most influential criterion, while value judgment and other objective criteria continue to have lower weights. The relatively narrow interquartile range for other objective criteria confirms their marginal role. These patterns highlight a system still strongly influenced by price, even in contracts with considerable cost deviations.

The use of logarithmic transformations for economic variables is a common practice in similar analytical studies, particularly when dealing with highly skewed distributions. However, in this descriptive section, standard statistical measures such as the median and interquartile range were preferred to better capture the underlying distribution of each variable without introducing interpretative complexity.

In subsequent graphical analyses, most variables are already expressed as relative percentages, for which a logarithmic transformation did not improve interpretability. An

exception is Figure 5, where a log scale was applied to the absolute monetary values of contract modifications, as it proved useful to visualize dispersion and detect high-impact outliers more effectively.

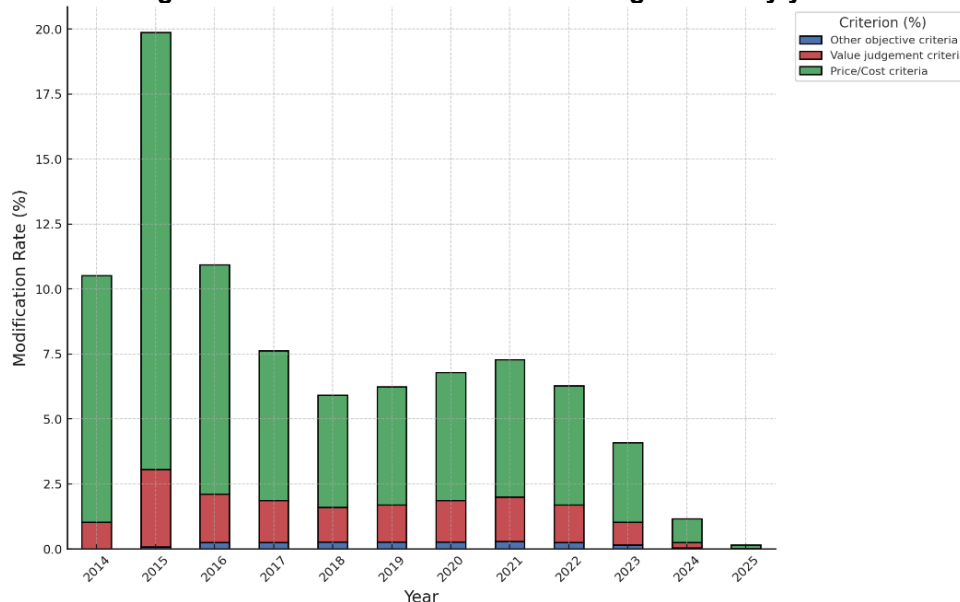
Table 4: Summary statics of Modification_DB dataset.

Variable	Min.	Mean	Max.	Median	Q1 (25%)	Q3 (75%)
Price/Cost criteria(%)	0	66.47	100	60	49	95
Other objective criteria (%)	0	2.37	100	0	0	0
Value judgement criteria (%)	0	31.14	98	35	0	50
Tendering Price (€)	0	1,307,723	4.29E+08	109,318.2	32,833.2	458,018.5
Tenders (n)	1	4.23	73	2	1	5
Awarding Price (€)	5,012.8	1,150,237	3.66E+08	92,591	28,480	394,949.5
Final Price (€)	5,136.67	1,484,458	3.69E+08	130,144.5	46,044.1	535,789.9
Modification (%)	0	59.77	7,458.34	33.15	12.55	100

4.2 Graphical representation discussion

Below, an analysis and discussion of graphical results for the gathered data are presented. Each analysis will include a joint discussion of the Awarding_DB dataset, focusing on the ratio of modifications, and the Modification_DB dataset, focusing on the relative size of these modifications.

Figure 1: Modification rate and awarding criteria by year.

