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PRINCIPLES FOR INTEGRITY IN REDISTRICTING

by

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This chapter defines redistricting and analyzes its relationship with electoral integrity. It describes redistricting's relationship to the four guiding principles of this book–*contestation, participation, deliberation*, and *adjudication.* It characterizes the role played by the various actors and the rules used to implement the process. It identifies how redistricting can undermine electoral integrity, which mechanisms can aid in making this process more accountable, and discusses the foundational methods to evaluate the process and its outcomes. Finally, the chapter concludes by delineating key questions for scholars and offering policy recommendations for practitioners interested in redistricting.

Keywords: Electoral Boundaries, Integrity, Redistricting, Gerrymandering

What is redistricting?

Electoral boundary delimitation–also referred to as redistricting in the United States or as redistribution in the UK–is the creation of geographically defined electoral subdivisions within a country's administrative divide, such as states or regions (Cox and Katz 2002, Handley and Grofman 2008). Its primary objective is to enable the representational recognition of geographically linked communities subject to the principle of equal voting power. This principle, also known as the "one person, one vote principle," is met by ensuring that the population is relatively balanced across legislative electoral districts (Venice Commission 2017).[1]

According to the ACE Electoral Knowledge Network, two-thirds of countries around the Globe have some form of boundary delimitation (ACE 2024). This process usually happens after population shifts occur–due to migration or natural demographic changes affected by birth and mortality rates. Redistricting can also occur after a country's administrative boundaries have been modified or when a new electoral system has been adopted to elect legislative representatives.

Redistricting advances democracy to the extent that it translates citizen preferences into votes, votes into representative seats, and seats into substantive policies. Redistricting rules–including the restrictions considered, the data used in the process, and the actors enabled to participate– substantially affect the probable

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distribution of legislative seats. Further, its credibility depends on the structure, independence, and resources of the institutions managing the process.

Except for a few cases where the legislative branch still controls redistricting (e.g., the US and France), most countries have delegated this process to independent electoral bureaucracies (Handley 2008:265). While redistricting's core purpose appears straightforward, it is one of the most politicized and technically challenging procedures to implement in many countries (Handley and Grofman 2008:3-4).

Redistricting typically requires two phases. First, population is measured through a census, and seats are (re)apportioned across regions, typically proportional to each region's population. Second, each region is subdivided into an assigned number of districts based on constitutional requirements, statutes, and regulations (Cain 1984).

Reapportionment and redistricting have significant consequences for political representation. For example, districts can become unbalanced in population ("malapportioned") when either census measures or apportionment is infrequent.[2] Furthermore, the rules used to distribute seats among states can create an imbalance favoring a particular political group (Cain 1984, Cox and Katz 2002, Johnston, Pattie, and Rossiter 2008).

Further, boundary lines can be directly manipulated for political advantage (Cox and Katz 2002). The term *gerrymandering,* referring to this type of direct manipulation, originated in the US state of Massachusetts, where senate districts were drawn resembling a “salamander shape.” The extent and importance of gerrymandering in the US is particularly well-documented (Tufte 1973, Erikson 1972, Cox and Katz 2002, and Engstrom 2006). Overall, it shows how: i) redistricting can substantially affect political representation; ii) partisan actors systematically try to maximize their electoral returns or expected seats through gerrymandering; and iii) specific institutional configurations–i.e., independent commissions–can mitigate gerrymandering.

Although the US is an outlier, it has captured the world’s attention because of its high politicization, litigation, and political manipulation (McDonald 2008). Other countries, however, have not been exempt from controversy and allegations of bias (Kasara 2014, Wong 2019, Daxecker 2020). Politicians in many third-wave countries have tried to influence redistricting by drawing electoral maps that: i) maximize the number of legislative seats parties expect to win; ii) improve the winning odds of incumbents; or iii) undermine the representation of communities of interest.

Electoral manipulation in redistricting can occur in hybrid–or electoral authoritarian–regimes such as Venezuela during Chávez and Maduro (Monaldi 2010, Briceño 2013 and 2017), developing countries, such as Kenya (Greiner 2013) and St. Kitts and Nevis (Midgett 2003), or well-established democracies such as the UK (Rossiter, Johnston, and Pattie 1999). This chapter offers a comprehensive approach to redistricting by discussing key concepts and focusing on four fundamental principles for electoral integrity–*contestation, participation, deliberation*, and *adjudication.* It provides

a perspective beyond the classic debates found in the literature focusing on well-established democracies (Butler and Cain 1992, Johnston, Rossiter, and Pattie 1999, Jackman 1994, Cox and Katz 2002, Sauger and Grofman 2016).[3]

Key concepts in redistricting

Redistricting in Majoritarian, Mixed, and Proportional Electoral Systems

The relevance of redistricting varies widely depending on the type of electoral system used to elect legislative representatives. Redistricting generally has the most impact on outcomes in election systems with single-member electoral districts, such as the United States, and the least impact in fully proportional systems (Handley 2018, Martinez i Coma and Lago 2018).[4]

In a comparative study focusing on the perceptions of gerrymandering in 54 democracies around the Globe, Martínez i Coma and Lago (2018) find that majoritarian systems are perceived to be more prone to gerrymandering than mixed-member and proportional representation systems. Some cases, such as Venezuela, confirm this trend by showing how tensions surrounding the redrawing of electoral boundaries substantially increased after the country transitioned from a predominantly proportional system to a majoritarian one (Monaldi 2010 and Corrales 2022).

In between these extremes, the importance of redistricting within the mixed-member family of electoral systems–the mixed-member proportional (MMP) and mixed-member majoritarian (MMM)–tends to be less pronounced in the former. While the proportional tier in the MMP system compensates for the seat-to-vote distortion introduced by the majoritarian tier, the effect of the MMM system on election outcomes becomes more pronounced as the ratio of majority to party list seats increases. Germany and New Zealand are probably the most emblematic cases using the MMP system. Examples of the MMM system include Russia, Mexico, Japan, Italy, and Venezuela.

Representational Objectives and Redistricting Authorities

Countries relying on district-based systems derive value from organizing elections using a geopolitical subdivision that: i) establishes a direct connection between voters and representatives; ii) reflects communities of interest by providing voters with opportunities to elect candidates that they identify with or that truly represent them (representativeness); and iii) ensures the equal influence of voters across districts.[5] Compared to proportional systems, these representational objectives are advantaged in district-based systems that convert votes into representative policies (e.g., minor parties in proportional systems with extreme views can play a pivotal role in governing coalitions generating non-representative policy outcomes). However, district-based systems are inherently weaker at satisfying criteria directly related to translating votes

into seats–such as responsiveness, proportionality, and bias (Butler and Cain 1992, Herron et al. 2018).

Fulfilling these representational objectives–legislator-voter connection, representation of communities of interest, and equipopulous districts–varies tremendously depending on a country's demographic, geographic, administrative, and institutional characteristics. What all majoritarian-based systems have in common is that multiple representational objectives (e.g., responsiveness, proportionality, and number of competitive districts) are in tension, even in ideal circumstances.[6]

Furthermore, in practice, achieving even what is theoretically possible is often computationally intractable. In computational terms, redistricting is an NP-hard problem that cannot be optimally solved because of its mathematical complexity (Altman 1997). Given the difficulty of optimizing any single criterion, and the multiple criteria to be balanced, the authority responsible for implementing this process has a wide range of discretion over plans and their outcomes (Handley and Grofman 2008).[7] As a result, transparency and consistency of the process are necessary to achieve electoral integrity.

