TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Roy Breckenridge Shuyler IVGM165532

Aiding Election Observation Using BPMN:

A Case Study of the 2017 Estonian Municipal Council Elections

Master's Thesis

Supervisors: Prof. Dr. Dr.
Robert Krimmer

Prof. Dr.
David Dueñas i Cid

Tallinn 2020

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

Roy Breckenridge Shuyler IVGM165532

BPMN-i kasutamine valimiste vaatlemise abivahendina Eesti 2017. aasta kohalike omavalitsuste valimiste näitel

Magistritöö

Juhendajad: Prof. Dr. Dr.
Robert Krimmer

Prof. Dr.
David Dueñas i Cid

Tallinn 2020

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the materials used, references to the literature and the work of others have been referred. This thesis has not been presented for examination previously.

Author: Roy Breckenridge Shuyler

17.12.2020

Abstract

As new voting technologies are incorporated into elections and the number of balloting options available increases, the scope of observing elections will grow. To keep pace with the changing landscape of elections, election observers stand to benefit from having visual representations of the election laws in the form of business process models. This thesis will examine the modeling of the Estonian Municipal Council Election Act using Business Process Model and Notation (BPMN) for the purpose of enhancing election observation. An exploratory case study is conducted on the modeling of election laws using BPMN and the use of the resulting process models during the observation of the 2017 Estonian Municipal Council Elections. The case study shows that the use of BPMN models can aid in the observation of elections by providing election observers with an additional source of data in the form of process models of election laws.

This thesis is written in English and is 148 pages long, including 7 chapters, and 91 figures (14 figures and 77 process models)

Keywords: e-voting, i-voting, remote internet voting, Business Process Model and Notation (BPMN), Estonia election law

Annotatsioon

Kuna valimiste läbiviimisel kasutatakse uusi hääletamistehnoloogiaid ja suureneb hääletamisvõimaluste arv, siis kasvab ka valimiste vaatlemise töömaht. Selleks, et valimisvaatlejad suudaksid valimiste muutumisega sammu pidada, lõikaksid nad kasu valimisseaduse visuaalsest esitamisest äriprotsessi mudelite kujul. Selles magistritöös uuritakse Eesti kohaliku omavalitsuse volikogu valimise seaduse mudeldamist, rakendades valimiste vaatlemise tõhustamise eesmärgil äriprotsesside modelleerimiskeelt *Business Process Model and Notation* (BPMN). Valimisseaduse mudeldamisest BPMN-i abil ja selle tulemusel loodud mudelite kasutamisest Eesti 2017. aasta kohalike omavalitsuste valimiste vaatlemisel valmis käesolevaga juhtumiuuring. See juhtumiuuring näitab, et BPMN-i mudelitest võib olla abi valimiste vaatlemisel, kuna need annavad valimisvaatlejate kasutusse täiendava andmeallikana valimisseaduse protsessimudelid.

Käesolev magistritöö on kirjutatud inglise keeles ja on 148 lehekülge pikk, koosnedes seitsmest peatükist ja 91 joonisest (14 joonisest ja 77 protsessimudelist)

Märksõnad: e-hääletamine, i-hääletamine, kaughääletus interneti teel, Business Process Model and Notation (BPMN), Eesti valimisseadus

List of Abbreviations and Terms

ABC	Activity-based Costing
BPMN	Business Process Model and Notation
BPEL	Business Process Execution Language
BPR	Business Process Reengineering
DRE	Direct-recording Electronic
EVS	Electronic Voting System
ISO	International Organization for Standardization
NVT	New Voting Technology
ODIHR	Office for Democratic Institutions and Human Rights
OMG	Object Management Group
OSCE	Organization for Security and Co-operation in Europe
PC	Personal Computer
PIN	Personal Identification Number
SEO	State Electoral Office
XML	Extensible Markup Language

Table of Contents

List of Figures

1 Introduction

From the perspective of Western society, the democratic process is considered the most effective method of creating the conditions in which a nation's inhabitants feel the liberty to exercise their fundamental freedoms. Democracy has been argued by some to be the pinnacle of human history [1], and there is good reason for this assessment. The fact that the democratic process allows for large portions of the population to participate in the process of making decisions as a group, via an election or referendum[1], is a significant part of what justifies its broad acceptance.

In their most basic sense, elections are a means by which a large number of the governed are able to participate in the making of decisions. When making collective decisions, polyarchy, hierarchy, bargaining, and markets are all considered legitimate sociopolitical processes [2]. Yet modern governments tend to be organized according to the liberal democratic principles associated with polyarchy. This is because group decisions are thought to be an impartial way to represent the will of the people when they are made in accordance with the outcome of a free and fair election. Although a single, individual sociopolitical process is rarely used in isolation from the others, the fact that a modern form of government, which has its roots in Classical Greece, continues to endure is a testament to its importance to society.

The resilience of liberal democracy and our wide-spread reverence for it are linked to core values that include its focus on the importance of individual rights, the fact that electors are assumed to be rational beings, and universal suffrage [3]. In this manner, participants are able to accept the outcome of a decision even if their choice does not prevail. Although an election might not coincide with an individual's desired outcome, the individual is able to rationalize that – as long as the majority of the participants shared an opinion that differed from their own – it is nevertheless

[1] For the sake of simplicity, since the case study focuses on an election, this thesis will use the term election (the process of choosing representatives of the people through a vote of the electorate) when referring to electoral systems, even though the term can be used to refer to a referendum or plebiscite (the process of the electorate directly making a decision).

fair, even though it was in opposition to their own particular preference. On the contrary, when a decision is made by an autocratic government, this psychological mechanism that allows one to logically tolerate a decision they oppose is absent. This can be attributed to the fact there is no evidence that the majority shared a contradictory opinion, and as a result they might find it more challenging to tolerate the decision. In this way democratic systems are able to legitimize decisions that might be unpopular even with large segments of the populace.

The values that underpin liberal democracy are not important solely because we find them to be pleasing, rather they each serve a function of the system. For instance, without strong individual rights there might not be adequate incentive for the limiting of governmental power [4]. This can be seen to help democracy achieve one of its most conspicuous benefits: the prevention of the tyrannical consolidation of power.

Additionally, since electors are considered rational beings, greater significance is placed on how they are able to judge their world empirically rather than based on existing customs or long-standing traditions [3]. This acts as a way of transferring sovereignty to the citizens away from the state's actors by allowing the former to constrain the latter [5]. As a result, the governed are not necessarily bound by the constraints of their culture; instead, democracy allows for the possibility to make one's personal opinions known and gives the opportunity to vote in a way that best serves their self-interest and local community.

And finally, universal suffrage, the fact that nearly all adult members[2] of society regardless of their gender, race, religious affiliation, sexual orientation, or socio-economic standing in society, are able to participate equally helps to maintain fairness among the electorate by giving no person more votes than the others which contributes to the impartiality of this particular group decision-making process.

These liberal democratic values, in conjunction with the endorsement of democratic election results, help legitimize the institutions and policies of a state. This serves as an explicit mandate given to the local, regional, or national government in question, which can help to ensure the will of the people is being considered in addition to offering the citizenry a procedure to peaceably

[2] Voter enfranchisement is often predicated on citizenship, residency, and having not committed a felony.

adjust how they are being governed. Machiavelli recognized the power of having a mandate when he wrote, "{… a ruler} can never secure himself against a hostile populace, because they are many {…}" [6, p.193].

The psychological effect of elections noted above is no secret, it is also well known to despots and would-be tyrants. Autocrats are therefore incentivized, not only by the power wielded over them by international forces, but also by internal pressures that build up over time, to at least appear to have democratic traditions [7]. This demonstrates that there is motivation for those who seek power and wish to maintain it to stage sham elections which serve to give the impression that the electorate participates in making group decisions. As a result, not all elections are free and fair.

Because free and fair elections are considered to be a legitimate process for group decision making, the propensity exists for tampering with voting and elections. The argument behind this is that if the majority of the electorate is in favor of something or someone to represent them, then it is a superior choice. Public elections are a central part of any democratic system of government. National governments that do not hold elections or hold elections that are not considered to be free and fair are typically not held in the same regard as other Western democracies by the international community and therefore are not known for honoring the liberty of their citizens.

Due to the incentive of holding elections that intentionally subvert the will of the people, the tradition of monitoring or observing[3] elections has become an established way for non-partisan actors to systematically witness an election to evaluate the legitimacy of the process and procedures. Additionally, election observation is also used to acquire other outputs beyond just certifying its legitimacy; it is also a practice used for research, as is the circumstance with this particular case study. Given the variation of election laws in the world and the numerous languages, local customs, and electoral systems under which the elections are established, shaped, and held, election observation can be a challenging task to accomplish. In this thesis, the author will argue that election observers stand to benefit from using visual models to help bring additional clarity to the laws, processes, and procedures of the election being observed.

[3] Observing and monitoring are interchangeable, but the terms observing, observation, and observer have been chosen for use throughout this thesis.

This thesis specifically addresses the observation of the 2017 Estonian municipal council election conducted for the purpose of costing the administration of balloting in an election that has multiple available balloting options, otherwise known as a multichannel election. Since this election's scope, timeframe, and quality are stipulated in legal Acts[4], they will be considered to be known. The author proposes that, because of the inherent complexity of election administration, especially in a multichannel election such as Estonian elections, election observers can directly benefit from having alternative representations of the rules that guide the administration of elections to aid them in observing the conduct of the election.

As voting technology transforms over time and more voting channels are added to elections around the world [8], it will be increasingly important to be able to reduce the barriers for the expansion of election observation so the limited resources of observers can be used more efficiently and effectively. This thesis will examine the possibility that representing the election law with a formal, standardized system of graphical representation, in this case Business Process Model and Notation (BPMN), can help election observers more easily gain a better understanding of how a particular election is administered so that they can more effectively allocate their resources.

The focus of this thesis will be the modeling of the Estonian Municipal Council Election Act (and sections of the Election Act which establish the legal framework for electronic voting) using BPMN for the purpose of assisting election researchers and observers and will ask the following research question and its sub-research questions.

- **RQ1. How can BPMN help facilitate observation of the voting technologies included in multichannel elections?**
    - **SQ1: How can BPMN help simplify the complexity of elections?**
    - **SQ2: How can BPMN help improve election observers' comprehension of elections?**
    - **SQ3: How can BPMN help facilitate the work of election observers?**

[4] The election laws that were in effect at the time of this case study can be accessed on Estonia's official Riigi Teataja website. The Municipal Council Election Act: https://www.riigiteataja.ee/en/eli/ee/514112016001/consolide and the Riigikogu Election Act, in which Chapter 7^1 provides the relevant legal framework for Estonian internet voting: https://www.riigiteataja.ee/en/eli/ee/514112016004/consolide.

The research for which this modeling was completed was a part of an investigation to develop a new methodology for using Activity-based Costing (ABC) for the costing of various channels of a multichannel election [9, 10]. The researchers were not native to Estonia and were not necessarily specialists in Estonian election laws. Given that the time the researches had to prepare their research design and conduct the research was limited, and the researchers' imperfect understanding of the Estonian Municipal Council Election Act, this modeling using BPMN was done to help guide their research design and subsequent research observing the election through an alternative, graphically represented, perspective of the election law.