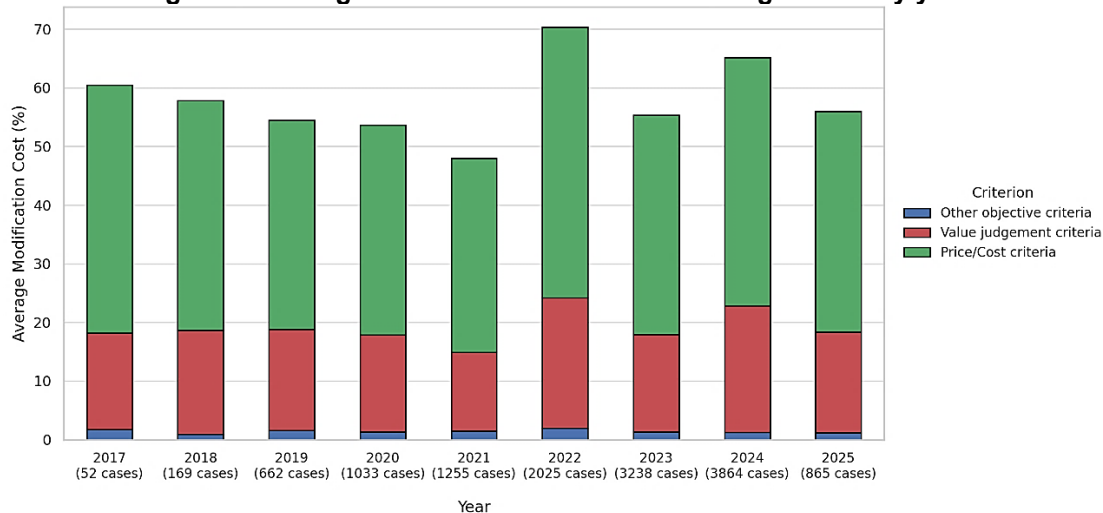


First, the temporal evolution of award criteria and their relationship with contract modifications is illustrated in Figure 1 and Figure 2. There is a clear downward trend in the ratio of contracts incurring modifications between 2015 and 2025, with a particularly pronounced drop beginning

in 2018. This point coincides with the entry into force of Law 9/2017, suggesting a possible positive regulatory effect on controlling contract modifications.

However, this reduction in frequency does not translate into lower severity. The average cost of modifications, expressed as a percentage of the awarded amount, remains relatively stable, ranging between 50% and 70%. The year 2022 stands out with a substantial increase in this indicator, indicating that although there are fewer modifications, those that occur still have a considerable economic impact.

Figure 2: Average modification cost and awarding criteria by year.