There are two overarching models for managing the redistricting process. One involves delegating the redistricting authority to a political body. The other one involves delegating this responsibility to a non-partisan institution. The first model originates in the European governmental model of electoral management established in most democracies during the nineteenth century (Butler and Cain 1992, Posada-Carbó 1996). In this model, key administrative procedures, including redistricting, were implemented by governmental authorities, such as the executive or legislative branches.[8]

The second model arises as a response to electoral mismanagement–including gerrymandering–and the domestic and international pressures to delegate electoral management to *de jure* independent bureaucracies during the third wave of democratization (Posada-Carbó 1996, López Pintor 2000, Norris 2015, Trelles 2025).[9] Within the non-partisan model, countries have opted to either delegate redistricting to an electoral boundary commission or a formally independent electoral management body (EMB).[10]

Regardless of which model is used, many countries include the judiciary in the final stage of the process.[11] Except for the United States, where the courts have historically played a proactive role in the interpretation, implementation, and ruling phases of redistricting, countries inviting the courts usually include them as only one part of the revision process (Handley 2018).[12]

The type of authority managing the process (e.g., governmental vs non-partisan) has been found to affect the credibility of the process. If the redistricting authority is perceived as capable of implementing the process with neutrality and includes broad

sectors of society, outcomes are more likely to be embraced by citizens and political stakeholders (ACE 2024).

Operational Dimensions (Administrative, Demographic, and Geographic Criteria)

In most countries, the Constitution establishes the frequency of redistricting and the allocation of seats across states. Often, redistricting is required to follow a decadal population census, but its timing may depend on the availability of data or budget, and may also be triggered by changes in the administrative (e.g. state) subdivisions, or statutory reforms.[13]

After a country's redistricting authority has validated incoming demographic information, it allocates seats across states or regions–this is known as "apportionment." Federal countries like the United States, Canada, Mexico, and Australia undergo this process. Some constitutions require that states have a minimum number of seats, introducing demographic imbalance before lines are even drawn.

During the line (re)drawing phase, how a redistricting authority treats demographic, administrative, geographic, and social criteria vary significantly across countries.[14] The first and most commonly used of these criteria is population deviation, which aims to measure the uniformity of a district's population. Population may be defined with reference to total census counts, numbers of registered voters, or counts of citizens from civil registries (Handley 2018).[15]

A second type of criteria is related to a country's administrative divisions, such as national, state, and municipal boundaries, as well as other geo-statistical units or boundaries (typically constructed through the census process) used to define a district. Among the most common restrictions related to this dimension are i) contiguity; ii) completeness; iii) alignment with administrative boundaries; iv) compactness; and v) traveling times.

A third type of criteria references natural or geographic features. These criteria may significantly impact a district's shape, and their implementation varies substantially across countries. Important considerations include how a redistricting authority addresses individually named features (e.g., a large island, mountain range), and the general approach to evaluating other administrative criteria (such as compactness) in the presence of uninhabitable areas (e.g., lakes) or barriers to travel (e.g., rivers, roadless areas).

Normative Dimensions and Outcome-Based Measures

Redistricting is normatively justified to the extent that it promotes "good" representation. It can achieve this goal either directly–by influencing how votes are translated into seats–or indirectly, by affecting contestation, participation, deliberation, and adjudication (as discussed in the next section). However, there is no universal agreement on how to quantify representation. Both countries and scholars differ in the outcome measures

they employ. While these measures are typically applied to political parties, many countries also incorporate indicators of representation linked to socio-cultural characteristics–for example, rules designed to prevent the division of geographically organized communities of interest or to promote the creation of districts that enhance representational opportunities for marginalized minority groups.

Outcome measures play several important roles in safeguarding electoral integrity. In general, quantitative indicators can serve as effective tools for adjudication, helping to limit the ability of political parties to maximize their advantage during the redistricting process. To some extent, the criteria discussed in the subsection on operational dimensions–such as administrative, demographic, and geographic factors–can also constrain manipulation when applied *ex ante*.

Outcome measures such as symmetry, responsiveness, and the number of expected competitive districts (see definitions in Table 1) offer stakeholders the possibility to assess the extent to which parties can contest for seats under a given redistricting plan. Measures of outcome representativeness–such as proportionality or the number of representative districts–reflect a complementary notion of integrity: that democracy is, in part, defined by voters' ability to choose their representatives. In addition, representational outcome measures, along with rules designed to encourage the representation of minority groups or parties (e.g., minimum seat quotas), can be understood as a mechanism to promote deliberation within the assembly by amplifying diverse voices and fostering coalition-building among different groups.

Although most scholarly work evaluating redistricting plans relies on some form of outcome measure to assess whether specific objectives have been achieved, there is no consensus on which particular measure–or combination of measures–should be considered the gold standard for determining the neutrality of a redistricting process. Moreover, countries differ in the extent to which outcome measures capture direct representational characteristics and in how effectively they reflect the ability of parties to contest districts or influence policymaking.

Country-level experiences show that redistricting processes are perceived as more objective when implementation adopts a holistic approach–combining multiple descriptive measures with quantitative criteria that capture key aspects of the votes-to-seats relationship. In the next section, we present examples illustrating how these normative dimensions align with the four guiding principles of integrity discussed in this book–namely, contestation, participation, deliberation, and adjudication–and how these principles are supported not only by direct measures but also by institutional structures and processes.

The recognition of social, historical, religious, economic, or cultural differences, for instance, became relevant in countries such as Germany, Australia, Hungary, and Pakistan after the second half of the twentieth century. Additionally, some countries have become more proactive in considering ethnic, racial, or linguistic minorities. In the

US, for example, the Voting Rights Act of 1965 protected African American, Hispanic, Asian, and Native American communities from being either split or concentrated into districts to diffuse their congressional representation (O'Loughlin 1982, Polsby and Popper 1993, Charles and Fuentes 2017, Durst 2018). Other countries, such as India, Fiji, New Zealand, and Mexico, have also adopted rules to guarantee the congressional representation of minorities (Handley 2018).

Variation in the representational criteria notwithstanding, quantitative estimation of the counterfactual outcomes from proposed redistricting plans is a common approach used worldwide to evaluate the electoral representativeness of plans (see Katz, King & Rosenblatt 2020 for a summary focused on evaluating partisan outcome measures). These methods have advanced tremendously over the last three decades and, as a result, redistricting authorities have significantly improved their capacity to evaluate the consequences of adopting specific plans (see, for example, Kenny et al. 2023).

The general approach to quantitative representational outcome evaluation involves five steps: (1) identifying a set of representational properties of interest (e.g., partisan symmetry); (2) selecting a specific quantitative measure of that outcome property; (3) applying statistical models to predict election outcomes (e.g., expected seats for each relevant group and party) under a set of plausible electoral conditions; (4) applying the measure selected in step two to quantify the representational property of the distribution of potential election outcomes; and (5) comparing the expected representational outcome to other proposed plans and to historical and normative baselines. When the difference between the predicted representational outcome from a proposed plan and the reference (baseline or proposed alternative) is too large, a plan is rejected and it can be considered invalid or lacking electoral integrity. Table 1 provides examples of selected representational measures.

Further, in the presence of large sets of alternative plans, such as those generated through public mapping or machine-based automated processes, predicted outcome measures can characterize the practical trade-offs among competing performance criteria and reveal potential improvements in representational outcomes. In the last decade, large scale public participation and computer simulation have been fruitful sources of alternative plans for outcome evaluation (see Altman & McDonald 2010, for a review of the use of computational approaches to redistricting, McDonald and Altman 2018 for a review of public-mapping approaches, and Becker & Solomon 2022 for an overview of redistricting algorithms). This approach has been particularly useful for evaluating group representation outcomes (see Becker et al. 2021). Moreover, using a large set of plans to map trade-offs can reveal plans with extreme outcomes–and can shed light on the intent of the redistricting authority in selecting such plans (Altman & McDonald 2010; Altman *et* al. 2015).

Table 1: Selected Normative Properties of Outcomes

Outcome Property	**Description**
Proportionality	The degree to which the expected number of seats awarded to a party (or a relevant group) is proportional to the vote share received by that party.
Competitive districts	The number of districts where the expected vote within a district does not strongly favor one party (or relevant group).
Represented districts	The number of districts in which a specified group is expected to elect a candidate selected by that party (or group).
Responsiveness	The rate at which expected seat allocation for a party (or group) shifts as vote shares change.
Symmetry	The degree to which the expected seats-to-votes relationship is invariant across groups.

Note: Table created by the authors

For example, an approach often used in the US is to evaluate the expected number of competitive districts by using previous election returns at the voting precinct level to predict future elections, and reaggregate them according to the new redistricting boundaries. The number of districts in the proposed plan with predicted two-party margins between 48-52% (a range based on historical comparison) are then counted and compared with the predicted outcomes from other plans, and to the rate of previous competitive contests in the historical record.