The following chapter lays out the theoretical framework of this case study by giving an overview of elections, and how election observation fits into the anatomy of an election. Chapter 3 introduces BPMN and how it relates to the case study. After the background of the case study has been sufficiently expounded, the methodology of the case study will be described, followed by the case study, a subsequent discussion, and finally a summary and conclusion of the author's findings. All the process models that were made for the case study are presented in an appendix to the thesis.

2 The Anatomy of an Election System

Part of the reason democracy is so cherished by modern liberal societies as a political concept are the aforementioned supporting values of individual rights, rationality, and the inclusivity and impartiality provided by universal suffrage. However, the element that creates a democracy in practice are its free and fair elections. In its most basic sense, an election is a formal process for inhabitants of a political territory to have a regular opportunity to directly participate in the manner in which they are governed. During an election, each voter is authorized to select their preferred option from a slate of candidates, propositions, initiatives, or referenda through the use of a ballot. Ballots are then collected and tabulated by election administrators to be reviewed and certified by election officials after the close of an election.

This chapter presents an overview of elections in terms of election laws, electoral systems, and voting technologies. In addition, this chapter will describe the general responsibilities of election administrators in orchestrating elections. Combined, this background will serve to establish both the variety of democratic election practices as well as a context for this investigation. Finally, the topic of election observation will be addressed.

2.1 Election Law

Democratic election laws are what define the rules of the electoral system of the political jurisdiction within which they are held. Details about how elections are conducted, from defining voter eligibility and candidate qualification, through to the certifying of results, and beyond, are all codified in the prevailing election law of the land. Because the creation of laws, including election laws, is guided by the values, norms, traditions, customs, and culture of the people and institutions they are intended to govern, there is no universal standard for how elections should be held. As a result, election laws vary between countries but can also vary dramatically between political jurisdictions within a country.

Even though there is no standard, principles found in Article 25 of the United Nation's International Covenant on Civil and Political Rights prescribe certain principles that should be followed to assure that an electoral system is to be considered free and fair. These basic guiding principles are: that all citizens (with reasonable restrictions such as age, residency, and citizenship) shall have the legal opportunity to participate, either directly or through their representatives, in conducting public affairs; that they should have the right to vote in and stand for election in 'genuine, periodic elections', to be held by 'equal and universal suffrage', using 'secret ballot' [11]; or in the seven words of the Organization for Security and Co-operation in Europe (OSCE), an organization whose key components includes election observation: elections should be "universal, equal, fair, secret, free, transparent, and accountable" [12].

2.1.1 Electoral Systems

Electoral systems can be structured differently depending on what type of election laws are in effect. Included in the election law of a political territory are the rules that determine how an election is run, how citizens are able to vote in the election, and what process is used to decipher the votes of an election into the victors of the electoral process [13]. According to David M. Farrell in *Electoral Systems: A Comparative Introduction*, the three main components of an electoral system are as follows: (i) Magnitude of the district, or how many political positions represent the constituents of a district. (ii) Structure of the ballot, which determines whether voters are able to vote only for the candidate of their choice as is the case with categorical ballots, or whether they are able to vote for every candidate by means of ranked choice as is the case with ordinal ballots. (iii) Electoral formula, or how the final tally of votes is deciphered into the political positions of the election [13]. There is no limit to the number of formulas that could be used for this process, but the most typical methods used are plurality (the most votes received wins), majority (more than half of the votes are required to win), or proportional (the number of political positions awarded is proportional to the number of tabulated votes) [14].

2.1.2 Voting Technology

Democratic governments do not independently arise from chaos; upon inception they must be carefully crafted and throughout their existence they must be periodically maintained to help

continually refine and uphold the purpose of putting power in the hands of the majority. This has led to an evolution of the system from its initial form of direct democracy in ancient Greece to the democratic representation of the Roman Republic, leading up to the variances seen today between different pluralistic and proportional electoral systems. Not only has the organizational structure of democratic institutions changed over time, so has the technological means used to conduct elections.

The methods allowed for electors to vote are defined by the jurisdictional election law. How voting is actualized in the form of a ballot depends on the electoral system. The history of voting technologies is long and well documented [15]. However, a brief overview is given below to provide the necessary context for the technologies that are investigated in this case study. A deeper look at the specific voting technology relevant to this investigation will then be presented.

Historical Overview of Voting Technology

As technology has evolved, various methods of voting have been used to ascertain the will of the electorate. The sophistication with which voting technology has advanced has afforded modern democratic governments certain advantages which were not necessarily commonplace throughout history [15]. No longer do we need to forfeit our privacy by voting in public via acclamation by raising our hands, by using our voices *viva voce*, by clapping swords, nor by coming forward to have our votes tabulated by a *rogator* [16]. The principle of privacy has become such an important right that voting by secret ballot has become an integral part of what has come to be expected of legitimate elections.

Further developments, such as the double envelope system, have enabled voters to vote outside the confines of the controlled environment of a polling place. The use of a secrecy envelope in the double envelope system allows voters to maintain their right to secret ballot while voting remotely in uncontrolled locations via post [17].

Recent advancements in information and communication technologies have further expanded the available options for conducting democratic elections, adding more possibilities to the available assortment of voting technologies. These technologies, in general, are known as electronic voting, and each has its own set of advantages and challenges.

Electronic Voting (e-Voting)

E-voting, in its many iterations, gives more benefits to voters including increased privacy for some disabled voters, reduced tabulation times, and increased access to information on the candidates and referendums [18]. These advantages are not limited to the voters. The fact that electronic ballots are massless and can be tabulated in a much more efficient manner, has the potential to simplify the logistics required for the administration of elections.

The first voting machines which employed the use of electricity were invented in the nineteenth century, however, they were not considered useful by the parliaments that chose not to adopt this voting technology [15]. In the mid-twentieth century electronic devices that would optically scan paper ballots were proposed to help hasten their tabulation [19]. Among the next developments were direct recording electronic (DRE) voting machines which were first introduced to elections in 1974 [20]. These are proprietary voting machines that are used in voting booths at polling places that typically include an auditable paper trail. DRE voting machines can also be deployed as 'kiosks' in public spaces that are not controlled to the same degree as polling places.

Remote Electronic Voting (i-Voting)

In addition to DRE voting, technological developments have also allowed for remote electronic voting, or internet voting, which frees the elector from having to travel to a centralized controlled location on a prescribed day during a prescribed time. This thesis will use the term 'i-voting' to differentiate Estonian internet voting from other types of electronic voting such as DRE voting and kiosk voting [21].

i-Voting in Estonia

Estonian i-voting uses a digital two envelope system in the same manner a paper ballot in postal voting. The provider of the Electronic Voting System (EVS) in Estonian is Cybernetica AS. This Estonian company develops and maintains the EVS at the behest of the National Electoral Committee, the owner of the system's rights and intellectual property [22]. In order to maintain as much transparency as possible, much of the source code[5] (97% by one measure) is publicly available for peer review [23]. However, portions of the EVS that are essential for the security of

[5] https://github.com/vvk-ehk/ivxv

the system must remain secret to ensure the integrity of the system. To help ensure the security of the software, independent auditors are enlisted to check the source code [23].

Voters are able to download the official software to their personal computer (PC). Using this software, electors are able to cast a ballot during the days that are open for i-voting (from the morning of the tenth day before the election until the evening of the fourth day before the election) from their PC, even from uncontrolled environments. To reduce the risk of coercion that accompanies voting in uncontrolled environments, the Supreme Court of Estonia has ruled that "the possibility to change one's electronic vote is necessary for guaranteeing the freedom of elections and secrecy of voting"[6] upholding the right for voters to be able to change their i-vote as many times as they desire. Only the final status of the vote will be counted. And as an additional layer of protection to ensure voters are able to vote in private and free from coercion, voting via the internet does not preclude one from voting in person (until one day before election day). If a voter votes both in person and on the internet, their i-vote will be canceled out.

As an added layer of security against compromised hardware, voters are encouraged to download the software to a second, separate device (typically a smartphone) to ensure their ballot is not being forged or spoofed by some malicious code on the PC they originally used. The idea behind this is that it would be increasingly unlikely for multiple devices to be compromised in the exact same way necessary for that type of manipulation.

The development of the technology required for i-voting in Estonia has certainly required an upfront investment of resources. It is also important to note that i-voting is predicated on the existence of other technologies such as a digital identity and a digital signature [24]. The associated costs of developing all the required infrastructure and software are not insignificant, nor is it a one-time investment; the technology must also be maintained over time. However, the advantages offered by the ability to vote via the internet has the potential to lower the cost of voting for the voter in terms of time and resources required to get to the polls, and reduce the effort required to vote has been shown to increase participation [25]. i-Voting also has the potential to help keep voters out of harm's way during times when it would be unsafe to go to a centralized polling

[6] https://www.riigikohus.ee/en/constitutional-judgment-3-4-1-13-05

location, as is the case during a pandemic such as COVID-19, for example. Additionally, as the research that this case study arose from has shown, i-voting can also help reduce the cost of administering elections [9, 10].

Multichannel Elections

Even though democracy has a long history brimming with success, its path forward is not free of obstacles. Considering that one of the strengths of the institution is the elected official's ability to govern by mandate, the decreasing participation experienced by some established democracies weakens this rationale [26]. When low-voter turnout becomes the norm, it can be argued that democratic institutions are unable to uphold their own principles. When democracy is seen to fail in this regard, this so-called 'democratic deficit' could affect the legitimacy of this revered form of government [27]. If democratic institutions lose their legitimacy, voters see less incentive to participate. As this happens participation could decrease even further; therefore, it is generally believed that something will be needed to help prevent a collapse of trust in the system.

According to rational choice theory, one way to address the issue of a democratic deficit is through increasing the net sum of the difference between marginal utility returns and costs of voting [28]. Although the cost of voting for electors is already low, if introducing additional voting channels can help decrease it even further, by giving electors more options of how and when they can vote, then participation levels could be increased. One strength of i-voting as a voting channel is that the elector is able to vote from wherever is most convenient within a prescribed timeframe, and as a result it could significantly lower the cost of voting for electors, thereby increasing participation.

It is important to note that some voters, due to a digital divide, are unable to use the technology required to i-vote. Therefore, until no digital divide exists, all elections that incorporate the i-voting technology will necessarily require the use of other channels of voting technology so that they maintain their universality [29].

As detailed above, multichannel elections can help provide the electorate with more options, which should help increase participation. However, the benefits of multichannel elections come with at the cost of increased complexity, especially to preserve the equality among voters so that only one vote per voter is allowed to be tabulated.

2.2 Election Administration

Even if an archetypal law against which all elections could be compared were to exist, how the electoral process and procedures are actually carried out by election administrators in practice might vary significantly from the law. Numerous participants, known as election administrators, are required for the functioning of the complex processes and procedures necessary for running an election [30]. Election administration involves more than just the implementation of the allowed voting technology as defined by the election law. It is important to recognize that, as the number of channels of voting technology available to voters increases, the scope of the responsibilities of election administrators also increases.