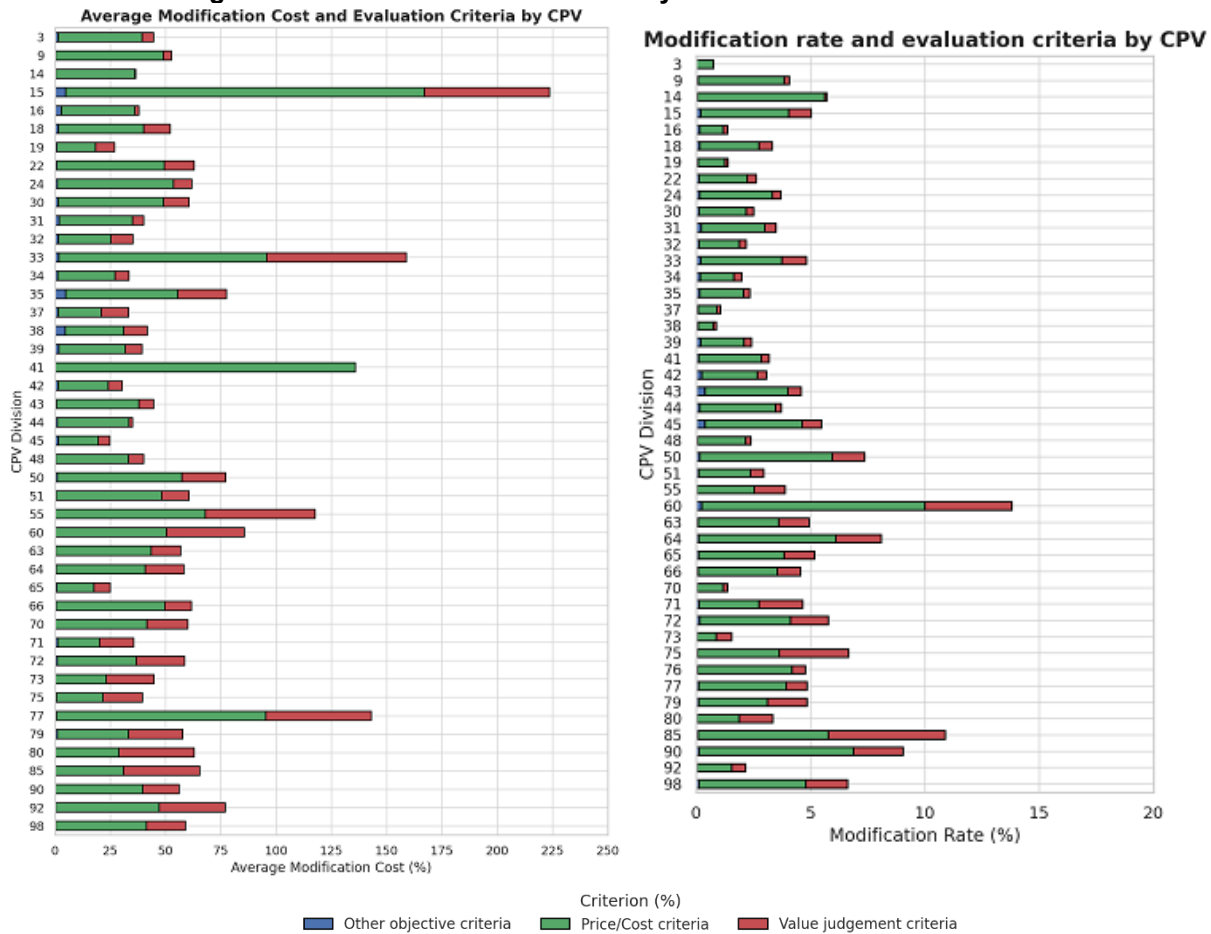


Regarding award criteria, the economic criterion remains clearly dominant throughout the analyzed period, although a slight increase in the value judgment criterion is observed in more recent years. Although this change is modest, it could indicate the early stages of a shift toward integrating qualitative criteria, in line with the aims of current legislation.

These findings highlight the need to review the balance between economic and qualitative criteria. While the decline in the frequency of modifications points to normative improvement, the stability of average costs suggests that current award criteria still do not guarantee the effective containment of budget deviations.

Segmenting projects by CPV division provides deeper insights into sectoral differences in both the incidence and economic impact of modifications. Figure 3 shows that some sectors have high modification rates, such as CPV 60 (transport services), 85 (health and social care services), and 90 (sewage, refuse, cleaning, and environmental services), while others, such as CPV 3 (agricultural products), 16 (agricultural machinery), or 38 (laboratory equipment), record almost negligible incidence. This variability suggests that the sector of activity significantly influences contractual stability, revealing that supply sectors—which are presumably more predictable—see fewer modifications.