More generally, the measures above, and other modern measures of representational outcomes, can all be represented as some function of a counterfactual seats-vote response curve (Tufte 1973), where the proposed plan is used, and vote share across a set of relevant groups (typically parties) varies across a designated range. In other words, all outcome measures reflect some desired property of how seats would be translated to votes, using that plan, under a plausible set of voting scenarios. Nevertheless, the prioritization of representational properties is both theoretically contested and practically important. Some priorities, such as competitiveness and proportionality, cannot be simultaneously optimized even in theory. In practice, tradeoffs among theoretically aligned criteria may be required because of the geographical constraints of redistricting.

Any of the properties in Table 1 may be empirically evaluated with respect to parties or to any other relevant groups. However, they are often assigned different labels when applied in different contexts–e.g., a district in which the expected vote for two groups is approximately 50% might be referred to as a 'competitive' district when the reference groups are parties, and as a 'minority-opportunity district' when the reference groups are related to culture or ethnicity. Further, properties such as symmetry and responsiveness are normatively meaningful to the extent that they are

calibrated to the expected normal vote and variation in the behavior of voters with respect to these groups–such as the swing of votes toward a party.

Outcome measures depend on baseline assumptions regarding the set of competing groups that are relevant for comparison (e.g. competing parties) and the distribution of vote allocations that should be used to estimate the counterfactual seats-vote curve–e.g., by combining the normal average partisan vote and observed levels of historical partisan swing across election years. For example, when the 'normal' two-party vote is 50%, and large swings are expected, a plan that is symmetrical and moderately responsive provides both parties with comparable expectations of future victory. However, if the expected normal vote is 55% and swings are small, the same plan could ensure the majority party's total and persistent control. Moreover, where one group has a persistent majority, and there is no variation in behavior across voters, properties such as symmetry and responsiveness are normatively and politically less meaningful than other dimensions–i.e., proportionality, competitiveness, and represented districts.

Outcome measures are affected by the data characteristics (e.g., previous elections, partisan registration) used to predict voting behavior. To reduce the levels of uncertainty when using outcome measures, redistricting authorities need to: i) adopt a uniform data source and method of measurement for all plans considered; ii) ensure the quality of raw data and avoid using incomplete information for predicting outcomes (see the work of James 2012 and James and Garnett 2024 regarding the perceptions of the credibility of elections when data sources are compromised); iii) use both district and aggregate-level data to evaluate outcomes; and iv) document and treat the uncertainty derived from measurement error, sampling, or modeling procedures.

More research is needed to understand how these evaluations vary and the impact they have on legislative outcomes and perceptions of integrity. For example, for different ways in which partisan bias has been measured, see the work of Grofman (1983), Jackman (1994), Gelman and King (1994), Magar et al. (2017), and Katz, King, and Rosenblatt (2020). Among the most critical areas of open research in evaluative methods are the generalization of seat-vote curve estimation in multi-party systems, robust and reliable measures of electoral efficiency, and reliable automated methods for simulating probability samples of feasible redistricting plans. In the case of outcome measures for multiparty competition, for instance, most work has focused either on the UK (e.g., Brookes 1959; Gudgin and Taylor 1979; Rossiter, Johnston and Pattie 1999) or the US system. With a few notable exceptions (King 1990; Alvarez and Nagler 1998; Honaker, Katz and King 2002; Tomz, Tucker and Wittenburg 2002; Jackson 2002; Linzer 2012; Calvo and Rodden 2015; Magar *et* al. 2017), there has been a paucity of work to develop software evaluation tools or methods of estimation that support reliable statistical inference in the multi-party context.

Principles for Integrity in Electoral Boundary Delimitation

In this section, we relate boundary delimitation to the four guiding principles used to organize this book–*contestation, participation, deliberation*, and *adjudication*. We describe how each can contribute to the acceptance of outcomes and the perception of redistricting as an impartial process.

In the case of *contestation*, we emphasize that having impartial arbiters with sufficient administrative capacity is critical for the impartial configuration of districts and allows parties to compete on a level playing field (Handley and Grofman 2008). In the case of *participation*, the quality of representation can be improved by allowing public input in redistricting (McDonald and Altman 2018). In the case of *deliberation*, we contend that allowing parties to participate in redistricting–without granting them control of the process–can facilitate the level of consensus surrounding redistricting outcomes (Trelles et al. 2024). Finally, redistricting requires an implementation based on clear and consistent publicly advertised rules. *Adjudication* in redistricting requires that rules, criteria, and the operationalization phase be aligned with normative goals and that multiple stakeholders can access information and audit the process (Trelles et al. 2023).

Contestation

De Facto Independence of Redistricting Authorities

In most countries, redistricting is implemented–directly or indirectly–by an electoral management body (EMB). The reputation of these institutions as truly independent agencies affects the perception of impartiality surrounding redistricting because, in most cases, these bureaucracies are responsible for overseeing, implementing, and validating redistricting outcomes. Even if formal rules are aligned with international standards, electoral integrity is at risk if these standards are *de facto* ignored or if the enforcement activity is compromised (Trelles 2025). Specifically, these agencies have an ample margin in redistricting's decision-making and operationalization process. If electoral commissions–or redistricting authorities—are perceived to be co-opted by the ruling party, redistricting outcomes are more likely to be perceived as unfair and challenged in court.

In Mexico, for instance, the EMB has been recognized as a *de facto* independent institution since the 1990s. The National Electoral Institute's reputation has positively contributed to generating a sense of neutrality in the EMB's adoption of rules, the processes' implementation, and the channels for stakeholders to participate in the process. The EMB's selection of normative criteria promoting the representation of indigenous communities and the use of quantitative metrics (e.g., a cost function based on population balance and municipal integrity) to evaluate partisan plans vis-à-vis to algorithmically-crafted outcomes, for instance, have been traditionally perceived as

objective principles by political stakeholders, increasing the levels of credibility around the process.

In contrast, the perception of Venezuela's EMB lacking *de facto* independence, along with the exclusion of parties from engaging in any activity within the electoral agency, has undermined the legitimacy of redistricting outcomes since the Chávez era (Monaldi 2010). Despite Venezuela's EMB's high levels of *de jure* independence–the EMB was constituted as a fourth branch of power since 2000–its opaqueness and high levels of discretion during redistricting (and most of the EMB's key administrative procedures) have negatively affected the credibility in elections (Corrales 2020).

Budgetary Framework, Bureaucratic Capacity, and Operational Constraints

Redistricting requires significant planning, bureaucratic capacity, and administrative resources. The initial stage, for instance, requires electoral officials to: i) collect and systematize information (e.g., demographic and cartographic data at different geo-statistical levels); ii) establish a calendar of activities; iii) determine how criteria will be operationalized; iv) determine which normative properties will be used to evaluate outcomes; v) develop or adopt the necessary technology to process and visualize information (e.g., optimization and data visualization platforms); vi) communicate clearly with the different institutions (e.g., census bureau) and stakeholders (parties, citizens, minority groups, communities of interest); and vii) provide all stakeholders with the necessary resources to participate (e.g., information, training, and tools).

Once maps are generated, the redistricting authority needs to: i) adopt a system to share the different maps considered and selected; ii) compare and evaluate the alternatives suggested by the different stakeholders; iii) communicate with the different stakeholders during the evaluation phase; and iv) justify its rationale to select specific plans, and v) announce the outcomes for validation.

While open-source mapping technology is still becoming available in more countries (Trelles et al. 2016), the direct cost of redistricting can vary significantly depending on the EMB's levels of bureaucratic capacity. On one extreme, many developing countries lacking the financial resources rely on foreign aid to renew their electoral cartography (e.g., many Caribbean and Sub-Saharan African countries). On the other hand, countries with weakly institutionalized electoral bureaucracies, such as Kenya's Independent Electoral Boundary Commission (IEBC), required 9.8 billion shillings (approximately 76 million US dollars) to carry out the delimitation exercise in 2023 (Mbaka 2023). In between, in countries with well-staffed and professionalized agencies, such as Mexico's *Instituto Nacional Electoral* (INE), redistricting costs oscillate between 1 and 1.5 million dollars (INE 2019).