Given that an election is more complex than simply the act of distributing and collecting ballots on election day, it is useful to categorize the various activities of an election into different stages. This thesis will refer to the same periods used by Suksi's Electoral Cycle included in which are the pre-election, election, and post-election periods [31]. During every phase of the electoral cycle, there are responsibilities that must be attended to by election administrators. According to the Ernst & Ernst *Election Administration Volume I: Managing Elections*, the eight main administrative functions of election administrators are (i) defining precincts, (ii) certifying candidate qualifications, (iii) registering voters, (iv) controlling campaign finance, (v) supplying voters with adequate information, (vi) balloting, (vii) tabulating, and (viii) certifying the results [32]. Most of these functions take place during the pre-election period, yet this case study, and election observation in general, tends to focus on the balloting and tabulating activities that take place during the election period.

2.2.1 Pre-Election Period

During the time leading up to an election period there are numerous steps that must be carried out, not only by the candidate, but also for the election administrators who are responsible for the administration of the election. Pre-election activities of election administrators include, but are not necessarily limited to, voter registration, determining who can run as a candidate and their certification, and anything else that is required to be on the ballot. Election officials also oversee campaigning practices and campaign financing laws to ensure they are compliant and enforce the

rules when not followed. They must also define the voting precincts, supply voters with adequate information about how to participate in the election, validate the voting technology, prepare the ballots, and have all the infrastructure in place and operational for election day.

2.2.2 Election Period

The election period is the time during which the balloting occurs. The length of the election period varies depending on the governing election law. In some jurisdictions the election period could be limited to a single day of voting on election day, while elsewhere it might extend over a longer period of several weeks of advance voting before election day. There are many aspects for which election administrators are accountable, even if this period only lasts one day. If the voting period is longer, then the span of time over which the duties occur increases along with the length of the election period.

Election administrators must arrange the locations where voting will take place in all of the precincts. It is their duty to recruit, assign, and manage the representatives who will be responsible for the polling palaces and the enforcement of the rules. It is their responsibility to operate the allowed voting technologies that are to be used. They must control when voting begins and ends on each day voting is allowed. And finally, after the votes have been cast, they must safely secure and transport the ballot boxes, voting machines, or other relevant voting apparatuses while ensuring a verifiable chain of custody.

2.2.3 Post-Election Period

After the polls have closed and the final votes have been cast by the electors, the election period is thought to be over. It is at this point that the votes must be tabulated, results must be announced, and if necessary, challenges to the results are made and carried out to their conclusion. Tabulating the vote involves counting the collected votes and recording an official count. The final results must be certified and announced by election officials following the official rules set out in the election law. The records of the election, including the ballots, must be a preserved for the length of time specified by the election law.

In the post-election period, if there are concerns about the final count or how the election was conducted, election administrators are responsible for the handling of challenges. There must also be the ability to conduct recounts of the vote, if necessary. Any legal challenges need to be dealt with during this period. In addition, runoff elections may be required to determine victors, particularly when an election requires a victor to receive a majority of the votes cast.

As described above, the duties of election administrators are many and the processes and procedures that are used can be complex for each voting channel. As the processes and procedures can vary between voting channels, the set of processes and procedures election administrators are responsible for increases with the allowable voting channels.

2.3 Election Observation

Periodically held elections are both an advantage to and an obligation of the democratic system in which Western Society places so much faith. However, because elections are run by humans who are capable of making errors and having personal biases, a legal analysis of the laws that govern elections is not, in and of itself, sufficient to evaluate how an election was conducted in practice.

2.3.1 Background of Election Observation

Elections are not free and fair by default; they are governed by laws written by lawmakers whose ability to acquire and maintain power paradoxically relies on the outcome of elections and are managed by election administrators who can accidentally or purposefully influence the outcome of an election. Election laws are typically written in a language style that can make them challenging to comprehend by ordinary electors, election administrators, and election observers.

Because of the inherent risk of election laws being misinterpreted due to the way in which they are written, and the potential for mismanagement of elections, it is important to be able to collect empirical evidence to document how an election was administered to determine whether or not the election was conducted within the rules and regulations contained in election laws [33]. If the evidence confirms the legality of the election, the vote outcome can be certified. If not, there may be legitimate grounds to dispute and challenge the apparent outcome of the election. Independent election observers are often utilized to provide empirical evidence needed in this process.

Election observation is the gathering of qualitative empirical data by election observers in order to evaluate a hypothesis or hypotheses. There is no limit to the type of hypotheses that might be researched, but it is typical for observers to seek evidence that an election system performed in accordance with the governing election law, or if the electorate was able to participate according to guiding principles [30]. When data is collected that does not support a hypothesis that an election is being held legally, or in a fair manner, it can help draw the attention of the domestic electorate to the corruption in their democratic process, or scrutiny from abroad which could affect international relations [30].

Election observation is typically carried out by organizations that are focused on human rights. The methodologies they employ are various; however, the Carter Center, an important, influential organization in the field of election observation, recognizes that "the core group of leading organizations associated with the Declaration of Principles for International Election Observation {…} uses similar methodologies and produces high-quality professional reports" [34]. This declaration, from 2005, lists the reasoning behind what makes election observation an important practice and outlines how an election observation should be conducted [35]. The OSCE plays an important role in election observation, as its Office for Democratic Institutions and Human Rights (ODIHR), originally founded as the Office for Free Elections, and developed the election observation methodology[7] which is perceived as the 'gold standard' [36]. The methodology is described in its 6th Edition released in 2010 as well as a number of specialized handbooks such as the *Handbook for the Observation of New Voting Technologies* (NVT)[8] and includes seven fundamental ideals that must be adhered to when elections are held.

1. Legitimate elections must preserve electors' right to secret ballot.
2. There must be a verifiable chain of actions which ensure the integrity of the election's outcome.
3. Electors' votes must have equal value.
4. No qualified citizen should be prevented from participating in an election.
5. Meaningful observation must be permitted to ensure transparency.

[7] https://www.osce.org/odihr/elections/methodology
[8] https://www.osce.org/odihr/elections/new_voting_technologies

6. Participating members in the administration of elections should be accountable for their actions.
7. The public's confidence in the management of the election process must not be ignored by election observers.

History of Election Observation

Considering the roughly 2,500-year history of democratic elections, election observation is a relatively new practice. Besides some informal observations before and shortly after World War II, the first election to be formally observed was the Organization of American States' observation of the 1962 Costa Rican presidential election [37]. However, since the practice has begun, many methodologies have been developed. One of the most important parts of election observation is to have a clear and specific hypothesis. These are particularly meaningful after changes to the law have been made, or if some part of the administrative procedure seems complicated [30].

Additionally, it is important for a consistent data collection method to be implemented among the observers. Even though election observation is largely a qualitative method, through a well-thought-out methodology, it is possible to collect quantitative data as well. A well-designed methodology should help observers to conform to certain guidelines that require them to systematically observe the aspects of the election that are the focus of the data collection. Then the determination of where election observers will observe should be made.

Election Observers

Ideally, election observers are non-partisan members of a team that has a unified mission to collect data about an election. Verifying the legitimacy of an election is the purpose behind most international election observation efforts. Usually carried out by members of a non-governmental or intergovernmental organization, election observers' presence is to act as impartial witnesses to the various processes that constitute an election. In Estonia, the main intergovernmental organization whose activities include election observation is the OSCE.

Election observers serve an important role in collecting data on the performance of an election for several reasons. By having a presence at some points during the election, observers might find themselves encountering some elements of an election that they were unable to anticipate while

they were designing their research. This function of the witnessing of events firsthand can be especially helpful if election laws, voting technology, or procedures of election administrators have been altered, because the way in which problems might be encountered would be difficult to predict beforehand [30]. Election observers' perspective can also help contextualize other data that is collected during an election. Sometimes when the data shows something questionable occurring, the election observers are able to help clarify why things on paper might seem different than expectations by applying context from their perspective. One additional way election observers serve an important function is that their observations are useful for studying interactions between the various participants in an election.

2.3.3 Challenges to Observing Elections

There are difficulties to election observation. Just as election laws vary from country to country, the election observers must be trained specifically for the election they are tasked with observing. Election observers should be carefully selected to take into consideration the appropriate skill sets, both personal and professional, to be able to work well in the particular environment in which they will be observing. The set of skills required is rather broad. For example, observers must be capable of providing the data input required of the hypothesis, while maintaining a demeanor that would be unoffensive to the locals who are participating in the election.

Since multichannel elections, by definition, do not function homogeneously, it is not always possible for ODIHR's seven elements of legitimate elections to be observed using the same methodology across every voting channel. The more balloting methods that are included and the more they differ from one another make it more likely they require different methods of observation, complicating the role of the election observer. Additionally, as balloting evolves and NVT are used for public elections, the methods of election observation become obfuscated even further. Therefore, in the case of remote internet voting, there are observational challenges that must be overcome so its use can meet the necessary criteria of lawful elections.

There are additional challenges to observing elections using NVT. According to ODHIR's *Handbook for the Observation of New Voting Technologies*, the benefits of adopting the NVT should be noted and the motivations behind their adoption should be investigated [12]. Because of

the possibility that the alteration of an election process can have serious consequences, ranging from the costs of development and administration, to impacts on voter rights and the confidence in the election, election observers should closely examine the decisions that led to the implementation of the NVT [12]. This examination should include the procurement procedures, the level of agreement that existed among political parties, and the involvement of the public for allowing the expression of different views [12].

2.4 Summary and Propositions

This section has demonstrated the complexity of election observation. The potential variation in how elections can be designed in theory is further compounded for election observers by how it is carried out in practice by the election administrators. The indefinite number of possible differences between elections requires each election to be viewed as independent from one another, producing inefficiencies for the practice of observing of elections. Investigating the set of propositions listed below will proffer additional insights on how election observers could benefit from utilizing a new instrument to help confront the some of the challenges of election observation.

Proposition 1 (P1): Because of the variations between elections, election observers stand to benefit from a tool that could help them easily identify differences between the various election laws and electoral systems of the elections they intend to observe.

Proposition 2 (P2): A tool that is able to provide simplification of complex legal text can aid election observers in overcoming possible barriers due to cultural or linguistic reasons.

Proposition 3 (P3): As elections become more complex because of the addition of balloting options, election observers will benefit from tools to help with the analysis of the election laws.

3 Business Process Model and Notation (BPMN)

The efficiency of the public sector in providing services has not always been considered to be commensurate with the private sector. However, given the reality of budget constraints, it is becoming essential for governmental bureaucracies to adopt the practice of Business Process Reengineering (BPR) to help find inefficiencies in their organizations. This trend can be seen in government literature where citizens interacting with election administrators and other governmental services have come to be referred to as 'customers' [30, 38]. BPR has been used by various governmental organizations to help their digital transformation to electronic governance [39]. For example, it has been used in the United Kingdom to help make reforms in the higher education sector [40], and in Serbia for reforming the Tax Administration processes [41].