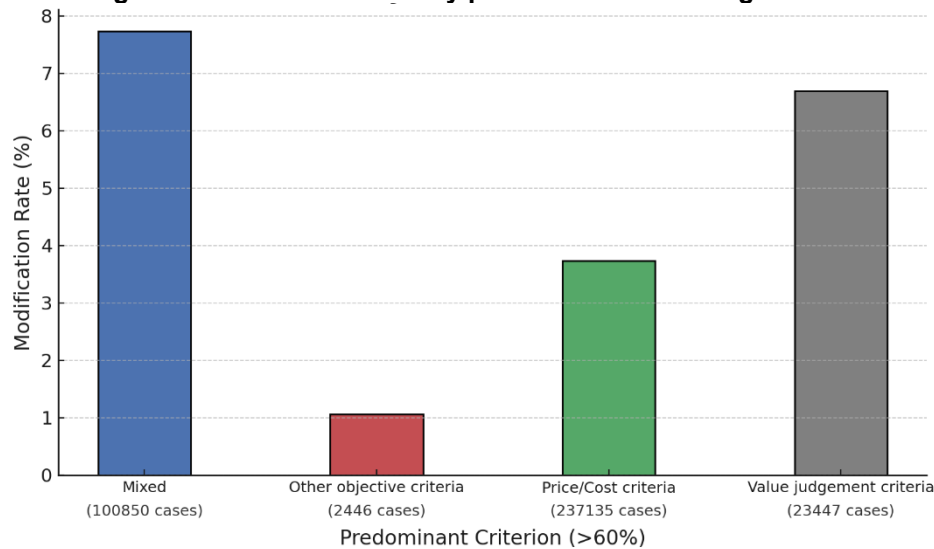
In terms of the average cost of modifications also shown in Figure 3, marked contrasts are also evident. Some sectors—those represented by CPV 15 (food products), 33 (medical equipment), 41 (water collection and treatment), and 77 (agricultural and forestry services)—show mean deviations exceeding 100% of the awarded amount, suggesting poor planning or unforeseen external factors.

Figure 3: Modification rate and cost by CPV and evaluation criteria.

Moreover, the analysis reveals that the distribution of award criteria varies by sector. Although the economic criterion continues to predominate, certain CPVs, such as 60, 85, or 75 (public administration services), exhibit a higher proportion of value judgment criteria. The correlation between a high weight for subjective criteria and higher cost overruns raises questions about the need to revisit award strategies in highly complex sectors such as certain service provisions.

Figure 4 and Figure 5 explore the predominant award criterion in each contract (where a single type of criterion exceeds 60% of the weight). It allows for a closer look at its practical effects on project stability and economic performance. As shown in Figure 4, contracts without a clearly dominant criterion have the highest modification rate (7.8%). This “Mixed” group corresponds to the worst results in terms of modification frequency, reinforcing the possible conclusion, noted in prior analyses, that the lack of a dominant criterion can generate greater ambiguity in the evaluation, potentially leading to increased uncertainty during contract execution.

This finding raises an important consideration: striving for balance among criteria may not, in practice, guarantee efficiency. Instead, it could become a source of uncertainty that negatively affects contract execution.

Figure 4: Modification rate by predominant awarding criteria.

However, when examining which type of criterion becomes more problematic if predominant, value judgment emerges clearly. Contracts in which value judgment exceeds 60% of the weight have a high modification rate (6.7%), only slightly below the “Mixed” category, and higher than those dominated by the economic criterion (3.7%) or other objective criteria (1.0%). This suggests that award processes relying heavily on subjective components may not ensure stable contractual outcomes.

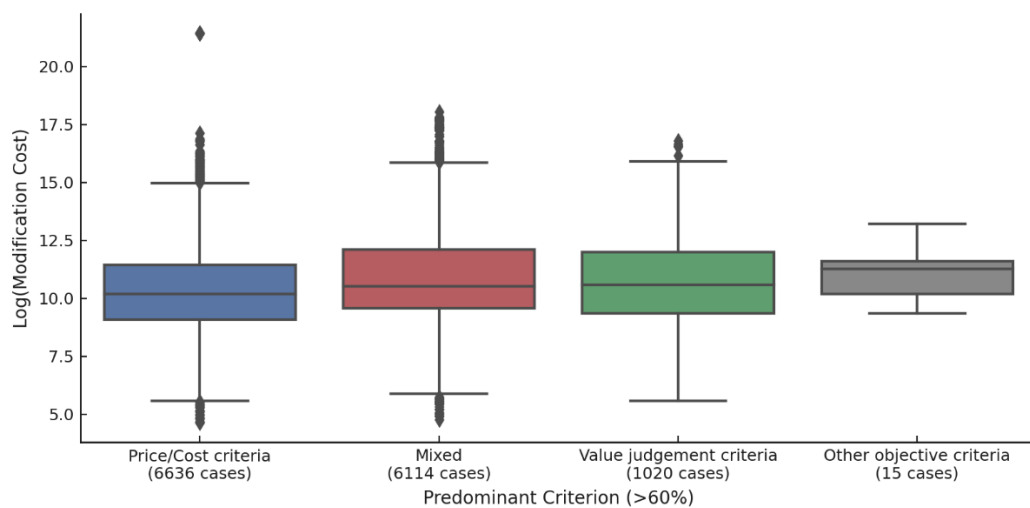
Figure 5: Distribution of Modification Cost by predominant awarding criteria.