This complexity implies that redistricting authorities with higher administrative and bureaucratic capacity are better positioned to avoid technical mistakes and prevent political contestation (Pastor 1999). The most important limitation for making redistricting a more accountable and inclusive process is the availability of financial

resources. Given that many countries require international assistance or can barely meet the administrative cost of renewing boundaries (e.g., technical expertise, data processing capacity, or computing equipment), it is not uncommon for transparency and public input to become a secondary goal.

More research is needed to understand the variation of financial resources allocated to redistricting around the world, the willingness of authorities to make redistricting a more accountable and inclusive process, and how budgetary limitations affect both the neutrality and credibility of redistricting outcomes.

Participation

Public Input and Citizen Participation

The degree to which a country's redistricting process is open for public input matters for electoral integrity because it is closely associated with transparency. For instance, having public input requires the redistricting authorities to: i) publicly advertise the process; ii) inform the public about the relevance of redistricting itself; iii) explain what normative principles will be used to evaluate and measure outcomes; iv) educate the public on how to engage; v) commit to a specific timeline; vi) generate the specific tools to receive and evaluate public input; and vii) establish clear communication with the public during the process.[16]

Public input is also associated with how different groups or individuals are granted equal opportunity to comment and submit alternative proposals. Other than political parties, the most common stakeholders allowed to participate in redistricting are minority groups or communities of interest. Some countries, however, open redistricting to all citizens, making it a more inclusive and accountable process (e.g., Canada, New Zealand, and India).

Furthermore, the evaluation of redistricting plans can be complemented by mechanisms providing meaningful public input and supporting the development of alternative proposals. Because local geography and demography often constrain the number of possible outcomes, it is difficult to distinguish which improvements over partisan plans are feasible. However, when many plans are independently created and shared, the range of viable outcomes is made clear and it increases the possibility of having better–more inclusive, efficient, and representative–plans (Altman and McDonald 2018). Having clarity on which normative principles (e.g., see our discussion in the section related to the normative dimensions) govern the process and what outcome measures will be used by the redistricting authority to evaluate plans is key for electoral integrity.

The variation found across states in the US offers a stark contrast. While redistricting in some states is extremely opaque and only allows legislative majority leaders to engage in the process (e.g., Kentucky, Wisconsin, and North Carolina), others (e.g., California, Montana, Colorado, New Jersey, and Idaho) have incorporated

public input to build trust around redistricting outcomes (see Qiu et al. 2015 and Greene 2018). For instance, the redistricting authorities in Virginia, Ohio, and New York have organized public competitions allowing individuals to formulate counter-proposals meeting legal standards so that they can be considered by courts or boundary commissions (Altman and McDonald 2012ab, Greene 2018 and 2021).

Many third-wave countries have opted to systematically exclude citizens from participating in redistricting. In Mexico, for example, the EMB has not created channels for the general public to participate in redistricting.[17] While the authority began considering the concentration of the Indigenous population across municipalities in 2004, it was not until the 2013/2017 rounds that Mexico's electoral court (known as the TEPJF) ruled that Indigenous communities should have an input in redistricting.

In contrast, redistricting authorities in countries such as Canada hold public hearings to receive input from local jurisdictions, political parties, members of parliament, independent candidates, non-governmental organizations, or individual citizens (Courtney 2001).[18] In New Zealand, multiple channels are provided to inform the public and receive input, including online, printed, and radio announcements. Additionally, interactive maps have been used to allow citizens to compare the newly created maps with previous districts. Objections can be submitted by parties, legislative representatives, statutory authorities, communities of interest, and individuals (Handley 2018, Green and Della Ventura 2024). In Sierra Leone, authorities have recently organized extensive education programs and awareness campaigns to include the public in the redistricting process (Politico 2022).

Overall, evidence suggests that public engagement tends to positively impact the credibility of redistricting, especially in semi-competitive environments. However, more research is needed to understand how public input impacts the neutrality of redistricting, which actors tend to engage in the process (e.g., individual citizens, interest groups, communities of interest), how redistricting authorities consider such input, and whether type of engagement should be considered an international standard.

Deliberation

Inclusion of Partisan Actors

The high levels of politicization around redistricting are frequently associated with the attempt of political actors to influence the process and gain an electoral advantage. This explains why most countries have delegated the implementation of redistricting to *de jure* independent non-partisan agencies. Within this subset of institutions, however, there are important differences regarding the degree to which they allow parties to engage in redistricting.

While some countries have completely excluded parties from the EMB's internal deliberation (e.g., Venezuela), others allow them to participate and oversee its implementation, formulate modifications, and guarantee that no party has a systematic

advantage. Among the most successful cases allowing party input in redistricting are New Zealand, India, and Canada (Handley and Grofman 2008, Greene and Della Ventura 2024).[19]

The latter set of cases share in common that parties engaging in the process recognize and accept the normative principles and outcome measures being used by the respective authorities to evaluate plans. Furthermore, these experiences show that in countries where redistricting is conducted by an independent bureaucracy, party deliberation in the process can contribute to electoral integrity by increasing the levels of consensus and allowing competing actors to validate outcomes and enforce compliance.[20]

The inclusion of parties in redistricting–within the bounds established by an independent bureaucracy–is especially important for the debate on if–or how–parties can be included in electoral management (Estevez et al. 2008, Otaola 2018, Trelles 2025). We believe that electoral bureaucracies can benefit from partisan inclusion, especially in countries organizing elections in semi-competitive or electoral authoritarian environments. More research is needed to understand how parties' engagement in redistricting impacts the neutrality of outcomes, the accountability of the process, or the acceptance of results.

Adjudication

Alignment of Rules, Criteria, and Operationalization with Goals

The internal deliberation that takes place within the redistricting authority during the implementation phase of redistricting is key for electoral integrity. Clarity and access to information throughout the decision-making process can become even more important than criteria selection. For instance, the adoption of facially neutral descriptive redistricting criteria is insufficient to guarantee impartial outcomes because, in practice, it can favor a particular group. To avoid bias, authorities should be able to carefully select and operationalize criteria, justify the rationale of selecting a specific evaluative method (see discussion in subsection related to normative dimensions), publicly advertise all decisions, and explain how they align with the normative framework.

As redistricting has evolved from a hand-made exercise focusing on (re)balancing a population across districts to a substantially more complex procedure considering multiple dimensions (Henry 1989, Altman 1997), normative frameworks at the constitutional level remain both succinct and vague. Most constitutions refer to the body responsible for establishing the electoral boundaries and broadly describe rules for apportionment (e.g., the minimum number of districts a state must have or the type of information that should be considered to establish a quota).

Furthermore, secondary statutes–electoral law–also tend to be vague, and it is often unclear how criteria should be operationalized. For instance, Butler and Cain

(1992:119) describe how the English Boundary Commission “operates under strict but confusing statutory rules. It is required to respect local boundaries ‘as far as possible,’ and it is required to make constituencies ‘as equal as possible.’ These two principles repeatedly conflict, and the commissioners have never had a consistent policy in deciding between them.” They recognize that when statutes require authorities to “consider creating, as much as possible, coherent districts,” “include the representation of diverse communities or interests,” or “consider factors such as economic, social, and regional interests,” uncertainty is introduced, and authorities can adopt drastically different solutions.