In this chapter a brief introduction to BPMN will be given to establish it as a legitimate standard that is used in the business sector for identifying inefficiencies in business processes. The reasoning behind the choice to use BPMN will be addressed. Then, an explanation will be given of how the scope of BPMN used in the case study was reduced for the sake of practicality and to fit the purposes of the case study. Afterwards an overview of various use cases will be discussed to establish the research gap to be addressed by the case study. Finally, an overview of the core BPMN modeling elements will be described to clarify the use BPMN models in the case study and as presented in Appendix 1 of this thesis.

3.1 Introduction to the BPMN Standard

When organizations adopt the business management strategy of BPR, they do so because they are seeking to find ways that they can organize themselves to be more efficient and effective. To do so, they first must know what it is they do, or what business processes they perform, before they can determine how they can be reengineered to maximize the value they generate for both the organization and their customers [42]. One step of BPR is to break down how things are done in

the organization into simpler components so that they can be measured, and then examine how they relate with one another. In doing so, it is typical to model the business processes.

Business process models are visual representations of the various inputs and outputs of a business process. Visual representations of business processes are helpful for the task of understanding what an organization does, much in the same way a map, or a visual representation of a geographic region, is helpful when trying to understand one's spatial surroundings. This thesis uses BPMN, one of many workflow graphical process modeling languages. For an overview of the variety of modeling languages available, more details can be found in Mili, Tremblay, Jaoude, et al. 2010 for help when 'sorting through the alphabet soup' of business process modeling languages. In general, their paper categorizes modeling languages into four main groups: traditional process modeling languages, object-oriented languages, dynamic process modeling languages, and process integration languages [43]. The authors of the aforementioned paper define BPMN as a dynamic process modeling language because it excludes the functional, information, and organizational layers. According to the authors, BPMN's "primary goal is human understandability" [43, p.36], precisely matching the use case of this case study.

BPMN has been available to the public since May, 2004 when the specifications of the first iteration, BPMN 1.0, was published by the Business Process Management Initiative [44]. Following a merger in 2005, the Object Management Group (OMG) has maintained the BPMN standard. OMG issued the first major update to the standard in 2011 with the release of BPMN 2.0. In 2013, BPMN 2.0.1 was adopted as an International Organization for Standardization (ISO) standard with its publication of ISO/IEC 19510:2013 [45], helping to solidify it, according to Bonnet, et al., as "a true *lingua franca"* of Business Process Management [46].

The use and wide acceptance of BPMN by the business sector, which is particularly adroit at optimizing business processes, is a reason it was chosen for this case study. Its use, rather than other options such as Unified Modeling Language or Petri nets, was predicated on BPMN's apparent balance of having a rich feature set, while remaining approachable for novices to quickly understand.

3.2 Scope of BPMN

It is possible for cartographers to make maps that are useful to the average person who has no cartography experience. Similarly, the purpose of this investigation is to show how the use of BPMN can help give a simplified perspective of election laws for election observers, without being conversant in BPMN. This chapter introduces the basic concepts of BPMN, many of which are incorporated in this case study to provide the reader with enough information to be able to make sense of the use of BPMN in the case study. However, additional detail is also provided to suggest further potential research on the topic.

It is noteworthy to mention that there is significantly more to BPMN than is discussed in this chapter. Some of BPMN's core elements and attributes such as interrupting and non-interrupting Sub-Processes, Event Sub-Processes, Loop activity instance attributes, Call Activity, and Transactions, were thought to be too complex for the purpose of the case study and therefore are not discussed. Certain aspects of BPMN's core structure, such as Infrastructure, Foundation, and Services, as well as Choreographies, and the possibility of mapping BPMN models to Business Process Execution Language (BPEL) are out of the scope of this research because they were determined to provide only marginal value for this particular case study. Alternative resources that provide a deeper understanding of BPMN [47, 48, 49] are available, but this case study draws directly from OMG's BPMN Specification version 2.0[9] [50] as the primary authoritative source material for the modeling utilized in this case study. As a reference, the OMG specifications provided clear and consistent conventions for the purpose of this case study.

3.3 Uses for BPMN

Graphical representations have proven effective at helping people process information as a result of the effects of computational offloading, re-representation, and graphical constraining [51]. These effects, which have been shown to improve a person's capacity to learn certain types of information when relevant graphics accompany text, are at least a part of why BPMN has proven to be useful. For example, it has been put to extensive use in the healthcare industry [52]. BPMN

[9] https://www.omg.org/spec/BPMN/2.0/

has even been shown to be helpful for citizens to gain an understanding of their role in a complex, overly-bureaucratic administrative car registration processes [53]. In addition to healthcare and government, according to the industries section OMG's homepage[10], BPMN is also a standard for the finance, manufacturing, and retail industries.

Alvarez, Atkeson, and Hall employed a workflow model in the "Auditing the Election Ecosystem" chapter of their book *Evaluating Elections: A Handbook of Methods and Standards* [30, p.119]. Their use of a workflow model as an illustration for "Step 1: Mapping the Election Process", is the first of eight suggested steps proposed for an effective audit of an election ecosystem. Although this model was not done in adherence to an ISO standard such as BPMN, its use and similarities to BPMN demonstrates how making a model of election processes can be useful for election auditors. Logically, if a process model is useful for election auditors, then process models of election laws should also be useful for election observers.

However, to the author's best knowledge, prior to the publication of the research for which this case study's process models were produced [9, 10], BPMN has not been used to model election laws for the purpose of election observation. Considering the purview of the research project was the topic of creating a methodology for costing different voting channels using ABC, the author contends that the research gap for using BPMN to aid election observation still remains.

3.4 BPMN Core Elements

An important aspect of the BPMN standard is the ease with which it can be learned. This is because not every election observer will be conversant in BPMN. The following section gives the reader an idea about the feasibility of teaching the basics of BPMN to election observers who have no familiarity with it. Therefore, a summary of BPMN's core elements will be presented below.

3.4.1 Participants

Participants in BPMN models are made clear through the use of Pools and Lanes. A Pool is a rectangular container that can be used for grouping the modeling elements and Sequence Flows of

[10] https://www.omg.org/industries/index.htm

a Business Process for an entity, actor, or even a technical system which has some role in the process model. Processes models that involve multiple Participants working directly with one another are possible to depict with the use of multiple Lanes that have been partitioned from a single Pool, one Lane for each Participant. It is possible to label both Pools and Lanes for easy reference.

Processes models that depict a collaboration between multiple Participants which do not work directly with each other are represented with the use of multiple Pools in order to signify the indirect interactions that exist external from a single organizational unit. For instance, when using a credit card for a purchase at a shop, the process involves authorizing the card. However, the authorization process is not done by the shop itself; it is a collaboration in which the shop sends and receives messages from the credit card company. BPMN models with multiple Pools are thusly called Collaboration Diagrams.

Figure 1: BPMN Pool and Lanes in Camunda Modeler.

3.4.2 Connecting Objects

Connecting Objects are the lines and arrows that connect Events, Activities, Gateways, Data, and Artifacts together in a process model. The process models of this thesis' case study employ the use of four types of Connecting Objects: Sequence Flows, Message Flows, Associations, and Data Associations. Also included in BPMN are Conditional Sequence Flows, Default Sequence Flows, and Exception Sequence Flows. However, since it is possible to make process models while excluding them, they have been omitted from use in the process models of this case study because

they add an extra dimension of complexity, which would be counterproductive for the goal of the case study. Both Associations and Data Associations will be discussed below along with Data and Artifacts.

Sequence and Message Flows

Sequence Flows are comprised of an arrow with a solid line, whereas Message Flows are comprised of an arrow with a dashed line that starts with an open circle and ends with an open arrowhead. Sequence Flows are contained to a single Pool, while Message Flows are used to connect Elements within separate Pools or the boundaries of separate Pools (as is shown in Figure 2). The sequence of the process model can be visualized with the passing of theoretical 'Tokens' along the path of the Business Process' Sequence Flow. In Collaboration Diagrams, no Tokens are passed between Pools, instead a Message Flow is used to represent the flow of communication through messages that occurs between collaborators.

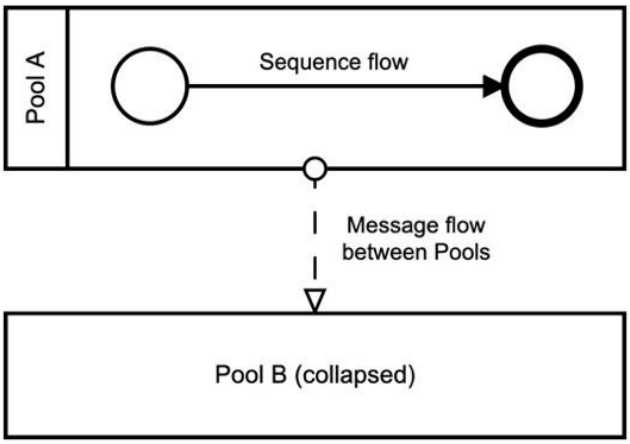


Figure 2: BPMN Sequence and Message Flow Connections in Camunda Modeler.

3.4.3 Events

Events are all represented with some variation of a circle shape. There are three main types of Events including Start, Intermediate, and End Events, each of which have different possible variations for more specificity. Start Events are represented with a single, thin circle; Intermediate Events are represented with two thin, concentric circles; Non-Interrupting boundary Events with a dashed circle or double circle (depending on if it is a Start or Intermediate Event); End Events are represented with a thick bold circle. In the most basic terms, a Business Process begins with the

‘generation’ of a Token at a Start Event. The Token then follows the Sequence Flow through any Intermediate Event in its path, before terminating at an End Event where the Token is ‘consumed’. All Events can be labeled to provide necessary information about the nature of the Event.

Start Events

All BPMN models begin with a Start Event (see Figure 3). This can be considered to be the ‘trigger’ that begins the Business Process or Sub-Process. There are various types of Start Events including Messages, Timers, Conditional, and Signal Start Events. When a Business Process is triggered it is useful to visualize a Token being generated at the Start Event before traveling along the Sequence Flow until it arrives at the next element of the process model. The Business Process will then continue depending on the particular element the Token encounters, and so on and so forth until it is ultimately consumed. The important thing about Start Events is that this can be thought of as a coin slot for the Token that will traverse the process model after the criterion of the Event has been met. A standard Start Event could be labeled ‘Customer enters’ or ‘Ballot requested’, a Timer Start Event could be labeled ‘Next business day’ or ‘09.00 on October 15’, and a Message Start Event could be labeled ‘Authorization required’ or ‘Ballot totals received from all LEOs’ (where LEO stands for ‘Local Election Offices’).

Figure 3: BPMN Start Events in Camunda Modeler.

Intermediate Events

Intermediate Events (see Figure 4) are similar to Start Events in that they will trigger the resumption of a Business Process or Sub-Process. Sequence Flows pass Tokens into Intermediate Events until the Token departs out from it. The unique characteristic of Intermediate Events is that it is possible to use them in pairs where one Intermediate Event throws the Token, and the other catches the Token. A throwing Intermediate Event will hold onto a Token until all of the conditions of the Intermediate Event have been met, and a catching Intermediate Event will resume the Business Process or Sub-Process after the Token has been caught and the conditions of the Intermediate Event has been fulfilled.