Figure 5 deepens—but also nuances—the article’s earlier claim that subjective or evenly-balanced evaluations foster economic instability. The blue box (Price/Cost-dominated; $n \approx 6.6$ k) displays the tightest inter-quartile range and the lowest median log-cost, suggesting that a price-centred decision rule yields comparatively predictable overruns, even if those overruns remain non-trivial. Conversely, the red “Mixed” group ($n \approx 6.1$ k) presents a visibly taller box and longer whiskers, pointing to both higher central tendency and markedly greater dispersion;

the evaluation ambiguity already criticised in the text clearly propagates to post-award performance.

The green box (Value-judgement; $n \approx 1.0$ k) does not explode uniformly upward, but its upper whisker eclipses the price-based one and reaches the mixed-criterion level, confirming that subjectivity amplifies the tail risk of extreme modifications. However, its median is marginally below the mixed scenario, indicating that not every qualitatively-weighted tender is doomed—only that the volatility premium is larger.

Overall, the figure corroborates the article's broader narrative: prioritising price curbs variance, whereas blending criteria—or leaning heavily on qualitative assessments—magnifies cost-escalation uncertainty. Policymakers aiming for “best value” must weigh this volatility trade-off, not merely the mean outcome.

5. Conclusions and future research

The findings of this study underscore the pivotal role that award criteria play in the stability and economic performance of public contracts in Spain. Despite recent legal reforms (most notably the enactment of Law 9/2017) price continues to dominate tenders, and its prevalence appears linked to lower modification rates compared to value judgment criteria. Nonetheless, the severity of cost overruns remains significant, indicating that the mere reduction in the frequency of contract modifications does not necessarily translate into reduced budgetary impact.

An important insight is that tenders characterized by an evenly balanced distribution among price, objective, and value judgment criteria show higher modification rates and more substantial cost deviations than those with a clearly dominant criterion. This finding challenges the assumption that a uniformly weighted set of criteria necessarily yields more stable contracts. While the impetus toward qualitative factors aligns with broader policy objectives of sustainability and innovation, it also introduces potential ambiguity if not managed with well-defined, transparent metrics.

Sector-based segmentation reveals that specific activities, such as transport (CPV 60) or health and social care (CPV 85), are more prone to contract modifications and sizable overruns.

Looking ahead, further research could expand upon this analysis by incorporating additional dimensions, including project complexity indicators, market conditions, or supplier characteristics. Employing advanced data mining and machine learning techniques could yield predictive insights into high-risk contracts, enhancing the capacity for preventive measures.

In summary, while recent legislative measures show promise in reducing the overall frequency of contract modifications, the persistence of significant cost overruns indicates a need to refine award strategies. Developing clearer frameworks for evaluating qualitative elements and fostering evidence-based decision-making remain critical steps toward more efficient and transparent public procurement.