In most countries, it is at the tertiary level–e.g., legal agreements adopted by the redistricting authority–where most of the operationalization takes place. This includes defining all the rules governing the decision-making surrounding the selection, hierarchization, and measurement of specific criteria, as well as the technology that will be used (e.g., algorithmic optimization). It also includes the definition of the stakeholders that will be involved (e.g., parties, communities of interest, citizens) and the evaluative methods used to compare plans.[21]

To guarantee the integrity of the process, redistricting authorities need to publicly advertise and justify the rationale of the operationalization process, including the normative dimensions and outcome measures used to evaluate plans. They must ensure that the different normative levels are consistent with higher-order restrictions. The rules governing the process, the operationalization of different dimensions, and the evaluation of plans should all be aligned with the primary goals. This is an area where more comparative research is needed to better understand i) the existing variation of normative dimensions, rules, and operationalization of criteria across countries; ii) if the adoption of certain rules has a constraining effect on electoral outcomes; and iii) the degree to which the deviation from publicly advertised rules is associated with malpractice–i.e., *gerrymandering.*

Accountability (Transparency, Consistency, and Enforcement)

Two fundamental prerequisites for accountability in electoral management are transparency and consistency (Fung 2007, Hollyer et al. 2011, Norris and Nai 2017). In redistricting, these two dimensions are fundamental for ensuring the process' neutrality and allowing stakeholders to understand, participate, and evaluate the outcomes. New Zealand, Canada, and Australia are cases that have systematically outperformed third-wave countries in these dimensions (Greene and Della Ventura 2024).[22]

Transparency refers to the degree to which all steps are publicly available before, during, and after an outcome is adopted. Consistency refers to the degree to which the decision-making rules and actions are unambiguous with each other, do not contradict each other, and the subordination among them is aligned with higher-level objectives (Trelles et al. 2023, Greene and Della Ventura 2024).

To ensure the accountability of redistricting, however, these two dimensions require a systematic evaluation of the alignment between actions, outcomes, and goals (auditing)–e.g., external agents such as citizens, communities of interest, and the media. They also require the effective enforcement and sanctioning of any actions deviating from publicly advertised rules (compliance)–e.g., the authorities responsible for overseeing and validating the process. Although the most common approaches to evaluate a redistricting process focus on the plans being considered and their expected outcomes, the evaluation of adoption intent–i.e., gerrymandering–may also require examining the redistricting process itself.

For this examination to happen, accurate, detailed, and timely data must be readily available. To measure the characteristics of a single redistricting plan, for instance, an agent evaluating the process requires: i) a detailed definition of the proposed plan; ii) current and past electoral results; iii) demographic data; and iv) detailed information on natural and administrative geographic features. Further, to fully evaluate a plan, an agent would typically require a comparison to other competing (contemporary) and historical plans, along with the information needed to measure each scenario. Additionally, a detailed account of the decision-making process is needed to fully understand why specific outcomes prevailed over others.

The availability of information and the capacity of external observers–e.g., citizens or communities of interest–to assess whether rules have been consistently applied are key to electoral integrity. Malpractice in redistricting tends to be associated with ambiguity in how rules are applied, the absence of readily available information, and a poor institutional design to audit and sanction any deviation from publicly advertised rules.

While research in the US shows that increasing transparency and public engagement can positively impact the legitimacy of redistricting outcomes (McDonald and Altman 2018, Greene 2021), many redistricting authorities are still far from holding an open data policy or consistently applying publicly advertised rules when audited.[23] More research is needed to document how increasing levels of accountability can increase the credibility surrounding redistricting outcomes.

Concluding remarks

This chapter synthesizes key dimensions for strengthening the integrity of the redistricting process. As electoral bureaucracies have become more professionalized and technology has evolved, redistricting can become a more accountable and inclusive process. However, those interested in analyzing redistricting from a comparative perspective remain ill-equipped to identify legal gaps, administrative limitations, violations of publicly advertised rules, or general malpractice during the process's implementation.

Open Questions and Research Agenda

The challenges faced by those interested in understanding the process mainly arise due to: i) the legal and technical complexity of the process itself; ii) the wide cross-country variation in the way redistricting is implemented; and iii) the lack of available information to fully understand the details associated with the evaluation phase. While the use of evaluative methods has advanced tremendously and is used to predict seat-vote relationships for two-party races, more research is needed to develop a reliable seat-vote curve estimation in multi-party systems.

Country-level studies have been useful to understand the overarching similarities and differences in redistricting. However, more research is needed to understand which mechanisms are crucial to increase the integrity of this process. Regarding the inclusion of parties in redistricting, many cases reveal how their engagement can aid in creating consensus surrounding outcome. However, we still know very little about how parties interact within a specific set of rules; which parties are more effective or better positioned to formulate winning plans; how best to integrate party, automated, and public plan creation; or the type of rules that constrain outcomes regardless of how parties engage in the process.

There is still much to be learned about which type of rules and practices are most effective in reducing political manipulation. While we understand that the rules governing redistricting–and their operationalization–respond to a country's specific socio-cultural and administrative context, authorities should be able to clearly distinguish which rules and practices tend to constrain more redistricting outcomes and reduce the margins of political interference; and conversely, which promote better representational outcomes.

As mapping technology has evolved, it has become easier for the redistricting authority to create online resources to inform citizens, receive public input, and display redistricting outcomes in real time. While research in the US shows that increasing transparency and public engagement can positively impact the credibility and legitimacy of redistricting outcomes, more studies are needed to understand if external participation, transparency, auditing, and sanctioning mechanisms are reducing the likelihood of manipulation across district-based systems.

Similarly, information technology has facilitated the redistricting authority's capacity to process information and use evaluative methods to compare multiple dimensions. However, it remains unclear how qualitative considerations should be balanced with quantitative metrics during the evaluation phase, how frequent are violations of publicly advertised rules, or how likely are external agents to identify, denounce, or sanction them.

While there are multiple examples of countries allowing public engagement in redistricting, we still know little about how these efforts translate into substantive

representation or policy change. More research is needed to understand what type of public engagement increases the representativeness of certain groups and helps create legitimacy around redistricting outcomes.

Lastly, administrative resources and bureaucratic professionalization are key to guaranteeing the quality of elections. We need to better understand how the redistricting authority's administrative capacity and institutional independence relates to the cost of redistricting, the likelihood of outcome acceptance, and the possibility of reducing administrative costs using open-source mapping technology.

Policy recommendations

From the practitioners' perspective, much work is needed to standardize best practices in redistricting. Although there is not much that can be done regarding the complexity of the process or the existing cross-country variation in the rules governing the process, there is room to make redistricting more accountable and inclusive.

In section 3, we listed four principles underlying electoral integrity in redistricting: contestation, participation, deliberation, and adjudication. Ensuring fair contestation and adjudication requires establishing and maintaining a separate bureaucratic redistricting authority's independence, professional reputation, and resources. This cannot be achieved only through immediate reforms and relies strongly on deep structures of governance and law that change slowly (see subsection related to *de facto* independence section).

Adequate financial and operational planning is required to ensure integrity in redistricting. Authorities should make available a detailed timeline allowing multiple stakeholders to participate and ensure that all information, training, and engagement tools are readily available. Even if redistricting is being carried out by a third party (e.g., government or international organization), electoral integrity must gradually be considered as part of the authority's financial and operational planning agendas (see subsection related to the budgetary framework and bureaucratic capacity).

In cases where the redistricting authority is interested in advancing public engagement, it should: i) ensure that all rules governing the process are complete, easy to interpret, and concentrated in a single public repository; ii) guarantee adequate planning and establish a clear timeline to inform, educate, and receive public input, ii) allocate the necessary administrative and financial resources to receive and evaluate public input, iii) adopt the adequate technology to enable participation and evaluation of alternatives, and iv) communicate how the final redistricting plans are the result of a straightforward application of publicly advertised criteria (see subsection related to public input and citizen participation).

Ensuring adequate deliberation requires that parties be involved in (although not in control of) the redistricting process. Parties are needed during deliberation over boundaries because they are incentivized to monitor and report bureaucratic

mismanagement, offer comments, and suggest alternative solutions that reflect their constituent-voter's interest. This is especially important in semi-competitive or countries with an evident gap between an EMB's *de jure* and *de facto* independence (see subsection related to the inclusion of partisan actors).

In most countries, the constitution offers only general principles related to redistricting. Although secondary statutes generally offer more detail, implementing redistricting requires specific guidelines during the deliberation and decision-making process. To ensure the normative framework's clarity and consistency, lower-level agreements must be aligned with the primary objectives described in the constitution. Lower-level administrative agreements or guidelines should clearly state how criteria are derived from higher-order principles and how each dimension is operationalized and evaluated (see subsection related to the alignment of rules and operationalization with goals).