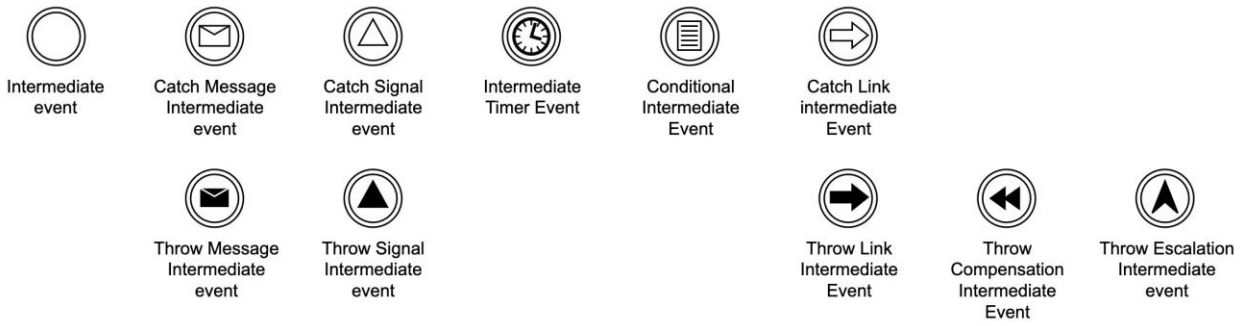


Figure 4: BPMN Intermediate Events in Camunda Modeler.

Additionally, there are both interrupting and non-interrupting boundary Events that can accept a normal Sequence Flow and, upon being triggered again, pass along an Exception Flow. These are called boundary Events because they are attached to the boarder of an Activity. The Activity to which a boundary Event is attached will either be interrupted when the Event occurs, or not depending on if it is an interrupting or non-interrupting boundary Event.

End Events

Syntactically speaking, End Events (see Figure 5) are optional, but the important thing to know is that all Tokens that have been created within a Business Process or one of its Sub-Processes, must be consumed for it to end. End Events are the most explicit way for Tokens to be consumed and are, therefore, commonly used to help with ending a Business Process or Sub-Process. If a process model has not used an End Event, then the final Activity of the Business Process or Sub-Process will act as an implicit End Event and consume the Token after the job of the Activity has been completed. The point in time in which all Tokens have reached an End Event (or been consumed by other means), the Business Process or Sub-Process is terminated. As a result, Sequence Flows can only flow into but not out of End Events.

Figure 5: BPMN End Events in Camunda Modeler.

3.4.4 Activities

Work to be performed by the Participants of a Business Process are referred to in general as Activities in BPMN. Activities are made up of Tasks and Sub-Processes. Returning to the concept of a theoretical Token traversing a process model, when it arrives at an Activity, the work described in the Task or Sub-Process is performed. Both Tasks and Sub-Processes can be labeled for easy reference.

Tasks

In BPMN, Tasks are represented by a rectangular shape with rounded corners. There are several different types of Tasks available (see Figure 6), each one helps to provide additional context to the type of behavior inherent to the Task. These Task types are distinguished from one another with a marker in the top left corner. A Task with no marker is known as an Abstract Task.

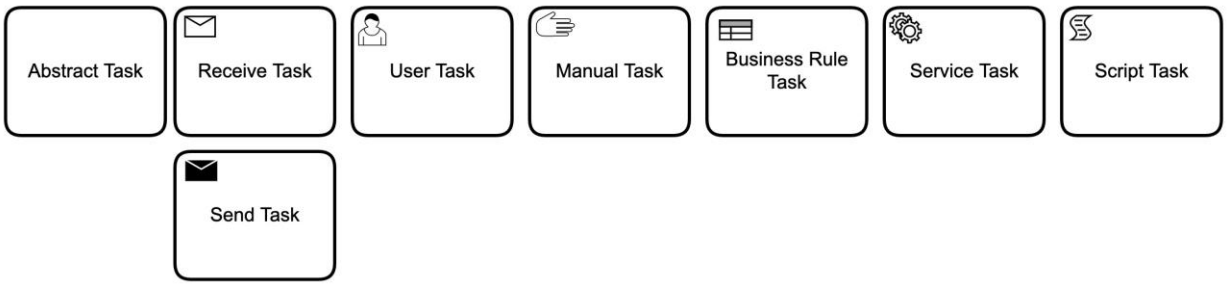


Figure 6: BPMN Task Types in Camunda Modeler.

Sub-Processes

Like Tasks, Sub-Processes are represented by a rectangle with rounded corners, however unlike tasks, there are no Sub-Processes types. Sub-Processes can either be collapsed or expanded. A collapsed Sub-Process is the same size rectangle as a Task and, like a Task, is capable of containing a label describing the Task, but it can be differentiated from Abstract Tasks because collapsed Sub-Processes contain a square with a plus symbol inside of it at the bottom center. Expanded Sub-Processes are typically represented by larger rectangles with rounded corners. Rather than just only containing the label, like a collapsed Sub-Process, an expanded Sub-Process can also contain other Elements in order to show the details of the process being represented with the Sub-Process (see Figure 7 for examples of a collapsed and expanded Sub-Process).

Activity Attributes

It is possible to assign different attributes to both Tasks and Sub-Processes in BPMN. This is represented visually with a marker at the bottom of the Task or Sub-Process (see Figure 7). However, the true usefulness of an Activity's attributes arises in simulations and program execution using BPEL, both of which are outside this thesis' scope. As a result of the reduced scope, the author will only discuss the Loop, Multi-Instance, and Ad Hoc attributes in how they pertain to a purely descriptive BPMN model, or in other words, a model that is not to be used in a simulation or to execute a process [47], as is the case with the process models made for the investigation of this thesis. For this reason, the extra complexity of using the Compensation attribute was not considered to be worthwhile for the purpose of this case study. The Standard Loop, parallel Multi-Instance, and sequential Multi-Instance markers of Activities are possible for both Tasks and Sub-Processes; however, only Sub-Processes are able to have the Ad Hoc marker, which is available to be used independently, or in concert with any of the other Activity markers.

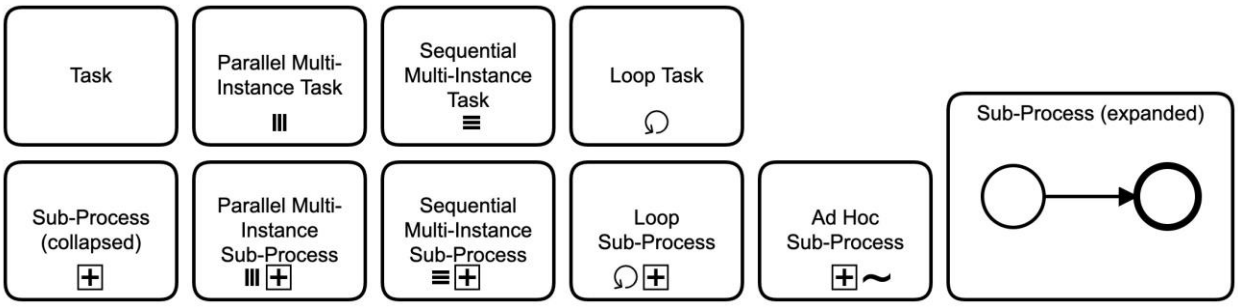


Figure 7: BPMN Tasks and Sub-Processes with Optional Attributes in Camunda Modeler.

Looping Activity of Tasks and Sub-Processes

An Activity with looping behavior is represented by including a Loop marker, an arrow that curves back on itself, at the bottom of the element. For a purely descriptive model, this allows the reader to know that the work of a Task or Sub-Process is not just executed once before finishing, instead it can be repeated as many times as is necessary before completion. When used in simulations, or for program execution, an integer can be entered for a maximum number of times the Activity should be repeated before exiting as well as the condition under which the Loop should end. A Loop Activity differs from Multi-Instance Activities in that the work is repeated an unknown number of times until the Loop is exited.

Parallel Multi-Instance Tasks and Sub-Processes

Parallel Multi-Instance Activities are represented with a marker that consists of three vertical lines at the bottom of the element. This attribute allows for a certain number of instances of the Activity to be created in order for them to be able to execute in parallel with one another. For instance, when preparing *n* hamburgers, rather than repeat the task of grilling a hamburger patty from start to finish *n* times, the same work should be done to *n* hamburger patties in parallel. Or when voters enter a voting precinct, the act of filling out a ballot can be multiplied by the number of voting booths present at the location and done in parallel alongside one another.

Sequential Multi-Instance Tasks and Sub-Processes

A sequential Multi-Instance Activity is represented with a marker at the bottom of the element consisting of three horizontal lines. This attribute allows for a certain number of instances of the Activity to be created and then executed one after the other in sequence. For instance, the hamburger patties that have been grilled in parallel with one another cannot all be picked up at once, they should be picked up from the grill and placed on a bun individually one after another in sequence *n* times. Likewise, the duty of dropping ballots in an individual ballot box should not be done in parallel with one another. The number of times this should be performed by voters should be equal to or less than (in the rare case a voter decides to return the ballot to the election administrators), but not more than the number of ballots that were distributed.

Ad Hoc Sub-Processes

The Ad Hoc attribute is reserved only for Sub-Processes and is represented with a tilde symbol, '~', at the bottom of the element. This attribute allows for the Tasks contained within the Sub-Process to be executed in any particular order for the completion of the Sub-Process. As a result, the Tasks contained in an Ad Hoc Sub-Process do not need to be connected to a Sequence Flow. For example, when a hamburger is being put together, depending on what condiments the client requested, the burger could be sent out with all, some, or no condiments. Likewise, when tabulating votes (in a categorical voting system), only the contests that received exactly one vote will be tabulated. If a ballot was left empty, then the tabulation process is completed without registering any vote for any contest.

3.4.5 Gateways

Gateways (see Figure 8) can be thought of as decision points. The easiest Gateways to comprehend, and therefore the most commonly used Gateways in the models of this investigation are: Exclusive Gateways, in which a Token is limited to only one of the possible outgoing Sequence Flows; Parallel Gateways, in which a single Token can be multiplied into more than one Token; and Inclusive Gateways, in which any number of out-going Sequence Flows can be traversed.

Figure 8: BPMN Gateways in Camunda Modeler.

Exclusive Gateways, in the most basic sense, can act as a Boolean decision, either ‘yes’ or ‘no’. However, it is possible to have more than just two Sequence Flows emerging from an Exclusive Gateway. For instance, it could be a decision of ‘type of rental car’ where a customer could choose an ‘economy’, ‘mid-size’, or ‘full-size’ automobile. It is possible to label the Gateways, and in the preceding example the Gateway itself could be labeled ‘type of rental car chosen’ and then the three Sequence Flows emerging from it would each be labeled with one of the aforementioned automobile types of the example. No matter the number of emerging Sequence Flows, only one exclusive Token is passed along to a single Sequence Flow.