6. References

- Alonso-Iglesias, G., Ortega-Fernández, F., Rodríguez-Montequín, V., Skitmore, M., & Ogunmakinde, O. E. (2023). The Relationship between Cost Overruns and Modifications for Construction Projects: Spanish Public Works and Their Legal Framework. *Buildings*, 13(10), Article 10. <https://doi.org/10.3390/buildings13102626>
- Du, J., Jing, H., Castro-Lacouture, D., & Sugumaran, V. (2019). Multi-agent simulation for managing design changes in prefabricated construction projects. *Engineering, Construction and Architectural Management*, 27(1), 270-295. <https://doi.org/10.1108/ECAM-11-2018-0524>
- Flyvbjerg, B., Holm, M. S., & Buhl, S. (2002). Underestimating Costs in Public Works Projects: Error or Lie? *Journal of the American Planning Association*, 68(3), 279-295. <https://doi.org/10.1080/01944360208976273>
- Fregonara, E., Ferrando, D. G., & Tulliani, J.-M. (2022). Sustainable Public Procurement in the Building Construction Sector. *Sustainability*, 14(18), Article 18. <https://doi.org/10.3390/su141811616>
- Fuentes-Bargues, J. L., Bastante-Ceca, M. J., Ferrer-Gisbert, P. S., & González-Cruz, M. C. (2021). Analysis of the Situation of Social Public Procurement of Works at the Valencian Region (Spain). *Sustainability*, 13(1), Article 1. <https://doi.org/10.3390/su13010175>
- Fuentes-Bargues, J. L., González-Cruz, M. C., & González-Gaya, C. (2017). Environmental Criteria in the Spanish Public Works Procurement Process. *International Journal of Environmental Research and Public Health*, 14(2), Article 2. <https://doi.org/10.3390/ijerph14020204>
- Kerzner, H. (2017). Project Management Metrics, KPIs, and Dashboards. En *Project Management Metrics, KPIs, and Dashboards* (Third edit). John Wiley & Sons, Incorporated. <https://doi.org/10.1002/9781119427599>
- Ley 9/2017, de 8 de noviembre, de Contratos del Sector Público, por la que se transponen al ordenamiento jurídico español las Directivas del Parlamento Europeo y del Consejo 2014/23/UE y 2014/24/UE, de 26 de febrero de 2014., BOE-A-2017-12902 (2018).
- Love, P. E. D., & Ika, L. A. (2021). The 'context' of transport project cost performance: Insights from contract award to final construction costs. *Research in Transportation Economics*, 90, 101062. <https://doi.org/10.1016/j.retrec.2021.101062>
- Naji, K. K., Gunduz, M., & Naser, A. F. (2022). An Adaptive Neurofuzzy Inference System for the Assessment of Change Order Management Performance in Construction. *Journal of Management in Engineering*, 38(2), 04021098.
- Niewerth, S., Vogt, P., & Thewes, M. (2022). Tender evaluation through efficiency analysis for public construction contracts. *Frontiers of Engineering Management*, 9(1), 148-158. <https://doi.org/10.1007/s42524-020-0119-z>
- Obwegeser, N., & Müller, S. (2015). Innovation in Public Procurement: Terminology, Concepts, and Applications. *Social Science Research Network*. <https://doi.org/10.2139/SSRN.2771035>
- Pedro Mediavilla, R. de. (2015). *La ejecución del contrato de obra pública* [Http://purl.org/dc/dcmitype/Text, Universidad Rey Juan Carlos]. <https://dialnet.unirioja.es/servlet/tesis?codigo=184616>

- Rhode, A. (2019). *Public procurement in the European Union: How contracting authorities can improve their procurement performance in tenders*. Springer Gabler. <https://doi.org/10.1007/978-3-658-28073-4>
- Salazar, A., Pérez, J. F., & Gallego, J. (2024). VigIA: Prioritizing public procurement oversight with machine learning models and risk indices. *Data & Policy*, 6, e75. <https://doi.org/10.1017/dap.2024.83>
- Tavares, L., Ferreira, J., & Ricardo, A. (2022). A multicriteria model to evaluate tenders for green procurement of public works. *European Journal of Public Procurement Markets*, 4, 23-50. <https://doi.org/10.54611/AEZB4539>
- Zadawa, A. N., Hussin, A. A., & Osmadi, A. (2015). Determinants of compliance with public procurement guidelines in the Nigerian construction industry. *Jurnal Teknologi*, 75(9), Article 9. <https://doi.org/10.11113/jt.v75.5243>

Use of Generative Artificial Intelligence

No generative artificial intelligence was used in preparing this communication.

Communication aligned with the Sustainable Development Goals