To advance transparency, the bureaucracy should provide open access to all information during all stages of the process, including: i) all data and software used; ii) the records considered by the authority (including proposed plans, scores associated with the SEMs, and selection decisions); and iii) a report of compliance by institutional, partisan, and any other stakeholder that engaged in the process. Over time, historical records should be preserved and made available to the public in a single location or repository (see subsection related to accountability).

To advance consistency, redistricting authorities should: i) document any exceptions to publicly advertised rules; ii) justify any change made to the administrative rules based on specific legislative objectives; iii) explain how changes to the operationalization of criteria are justified both technically and regarding legislative objectives, iv) offer metrics for evaluating the effectiveness of these changes at the end of the process; and v) take the necessary steps to minimize rule violations during the implementation of the process (e.g., preparing the process for internal and external audit) (see subsection related to accountability).

Lastly, since the evaluation process is critical to integrity, plan measurements should take a holistic approach. At a minimum, they should include descriptive measures of population deviation and geographic discontinuity and include quantitative criteria that capture relevant aspects of the seats-votes relationship–such as expected bias and responsiveness. If possible, redistricting authorities should avoid relying only on descriptive measures (i.e., compactness) or measures focusing on gerrymandering 'intent,' which can often be inconclusive or misleading (see subsection related to normative dimensions).

Endnotes

1. Electoral districts are also referred to as constituencies. For consistency throughout the text, we use the former. When referring to redistricting in this chapter, we refer to the exercise of redrawing the

electoral geography for legislative majority districts (associated with lower-house elections in bicameral systems).
2. This concept refers to the discrepancy between the size of a district (or group of districts) in terms of its population and the representation obtained in congress (measured by the number of seats).
3. The Appendix provides several examples based on Mexico's redistricting experience after the third wave of democratization to illustrate many of the concepts presented in the chapter.
4. Proportional systems usually compensate for demographic shifts across regions by adjusting the seat allocation rather than by redrawing district lines within the country's administrative divide.
5. See the concept of representativeness discussed in the Venice Commission (2017: 4).
6. For example, with respect to geographic goals, it is not generally possible to minimize population inequality while maximizing the integrity of existing administrative boundaries (Altman and McDonald 2012b). More surprising, it is impossible to simultaneously optimize for all desirable representational goals–such as responsiveness, proportionality, and number of competitive districts (See Niemi and Deegan 1978).
7. For example, if perfect population balance is required (e.g., a deviation beyond +/- 0% is prohibited), it is unlikely that secondary restrictions, such as geometric compactness (e.g., districts required to have a relatively compact shape) or municipal integrity (e.g., trying to create an overlap between the administrative and political geography) will be optimized, and vice-versa.
8. Today, the governmental model of electoral administration is still preferred in most European countries due to the overall high levels of bureaucratic professionalization. In contrast, the independent model of management has been adopted by the vast majority of third-wave countries across the Globe (Birch 2008 and Norris 2015).
9. According to Butler and Cain (1992:118-122), permanent boundary commissions were established in the United Kingdom in 1944 and recognize that although Britain pioneered the commission approach to redistricting, it no longer provides the best example.
10. There is an important variation in terms of how the redistricting authority is actually configured. While in some countries an independent boundary commission is formed temporarily, others delegate this authority to a commission formed by retired justices, and others to a permanent EMB, which in some cases subrogates the decision-making (or part it) process to a technical committee formed by experts and electoral officials (Venice Commission 2017: 2017: 27-28).
11. While countries such as India, Tanzania, Trinidad and Tobago, and New Zealand have substantially limited the role played by the courts in redistricting, Mexico, Singapore, Ghana, Kenya, and St Kitts and Nevis, allow the courts to intervene when legal challenges arise.
12. For more details on the different administrative models in the United States, see McDonald 2008 and Greene 2021.
13. In countries such as the Seychelles and Nepal, for example, redistricting takes place every three and twenty years, respectively. In between, countries such as the UK, Bahamas, New Zealand, Turkey, Zimbabwe, Australia, and Ireland renew their boundaries every five to twelve years (Handley 2018).
14. This variation in the relevance assigned to each of these dimensions usually responds to either differences in the normative framework or in the way in which the statutes are interpreted by the redistricting authority.
15. Handley (2008: 273) reports that while most countries do not set a deviation maximum, the US. is an exceptional case prohibiting any deviation (+/- 0%) and that countries such as Singapore allow a deviation up to +/- 30%.
16. Public input requires careful planning, having the necessary technology to process a high volume of information, and clear guidelines for stakeholders to participate. Without them, technical difficulties can be easily amplified and lead to confusion or distrust (Cain 2015, Greene 2018).
17. See Figure 1 in Appendix 6.1.
18. Other countries allowing public hearings include Australia, the UK, India, Liberia, and Sierra Leone (Handley 2018).
19. In the US, where redistricting tends to be dominated by party politics, the state of New Jersey is an exception where parties can also formulate counter-proposals to a judge instead of a TC (Stokes 1993).
20. See Figures 2 and 3 in Appendix 6.2.
21. See details of Mexico's operationalization in Table 1 of Appendix 6.3.
22. See Table 2 in Appendix 6.4.
23. See Table 3 and Figure 4 in Appendix 6.5 for examples of inconsistencies and rule violations.

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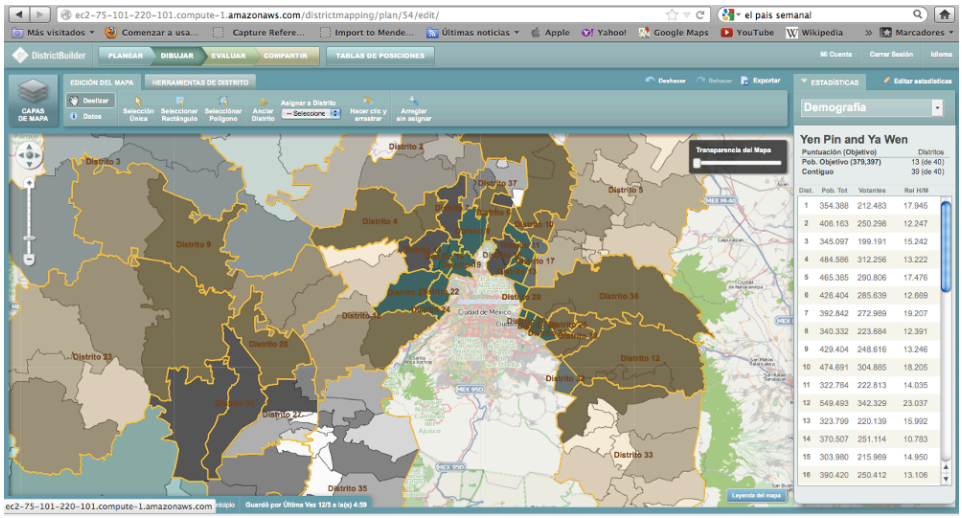
Online Appendix: Electoral Boundaries Delimitation in Mexico

We use examples primarily drawn from Mexico's redistricting experience to illustrate specific operational challenges during the process's implementation, evaluation, and participatory phases. This case is representative of most third-wave countries where redistricting has been delegated to independent electoral management bodies (EMBs). Since the 1990s, Mexico's EMB–known as the Federal Electoral Institute (IFE, INE since 2014)–has successfully implemented automated redistricting, allowing parties to suggest alternative plans and gradually enabling minority groups to comment.[2] Focusing on a single case with these characteristics helps us offer concrete examples related to the key dimensions for electoral integrity in the chapter.

Public Input and Citizen Engagement

Figure 1 shows a screenshot of an online public mapping platform known as District Builder developed to display the State of Mexico's electoral cartography in 2013 (Trelles et al. 2016). The image depicts the portion of the state bordering Mexico City's northern area and a view of some of its 40 federal electoral districts with its municipal subdivisions (with the most densely populated municipalities shown in darker colors). At the top of the screen are the tools for editing and analyzing the map. On the right there is a calculation tool with the values associated with the number of inhabitants, number of voters, and gender ratios in each district.