Parallel Gateways are used to create parallel Sequence Flows. After a customer orders a meal at a restaurant, the chef does not wait until one item is finished cooking before starting the next. Instead, each of the multiple items included in the meal are cooked in parallel. An additional Token will be passed to each and every Sequence Flow that emerges from a divergent Parallel Gateway. As the Tokens arrive at a convergent Parallel Gateway, they will wait for all other Tokens to arrive (and become one again) before the Business Process or Sub-Process continues.

Likewise, when a hamburger is ready to be dressed, the chef can be instructed to add all, some, or none of the available condiments. Unlike Exclusive Gateways, Inclusive Gateways are able to have more than one out-going token, and unlike Parallel Gateways, Inclusive Gateways are able to not

have tokens emerge for all out-going Sequence Flows. Each one of the conditions of the Inclusive Gateway is examined and a Token will continue onto every Sequence Flow that has a condition that has been met.

In order to maintain a low level of complexity, both Complex Gateways and Event-Based Gateways were avoided during the modeling for this case study.

3.4.6 Data, Artifacts, and Associations

Some process models need additional mechanisms for representing external information required for the Business Process. BPMN allows for the extension of the information available within a process model through the use of Artifacts and Data Elements (see Figure 9). The Data Elements available for data modeling in BPMN are Data Objects, Data Object References, Data Stores, and Collections of Data Objects (for Multi-Instance Tasks). Included with these elements is the ability to set their properties such as if they are inputs or outputs of data. Again, the scope of BPMN's available tools used in this case study's process models was limited for the sake of simplicity and only employs the use of Data Objects and Data Stores.

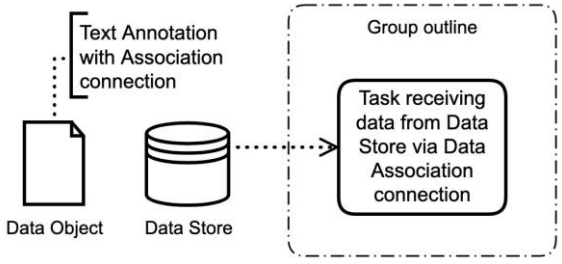


Figure 9: BPMN Artifacts and Annotations in Camunda Modeler.

Data Objects and Data Stores

A 'document' icon, a rectangle with the top right corner folded down, is used to represent a Data Object. A 'database' icon, a cylinder shape segmented with multiple horizontal lines, is used to represent a Data Store. A Data Object could be thought of as a list of construction materials used by a building contractor when placing an order with their supplier, or the list of eligible voters at a precinct provided to a local election official from an election manager. The Data Object is particular to the individual Business Process in which it is accessed. On the other hand, a Data

Store is intended to exist beyond a single Business Process. Extending the above examples, a Data Store would be the blueprint to which the contractor is able to refer to through many different Business Processes for the entire project of constructing a building, or the political territory's population registry that is the source of reference for different Business Processes including when a precinct voter list is produced.

Artifacts

BPMN allows for external relationships to be created through the use of Artifacts for the purpose of enriching the information available in the model. A single process model is not typically used independently from other process models, rather, an individual process model is typically a fragment of a set of Business Processes which relate with one another. Artifacts can be integrated into process models to extend the available information between related Business Processes in a non-intrusive manner. In this way, Artifacts are present in a model to enhance the information available, but do not semantically interfere with either Sequence or Message Flows. BPMN's specification allows modelers to create new Artifact types as long as they abide by BPMN's connection rules and cannot be confused with other elements visually.

One type of Artifact used extensively in the process models of this case study is the Text Annotation object. It is represented by an open bracket that is attached to an element in the process model (most often Pools in this case study) via an Association. Through the use of Text Annotations, it is possible for the process model to provide more thorough information.

Associations and Data Associations

Associations are represented in BPMN with a dotted line, and Data Associations also contain an arrowhead. The arrowhead is used to represent directionality of the flow of information when present. It is possible to link Artifacts or data elements (Data Objects or Data Stores, for instance) to some of the other elements through the use of Associations or Data Associations, respectively. In this way, the graphical elements of BPMN are directly associated with the data elements and Artifacts which will be used to extend the information available within the process model so it can have the access to the information required to accomplish the work.

3.5 Summary and Propositions

This chapter has outlined what BPMN is and how its features can be used to help with BPR. BPMN has thus been shown to be a suitable candidate for modeling processes, including those found in election laws because it has a rich, yet manageable, feature set. Additionally, software is freely available that can help to facilitate the modeling process. It is also important that it is possible to create models with BPMN that are clear and concise and can be intuitive to understand with just a basic introduction to the standard. An investigation into the propositions listed below will help to determine if BPMN is an appropriate tool to use for process modeling.

Proposition 4 (P4): Because BPMN is a freely available ISO standard that is actively maintained by an organization, it is a good option to consider using for a modeling use case.

Proposition 5 (P5): BPMN's feature set is rich enough to model complex processes but can generate models that are easy to understand by limiting the set of features used.

Proposition 6 (P6): Because BPMN models can be intuitively understood with very little experience with the standard, it is a good choice to use outside of its main domain of use.

4 Methodology and Design

This case study began out of a need to conduct a thorough analysis of the Estonian election law so that researchers would have a sufficient understanding of what observations would be necessary during the 2017 Estonian municipal council election. Case studies, according to Yin 2003, are useful research methods for "when how or why questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" [53, p.1]. This thesis will use the case study research methodology because it satisfies all three criteria listed above. The research question of this thesis is a 'how' question. The case study meets the second and third criteria because election observation is a contemporaneous set of events over which the investigator has no control.

As part of the data collection for the case study, process modeling was used. As a first step to effectively proceed with the task of modeling the law, the literature introducing BPMN as a modeling standard was reviewed before the decision was made to base the models on OMG's BPMN 2.0 specification. This document was then thoroughly analyzed to determine what aspects of the standard would help achieve the goal of the task and which aspects should be ignored due to the complexity they would introduce to the models.

This case study is exploratory because it seeks to find out how BPMN can help facilitate the observation of multichannel elections. Modeling election laws for the purpose of election observation is, to the best of the author's knowledge, a novel area of research. Because this area of study is new, there is a need to explore this new territory to lay the groundwork for any future research.

4.1 Case Study Design

Propositions

In order to clarify the intent of this research the following propositions to the research question and the sub-questions were formed based on propositions P1, P2, P3, P4, P5, and P6 listed in Chapters 2 and 3. These sets of propositions, when examined together, can be useful for the answering of the research sub-questions from Chapter 1. It will then be possible, using the answers to these sub-questions, to address the central research question of the investigation.

Proposition to SQ1 (PSQ1): Taking P1 and P4 into consideration, BPMN is able to be used to simplify the complexity of various election laws by transforming the plain text of the law into a standardized process model that can be referred to assess which participant is responsible for what activity, and to determine the order of activities in an election process.

Proposition to SQ2 (PSQ2): Bearing in mind P2 and P5, the use of BPMN is able to improve election observers' comprehension of elections using a manageable set of core elements and basic syntax for expressing legal clauses found in election laws.

Proposition to SQ3 (PSQ3): Considering P3 and P6, the use of BPMN facilitates the work of election observers by saving them time that they might otherwise need to spend studying the law.

Proposition to RQ1 (PRQ1): After PSQ1, PSQ2, and PSQ3 have been contemplated, it becomes clear that the use of BPMN is able to facilitate election observation by making the comprehension of legal requirements more approachable and explicit for election observers.

Units of Analysis

Case study design is centered around the unit of analysis. The unit of analysis should logically emerge from the research question, steering the case study research [54, 55]. For this case study, the units of analysis are the modeling of Estonian election law using BPMN and the process used to create them. Since both the models and the process used for modeling are this case study's units of analysis, it is an embedded case study.

The case study investigated in this thesis came from the author's participation in a research project which had the goal of analyzing, through direct observation, various voting channels in a multichannel election in order to establish a method for comparing their relative costs. The author of this thesis proposes that modeling the respective election laws using BPMN facilitates election observation, basing his analysis on his observations during the Estonian 2017 municipal council election and models of election law created using BPMN. The author also draws on findings and analysis in related research.

4.2 Data Sources

Outside of the general literature review, the reference for the modeling of the election law were the Estonian Municipal Council Election Act, and Chapter 7^1 of the Riigikogu Election Act because it was referred to by the former of these Acts. The main source of reference on BPMN models was OMG's BPMN 2.0 Specification.

Some direct observation of the 2017 Estonian municipal council election was also conducted by the author. Additionally, some of the process models included in this case study were used by the researches to help with the conducting of the research project. Their findings have been published and include an example of a BPMN model from this case study [9, 10].

4.3 Limitations

As with any case study, there were limitations that must be accounted for this particular case study. The following limitations listed are to address this case study's potential to lack an ability to be generalized. As a result of such limitations it is acknowledged that a case study might not have universal application [54].

The number of election observers who used the models of this case study was limited to a single research team of five members. This is a rather small sample size from which to draw conclusions but given that the published research [9, 10] featured at least one of the author's process models as an example, it gives credibility to the usefulness of the models for election observation. However, because the goal of the research project was centered around ABC, the use of a tool for

analyzing business processes might have made the process models seem more helpful than they would be for other use cases. As a result, future investigations should include larger numbers of observers, with a wider range of hypotheses.

Not only was this investigation limited to a individual research team, it was also limited to an isolated instance of a single election. Therefore, to increase this case study's ability to be applied more universally, the investigation of this case study could stand to be done for future Estonian elections. Furthermore, this type of investigation should be done in multiple additional multichannel elections other than just in Estonia.

5 The Case

5.1 Case Background

It is common for multiple channels of voting technology to be used in modern democratic elections. However, as more voting channels are incorporated into elections, observers' missions will become more complicated, requiring more planning and preparation in order to observe elections with the same level of scrutiny than elections with fewer voting channels receive. The preparation for participating in a research project that required the observation of multiple voting channels led to the modeling of the Estonian Municipal Council Election Act by the author of this thesis, and this case study will examine how this was helpful to the researchers who observed the 2017 Estonian municipal council elections.

The research of the project referred to in the case study is the result of the increasing automation of various aspects of our lives. As legacy systems are replaced by socio-technical systems, including voting, we will need greater levels of digital or electronic-governance. These e-governance systems need to be bound by certain elements fixed in reality. Because increasing efficiency in bureaucracy and administration is generally important to governments, there is pressure for the cost of elections to remain stable or to ideally decrease over time. Three ways to control costs are; eliminating waste, increasing efficiency, or reducing services [32]. In order to avoid the latter of these options, effort should be put into the prior two. If redundancies can be found between the various channels of voting, waste could be eliminated. If some channels of voting can be proven to be more efficient than others, then as long as the principles of elections such as universality are not affected, the less efficient modes could eventually be replaced without any reduction of service.

It is important to have enough information to determine if implementing a new system would be a worth-while investment. Therefore, before projects are given approval to commence, an analysis of the risks of the project as well as the development cost, operating cost, and the cost to maintain

the system should be completed. BPR is not used specifically for risk analysis, but its use has helped to locate some risk aspects [56]. As a part of this analysis there should be an understanding between stakeholders and developers on at least four factors. First, the scope of the project, or exactly what functionalities are and are not to be included, must be decided and clearly articulated. Second, the timeframe in which the project will be engineered must be agreed upon. Third, the resources necessary, typically in the form of a budget. Forth, the expected quality of the end result. Without clearly resolving these four factors, a project's chance for success will be significantly reduced.