Figure 1. Public Mapping Project Mexico Online Display (District Builder)



Source: Figure prepared by authors and originally published in Trelles et al. (2016)

[2] Federal electoral boundaries have been modified in 1996, 2004, 2017, and 2022. In 2013 IFE completed the redistricting process but it was rejected due to the negotiation of an electoral reform that took place in 2014 (Trelles et al. 2023).

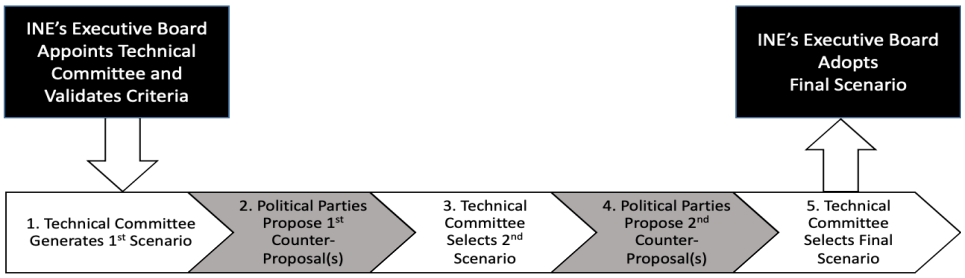
While online mapping technology was available to offer citizens an accessible platform to participate in redistricting during the 2013, 2107, and 2022 rounds, Mexico's EMB adopted an internal mapping system only to be accessed by political parties and electoral officials (INE 2019).

Deliberation and Marginal Impact on Redistricting Outcomes

Political parties in Mexico have historically shown high levels of engagement in redistricting. Since the 1990s, Mexico's EMB has incorporated parties in redistricting without granting them any decision-making authority over plans. In 2013 and 2107, for instance, they formulated a total of 522 and 463 alternative plans, respectively (Trelles et al. 2024). The high levels of engagement are *prima facie* evidence that parties are interested in the process. Overall, the outcomes have been endorsed by parties and the levels of politicization and contestation have been extremely low (Saldaña and Cervantes 2020).

Figure 2 describes the phases of Mexico's redistricting process. First, the EMB's Technical Committee (TC) adopts a specific set of criteria and produces the "first scenario" using an in-house optimization process. Then, parties represented within INE's national and local oversight commissions formulate alternative plans. Third, the TC evaluates all suggested plans and selects a "second scenario" from the first scenario and the parties' counter-proposals. Fourth, the parties are invited a second time to present counter-proposals. Finally, the committee evaluates all suggested plans–from the set of plans that includes the second scenario and second-round counter-proposals, selects a final scenario, and recommends it to the board for adoption.

Figure 2. Phases of Redistricting in Mexico

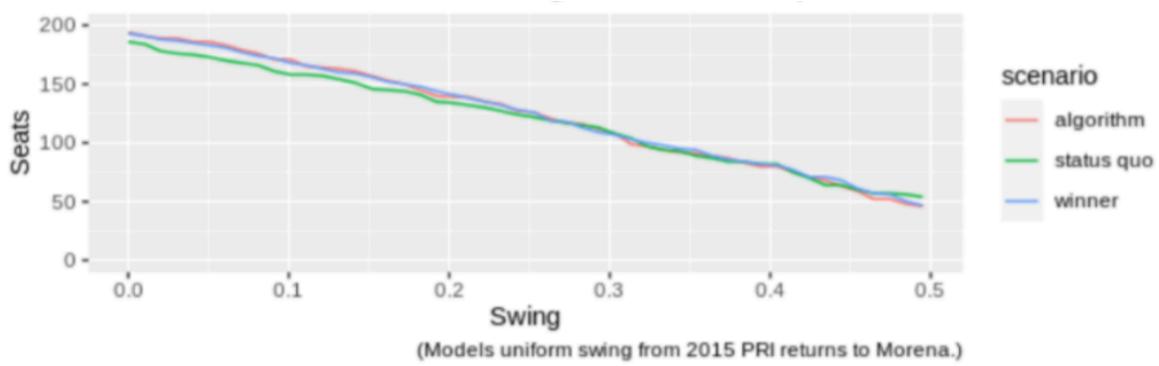


Note: Figure elaborated by the authors and originally published as supplementary material of Trelles et al. (2023).

Surprisingly, parties have historically accepted the rules and criteria imposed by the EMB (INE 2019), which substantially constrain the effect that redistricting has on electoral outcomes, regardless of how lines are drawn (Trelles et al. 2024).

Figure 3 compares the number of seats the PRI would have lost simulating a uniform vote swing from the PRI to Morena during the 2015 election. The results reveal that the number of seats that the PRI (the ruling party that year) would have obtained using the *status quo* plan (2004), the 2017 algorithmic, and the winning solutions based on the 2015 turnout are almost identical.

Figure 3. 2017 PRI Under a Partisan Swing - Scenario Comparison



Note: Figure elaborated by the authors and published as supplementary material of Trelles et al. (2024).

We believe that the high levels of partisan engagement in an institutional constrained environment confirms that the inclusion of partisan actors in redistricting has allowed INE to legitimize its decision-making process and for parties to build consensus around outcomes, while keeping their role of watchdogs of the process (Estevez et al. 2008, Trelles et al. 2024).

Normative Frameworks, Hierarchization of Criteria, Operationalization, and Mathematical Specification

Table 1 shows the complexity of the different rules governing Mexico's redistricting process. Rows display the normative framework at four levels: a) *The constitution,* b) *Secondary–electoral–law,* c) *Procedural agreements,* and *d) Administrative decisions*. Each column in the table characterizes how that level dictates–respectively–goals, criteria, and operational requirements.

Table 1. Documentation of Goals, Criteria, and Operationalization of Mexico's Redistricting Process[3]

Normative Framework	Goals Stated	Criteria Specified (Measures)	Process Requirements
Constitution (Article 53)	Formation of *electoral districts* linked to population	300 single-member majority districts 2 district state minimum Representation of Indigenous communities (Article 2)	It must be based on the last census Must consider the location of Indigenous communities and their opinion
Electoral Law	Delegates administrative responsibility Establishes INE's attributes	It does not specify any criteria Redistricting completed /approved before the election	The responsibility of approving and implementing the process relies on specific areas of the INE's bureaucracy
INE's Regulation (Acuerdos del Consejo General)	Defines criteria Delegates the process to the Technical Committee (TC) Defines hierarchy of criteria and offers justification	Defines criteria and its hierarchy Rationale - relation to goals	Enumerates the bureaucratic/administrative actors who are permitted to participate Defines the different phases of the process
INE and TC's Administrative Agreements	Operationalization of criteria Definition of the process Information and systems to be used Justification of the Decision-making Process	How to measure each criterion Optimization and weighting formula The rationale for optimization and weighting	Specifies which actors can submit and evaluate plans Specifies rules for rejecting plans. Specifies plan validity and selection rationale at each stage

The first two rows show how constitutional and electoral statutes merely describe overarching objectives. The real instrumentation of the process takes place at the third and fourth levels, where the redirecting authority decides how to operationalize the

[3] This table was originally published as supplementary material of Trelles et al. (2023). Auditable processes and outputs are shaded.

criteria through a specific methodology. For example, redistricting authorities can hierarchize criteria by prioritizing a specific stage of the process to guarantee that a criterion is met before others (e.g., avoid splitting all those municipalities with a sufficient population to form a district).

Another way in which redistricting authorities can proceed is by adopting a computational algorithm to draw district lines. This requires operationalizing and measuring criteria, collecting and curating data, specifying a rationale for optimizing and weighting mathematically the different restrictions, identifying a suitable combinatorial optimization algorithm, and adopting a specific system to process, display, and evaluate information (Altman 1997).