The researchers, whose observation of the 2017 Estonian election is the focus of this case study, utilized ABC, an accounting technique that allows for the accounting of the cost of each activity identified in a business process. The use of this technique was to enable the researchers to make accurate comparisons between the different costs of the voting channels they were observing. In this way each channel could be analyzed to achieve results that could be directly compared with each other [9, 10]. Using ABC requires that each voting channel would need to be systematically reduced to their fundamental actions, known as 'cost drivers', and evaluated to determine the average amount of time that is required to complete each action. These quantities of time can then be converted into monetary values using the market rate of the type of labor required. Once the other additional fixed costs are included, the total will more accurately represent the costs for each of the various channels than if ABC had not been used.

The resulting data collected through this type research can be useful when election managers are deciding on which investments to make in election infrastructure. By considering the combined cost of procurement and maintenance over time, it can be determined if a method of service delivery justifies the investment.

5.1.1 Multichannel Elections in Estonia

During Estonian elections there are several available channels for voting. Voters abroad are able to vote at an embassy. Merchant marines are afforded the opportunity to vote while at sea. Eligible voters who happen to find themselves unable to make it to the polls because they are in the custody of a 24-hour institution, or simply are too sick to leave their home are allowed to have election

managers come collect their ballot. However, the focus of this thesis, is on the traditional paper balloting done during a period of advance voting and on election day, and i-voting.

At least in part due to the openness to technological change which exists in the Republic of Estonia, demonstrated by point 19.2.1 of the Principles of Estonian Information Policy approved by the Estonian Parliament in 1998 [57],

> *"One of the central social issues is the acceptance and gradual implementation of the principles of universal information services in order to guarantee:*
>
> - *Equal and affordable access to communication facilities to everyone, independent of geographic location;*
> - *Regular high quality communication services to everyone."*

a system has been developed by which electors are able to vote via the public internet [58]. However, as more channels of electoral participation are used during an election, the complexity of administering elections increases. Likewise, because each voting channel should be a potential opportunity for conducting an observation, the planning required to conduct an election observation also increases with the number of voting channels.

5.1.2 Voting Technologies Relevant to the Case

As mentioned above, there are several channels of voting available to the Estonian electorate, but some were not readily available for the researchers to observe. Therefore, this section will give brief description of only the voting channels available to voters that were relevant to the observation conducted by the researchers.

Advance Voting Period

In Estonia some polling places are opened before election day for a period of advance voting. In every rural municipality and city at least one polling place is open from the sixth day to the third day before election day from 9 a.m. to 8 p.m. These polling places are typically in central locations with a high volume of traffic, such as shopping centers, for example. Observing this voting

channel, at least in an unofficial capacity, can be as simple as going shopping and watching from a distance. On the second day and the day preceding election day, all polling places are open from noon until 8 p.m.

Remote Electronic Voting (i-Voting)

After downloading and installing the i-voting software, the voter is required to digitally identify themselves in the EVS in order to access their ballot. Then, after making their selection, the voter must digitally sign their electronic ballot. In order to complete this process, the voter must have physical access to either their identity card or Mobile-ID, a service which requires a mobile device that has previously been authenticated, and knowledge of the personal identity numbers (PIN) codes that are connected to their digital ID. The PIN1 code is required for identification and the PIN2 code is required for the digital signature.

It is possible for an i-voter to check their i-vote to ensure it was accurately received by the EVS server as they cast it. This is done from a verification application on a smart device. i-Voters are able to scan a QR code from the screen of the PC from which they i-voted which will then display which choice was recorded by the EVS servers.

Because i-voting takes place in an uncontrolled environment, to help ensure voters are able to i-vote free from intimidation they are able to update their i-vote from the EVS during the i-voting period as often as they deem necessary. The previous vote will be cancelled out so that only the last recorded i-vote will count, ensuring there is only one vote per elector.

As an additional way to protect the secrecy of the ballot, i-voters are also afforded the opportunity to annul their i-vote, by voting in person until the day before election day. In order to uphold the ‘equal and fair’ principal of elections, these paper ballots must cancel out the elector’s i-vote. Therefore, the lists of voters that are compiled by the State Electoral Office (SEO) that are printed at all precincts each day before the start of voting, are made to indicate which voters have voted online. Then, on election day, after the period when an i-voter is able to annul their vote, this information is used by election administrators to identify i-voters and prevent them from voting when they are no longer allowed. If an i-voter does end up voting in person during the period of advance voting, their information will be included on the SEO’s list of i-votes to annul. These i-

votes are then removed from the final set of i-votes to be tabulated. Then, before this final set of i-votes is counted, they are separated from the personal data of the electors who cast them, ensuring a secret ballot.

Because remote electronic voting, by definition, takes place in an uncontrolled environment, it is difficult, if not impossible to observe voters in the act of i-voting. Therefore, there is not much during the election period for election observers to observe besides the tabulating of the electronic vote at the SEO. However, during the pre-election period, there is the possibility for observers of i-voting to scrutinize the code and the procedures of the EVS. Additionally, anonymized logs are made a part of the public record[11] so that analyses can be made using the data. This could then be used by observers to test various hypotheses.

Election Day Voting

This is the most traditional type of voting and it can be observed in the most traditional format. Election observers simply arrive at the location where an activity or procedure is being conducted by an electoral committee or an election manager and introduce themselves as an observer. So long as their presence does not interfere with the voting process, they should have the ability to operate with the freedom they require to conduct their observation.

5.2 Case Description

In late June 2017, the author of this thesis joined a research group to contribute towards a project titled, “Internet voting as Additional Channel for Legally Binding Elections: Challenges to Voting Process Re-engineering” for the Estonian Research Council. The goal of the project was to use ABC methods to analyze the different processes of various voting channels of the 2017 Estonian municipal council election [9, 10]. The desired output of the project was to develop a methodology that could be used for ascertaining the difference between the costs associated with the administration of various voting channels. These costs could then be used to compare the per-vote cost of each voting channel.

[11] https://www.valimised.ee/en/archive/open-data-estonian-elections

5.2.1 Modeling of the Estonian Municipal Election Act

In preparation for the observation of the 2017 Estonian municipal council election, the research team decided to model the entire Estonian Municipal Council Election Act. This task was assigned to the author of this thesis. This section contains a description of the process used to model the law so that the lessons learned by the author during this modeling, including best practices and pitfalls to avoid, will be available for any future research in the area.

Managing Election Law Text

In the first step, the author acquired the text of the law and copied it into a word processing application in order to analyze and simplify the text for modeling purposes. As a result of an effort to become, in the words of Mart Laar, the Estonian Prime Minister from 1992-1994 and 1999-2002, "the first paperless government" [59], Estonian legal acts are signed into law by the president with an electronic signature on a digital file containing the text of the law [60]. Additionally, in an effort to provide transparency to help combat corruption all laws are available to the public online[12]. Therefore, in the case of Estonian election laws, interested parties can be confident that the current laws that are in force, in addition to any existing previous or future versions, are available online on the Riigi Teataja website.

Estonian is the official language of Estonia, however, many laws, including the election laws that are relevant to this case study, have been translated into English. If an English translation is available, they are also readily available from the official website[13]. The author copied the official English translation of the election law and pasted it into an editable document on a PC. Using a word processing program, the author modified the text, without changing the meaning of the law, in a way to help facilitate its modeling. For instance, the author deleted nearly all of the text in the law contained within square brackets. The author determined that this type of modification could be made without changing the meaning of the law because the text contained within square brackets in the Estonian law is mainly used for providing a historical record of when and how the law was changed and is therefore irrelevant for the purpose of an election observation.

[12] www.riigiteataja.ee
[13] https://www.riigiteataja.ee/en/search/results?pealkiri=election&tekst=&valj1=Riigikogu+-+act&valj2=&valj3=&kehtivuseKuupaevKuupaev=14.12.2020

The substitution of repetitive sequences of words for a single abbreviation can be useful for reducing the size of the corpus of the law, thereby enabling a modeler to work through the text more quickly. For example, 'rural municipality or city', which occurs 182 times in the text of the Estonian Municipal Council Election Act, was substituted for 'RMoC'. This one modification reduced the corpus of the text by over four thousand characters. This type of substitution can be made quickly through the use of 'Find and replace all' which is a common feature of word processors. This practice can also help when the abbreviations are used within models because it makes more efficient use of the space made available by the software for the labeling of objects. The result of these modifications is a simplified version of the law that can be easier for the process modeler to manage.

Choosing Modeling Software

Before process modeling can begin, a decision about what software to use for the modeling should be made. As long as the specifications of the standard are followed, BPMN does not depend a specific piece of software for modeling. However, software[14] is available specifically for the purpose of modeling BPMN and can be extremely productive to use. Of the available software choices for modeling BPMN, Enterprise Architect, Bizagi, and Camunda Modeler, all of which have free versions to use, were considered for the modeling done for this case study.

Enterprise Architect is a very powerful tool, but much of its strength resides in the ability to model the information and organizational perspectives, both of which are not a part of BPMN. The free version of Enterprise Architect is only good for 30 days, and since the modeling project lasted longer than a month, it was not a suitable choice. The feature set found in Bizagi is also very rich. Bizagi contains features that allow the user to validate the syntax of the models in addition to running simulations. Lastly, because Camunda Modeler does not have an overwhelming array of sophisticated features, it can be highly intuitive for a novice modeler to create and edit models quickly and efficiently because it is easier to learn than some of the other available modeling software. Camunda Modeler can be an effective tool for creating a preliminary 'sketch' of a model. Even if simulations are required, it still might be useful to use Camunda Modeler to quickly draft an understandable model that could later be replicated in other software such as Bizagi. Because

[14] For a list of BPMN tool complied and tested by OMG: http://bpmn-miwg.github.io/bpmn-miwg-tools/

Enterprise Architect are limited to the duration of a free trial, and the research project did not require simulations to be run, the author decided to use Camunda Modeler.

Creating an Organizational Structure

To improve the efficiency of the complex process of modeling the election law, the author created an organizational structure using a directory of folders, one for each section of the law. Each folder was named with the title of the law's section, beginning with its number. An advantage to keeping the number of the section's title was that the folders could be sorted in a descending order, making for a directory that was efficiently navigated by the author.

Once a structure of folders had been created, an empty text file and an empty .bpmn file from Camunda Modeler could simultaneously be copied to each folder. Then, to take advantage of the efficiencies of an assembly line, the empty text and BPMN files were efficiently named by copying and pasting the name of the folder that contains it. Once a named text file for every section of the law had been created, the abridged text of each section was copied and pasted in its own text file and saved within its own folder.

One lesson the author took away from the naming convention was that it might not always be the best idea to include the '§' symbol, as it might create an issue in some programs or systems that were not designed to allow the use of this symbol. Naming everything with just the numbers and words of the title and avoiding the use of unusual symbols, would have worked just as well for the organizational structure.