For example, Mexico's redistricting authority first identifies whole municipalities that fall within the population quota and those municipalities with an indigenous population threshold (40%) to avoid splitting them during the optimization phase.[4] Then, using an in-house computational system, the TC specifies a mathematical model to run an optimization algorithm–"simulated annealing or beehive"–with multiple input parameters. In 2004, for instance, they decided to weight these restrictions as follows (relative weight in parenthesis): population balance (0.4), geometric compactness (0.3), municipal integrity (0.2), and traveling time across districts (0.1). Once an automated plan is generated, Mexico's EMB considers the input of both minority groups and partisan actors.[5]

Assigning specific values to the main parameters used during the optimization phase has allowed Mexico's redistricting authority–and other stakeholders–to compare maps using specific quantitative metrics for each dimension. Quantifying key parameters, however, has proven to be challenging in the evaluation phase when parties have proposed higher-cost (less optimal) solutions that are justified using a subjective rationale (e.g., considering socio-cultural characteristics) or a dimension that is not considered within publicly advertised rules (e.g., organizational efficiency of elections) (Trelles et al. 2023).

Accountability in Redistricting (Transparency and Consistency)

Table 2 depicts the availability of information on Mexico's redistricting process between 1996 and 2013. In the first column, we group the categories of information that an external actor would need to evaluate, replicate, and identify if any deviation from the process had occurred.

[4] The input of indigenous communities began to be considered in the 2017 round but only during the first phase of redistricting (e.g., when automated maps have been generated). This group, however, did not have the same capacity as parties to veto other plans or suggest alternative scenarios during the different stages of the process (Trelles 2017). Furthermore, it is unclear that the configuration of indigenous majority districts has improved the substantial representation (representativeness) of these groups in the legislature (Sonnleitner 2013 and 2020, Trelles 2017).

[5] Over the years, these specifications have varied. For a detailed account of Mexico's redistricting see Trelles and Martínez (2012), Trelles (2017), and Trelles et al. (2023 and 2024).

Table 2. Availability of Information in Mexico's Redistricting Process

Information	Description	Unit of observation	Available online	Difficulty in obtaining	Requires tool? Which?	Tool available?	Institution
Databases							
Population	Data	*Sección*--Municipality	✓	Low	No	-	INE-IENGI
Indigenous population	Data	*Sección*--Municipality	✓	Low	No	-	CDI
Roads	Data	*Sección*--Municipality	✓	Low	No	-	SCT
Travel times	Data	*Sección*--Municipality	✗	Medium	No	-	INE
Geographic contiguity	Data	*Sección*--Municipality	✓	Low	Software GIS	✓	INE
Single municipalities	Data	*Sección*--Municipality	✗	Medium	No	-	INE
Cartography							
Administrative (states, municipalities)	Data	*Sección*	✓	Low	Software GIS	✓	INE-INEGI
Geographic features	Data	*Sección*	✓	Low	Software GIS	✓	INEGI
Federal political division	Data	*Sección*	✓	Low	Software GIS	✓	INE
Local political division	Data	*Sección*	✗ *	**High**	Software GIS	✓	INE-OPLE
Mathematical formulas							
Optimizing algorithm	Text	-	✓	Low	No	-	INE
Model components	Text	-	✗	Medium	No	-	INE
Software							
Optimization engine	Software	-	✗	**High**	INE's Software	✗	INE
Indicator platform	Software	-	✗	**High**	INE's Software	✗	INE
Mapping platform	Software	-	✗	**High**	INE's Software	✗	INE
Maps and revisions							
Automated scenarios	Cartography	District-State	✗	**High**	Software GIS	✓	INE
Party scenarios	Cartography	District-State	✗	**High**	Software GIS	✓	INE-Parties
Party justification	Text	-	✗	**High**	No	-	INE-Parties
TC rulings	Text	-	✗	Medium	No	-	INE
Regulatory aspects							
Legal framework	Text	-	✓	Low	No	-	INE
INE's CG Agreements	Text	-	✓	Low	No	-	INE

Electoral results							
1997-2015 Period	Database	Polling station-*Sección*	✓	Low	No	-	INE

Note: This table was elaborated by the authors and published initially as supplementary material of Trelles et al. (2016)

Despite Mexico's EMB is characterized by its high levels of administrative capacity, administrative proficiency, and *de facto* independence, this case exemplifies how the redistricting's level of accountability is still quite limited compared to information availability and external channels for public comment in well-established democracies such as New Zealand, Canada, and Australia (Greene and Della Ventura 2024).

As it happens in many other third-wave countries, the statutory framework governing redistricting and the final cartography adopted once the process has concluded usually becomes publicly available. However, it is extremely difficult for an external actor to replicate or evaluate Mexico's redistricting process with the information that is made publicly available. Outside of the bureaucracy, it is extremely difficult to audit the process. For example, external actors cannot access the software parties use to formulate plans, the online platform to visualize and compare plans, or the hundreds of maps algorithmically generated or suggested by political parties during the process.

Inconsistencies and Rule Violations

Research in Mexico shows multiple deviations from publicly advertised rules in the 2013 and 2017 redistricting rounds. In many cases, plans with higher scores sponsored by an individual party or coalition of parties were selected by the TC. Table 3 shows different categories of unexpected winners in the process. The first two columns depict the proportion of cases where the best scoring–most efficient–plan and algorithmic solution lost. The third column refers to those cases where a plan that was unanimously endorsed by parties was adopted–without being the best plan. The fourth column shows the proportion of cases where parties did not agree on a winning plan and a solution that did not have the best score was adopted.

Table 3. Unexpected Winners

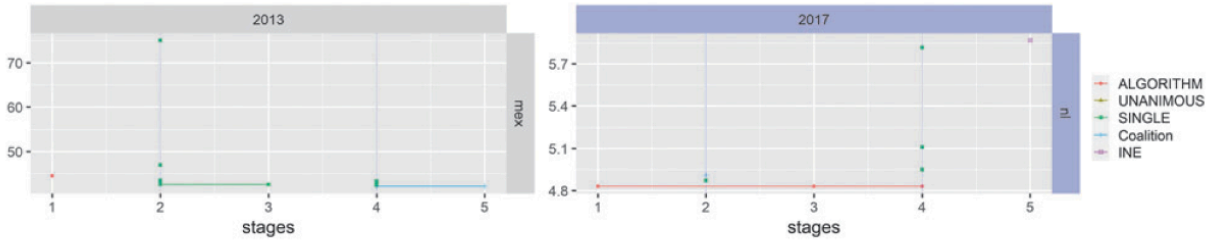
Year	Best Score Lost	Algorithm Lost	Unanimous- Not Best	No Agreement & Not Best
2013	**28%**	**84%**	**3%**	**19%**
2017	**72%**	**72%**	**22%**	**31%**

Note: N= 32 per year. Table elaborated by the authors and published as supplementary material of Trelles et al. (2023).

Although there is no evidence of wrongdoing, Table 3 reveals that during the 2017 redistricting round, a large proportion of plans (72%) selected were not those associated with the lowest cost-–the most efficient–solution (Trelles et al. 2023).

Figure 4 shows the plan scores associated with two states: the State of Mexico in 2013 (left) and Nuevo Leon in 2017 (right). The vertical axis represents the scale reported in each state associated with the optimization function.[6] The horizontal axis represents the five stages indicated in Figure 2 of the Appendix, representing: 1) the first scenario produced by the algorithm; 2) the first round of partisan interaction (vertical axis highlighted in blue); 3) the second scenario selected by the TC; 4) the second round of partisan interaction (vertical axis highlighted in blue); and 5) the third scenario submitted to INE's executive board for its final approval.

Figure 4. Redistricting Process Stages and Winners



[6] The scale on the vertical axis differs in 2013 and 2017 because of differences in the optimization process (number of restrictions, weighting, and algorithm). Even though the primary and secondary laws did not change, INE decided to modify the optimization phase by using two (*population* and *compactness*), instead of four (*population, municipal integrity, traveling time*, and *compactness*) restrictions in 2017. Comparisons in figure 2 should be made within each process.

Note: Figure elaborated by the authors and published as supplementary material of Trelles et al. (2023).

Figure 4 reveals that while in the State of Mexico the process worked out in a way that conforms relatively well with the public portrayal (i.e., the algorithm proposed a score that was incrementally improved upon in subsequent rounds, the final plan scored best, and was supported by a coalition), the process in Nuevo Leon evolved very differently (e.g., although the algorithm's score was best, it was not adopted. Instead, the adopted plan was the worst scoring map and was never proposed by a party but introduced by INE at the end of the process–after the submission phase for plans was formally concluded (Trelles et al. 2023).