Election Law Modeling Process

Once a modeling application had been chosen and the organizational structure was in place for each section of the law, the author was able to begin modeling. Because of the preparation that had already been done, the author was able to work one section of the law at a time by opening one of the folders to access the abridged text of that section and an appropriately named .bpmn file. This makes it possible to quickly open and analyze the abridged text of the specific section of the law alongside the process model, a highly redundant task.

One of the first steps the author took after opening up the files to begin modeling was to create and name a Pool with the name of the section of the law being modeled. The abridged text can then be

quickly scanned to discover all the Participants. Because legal texts tend to use uniform wording throughout the entire law when referring to terms, the previous step of substituting abbreviated text helped to efficiently locate the Participants. This process of locating Participants was made easier because these abbreviations could be quickly identified in the text. For example, the author could efficiently identify every time an electoral committee was a Participant in a section of the law by scanning the abbreviated text and quickly noticing the presence of 'RMoC EC'. Locating this abbreviation was quicker than locating the same Participant in the original text since the abbreviation is more visually apparent among the surrounding text. Once a Participant had been identified, the author partitioned the Pool and labeled the Lanes accordingly. An additional benefit of this abbreviation process, demonstrated in Figure 10, was that it helped to conserve space in the resulting models.

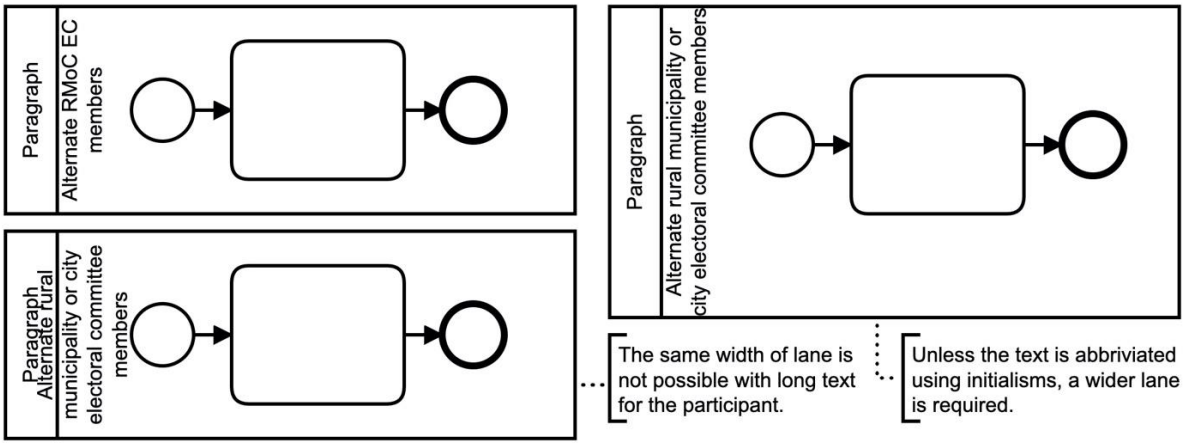


Figure 10: Use of Abbreviations to Reduce the Size of a Model.

Once each Participant was identified and the respective Pool Lane had been created for them, the author examined the text more closely to locate the Activities. The author found it useful to locate each verb of a sentence and attribute it to at least one of the Participants by creating an Activity in the Participant's Pool Lane labeled with the verb. Sub-Processes were created when multiple Activities were all found to be a part of a singular Activity.

Examining the Election Law Text

After all verbs of a section had been accounted for, the author closely examined the text to assess the logical order in which the Activities are intended to occur. This examination was necessary because legal texts are not typically structured in the form of an algorithm with a logical path from

the beginning until the end. As this order was determined, the Activities were placed in an order to reflect it. If the Activities of a Sub-Process were not required to be performed in a particular order, Ad Hoc Sub-Processes were used to help reduce complexity.

During this process of close examination, the author also found it useful to locate any instance time was mentioned. A corresponding Start, Intermediate, or End Timer Event was then created and labeled with the respective time. The author found Timer Events to be very useful for reducing the complexity of the process model, as shown in Figure 11, because their use would eliminate the need for a Gateway and the necessary Sequence Flow connections to add this logic to the process model. Once created, these Timer Events were placed in the order they belonged, however, the effort to ensure all Events were accounted for came later.

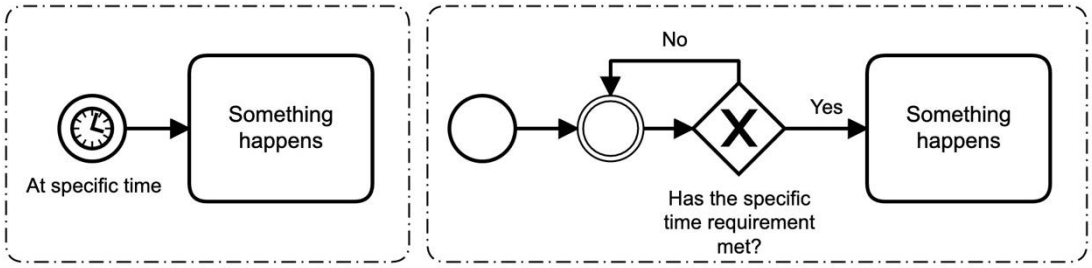


Figure 11: Use of Start Events to Help Reduce Model Complexity.

Scrutinizing the Election Law Text

The author then scrutinized the text of the law to a greater extent adding additional elements to the model. After the elements had been added, properly labeled, and attributed to a participant in the appropriate order, the author began making Sequence Flow connections. During this process of scrutinization, the author visualized a Token traversing the Sequence Flows of the process model and added any necessary diverging Sequence Flows from Gateways for each of the possible conditions. In their most common form, the Gateways were left to be Exclusive (this is the default type of Gateway in Camunda Modeler) and labeled with a question. The outgoing Sequence Flows from the Gateway were then labeled with the possible answers. Other Gateways, such as Inclusive and Parallel Gateways were also added and labeled (at least in the case of Inclusive Gateways). The Sequence Flows from Parallel Gateways are much more predetermined and did not require labels.

At this point, the models were good basic representations of what the law described; however, the BPMN syntax needed attention. To address this, the author began to scrutinize the process models for syntax. Additional Intermediate Events were added to the process model anytime the Participant changed. End Events were included anywhere Tokens needed to be consumed. Gateways were used to converge multiple Sequence Flows into a single Sequence Flow to help clarify the process model.

Finally, once the sequence of the process model represented the meaning of the law and the syntax fit BPMN's specifications, the author began a process of structuring the elements of the model in a manner that would help them be more comprehensible. For example, Sequence Flows were made to go around and not behind any elements. Additionally, the author worked on the placement of the elements of the process model in a manner that allowed for the elimination of as much white space as possible.

This was the basic process the author went through while modeling the Estonian Municipal Council Election Act. As an afterthought, a version of the law without bracketed text but no abbreviations was pasted as a Text annotation next to the model. The author made this decision so observers can refer to the original text of section of the law freeing them up from having to carry one document for the text of the law and separate document for the process model. The observer can manage with just a single unified document that they could examine if, for example, knowing the exact text of the law would be important.

Archiving of the Models

Camunda Modeler models are saved as .bpmn files. While .bpmn is just XML with BPMN definitions, the graphical process models are not able to be opened by most other software. The models can be exported as a common image file, including .png, .jpeg, and .svg. The .bpmn format is useful because it allows for the easy manipulation of the models, but for archival purpose the author did not find it to be adequate on its own. Therefore, the models were exported as an image file and were saved using the same naming convention as the other files in the folder.

The process of creating an organizational structure for each section of the law and the habit of saving files to the relevant folder, proved to not only be useful for providing quick access while

the author was creating the process models, but it also made the archival process simple. A similar structure would be recommended for any future research on the topic.

5.2.2 Observation on Election Day

On election day, a goal of the research group was to observe the election. As a result, the author had the opportunity to experience firsthand the effectiveness of having processmodels of the election law. The following section is an excerpt of a report of the author's account of the observation and has been included to demonstrate how the process models proved useful.

The following section is to introduce the scope of the author's participation in the observation on election day.

> *"On election day, as a participating researcher, I visited four polling places in addition to the State Electoral Office for the counting of the electronic vote. The first three polling places were in the Tallinn city district Lasnamäe and the final one was in the district Põhja-Tallinn.*
>
> *The first polling place I visited was polling place number 36. I arrived at 9.00. This polling place was located in a large room in a high school. {...}*

The excerpt below contains some of the observations of the voting procedures made by the author at the polling place. Having worked with the models of the election law, the author was familiar with the contents of sub-section (2) of the *Municipal Council Election Act § 42. Ballot box*, "The opening of a ballot box shall be opened only to deposit a ballot paper in the box" and was able to have confidence that the poll workers were in accordance with the law.

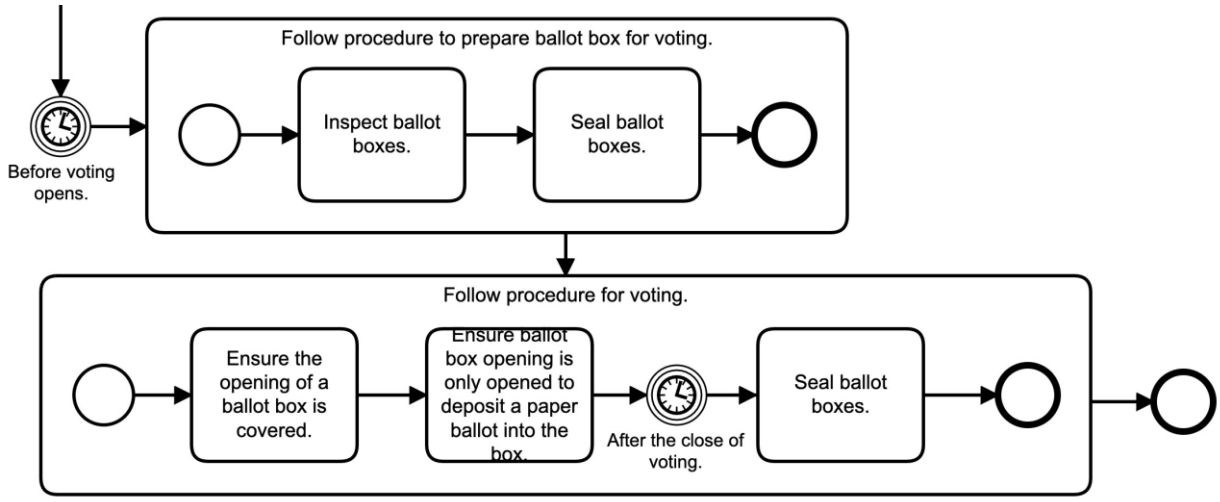


Figure 12: Section of process model § 42. Ballot box Shows the Activity Ensuring the Ballot Box is Opened Only to Deposit a Paper Ballot.

> *Five of the seven staff members were employed with the task of locating the voters name in the list of voters and checking their credentials before collecting a signature on the list and handing the voter a ballot. One member was staffing the polling box and was tasked with stamping the ballots. The final staff member was preforming what could be described as a supervisory role. She was the one who came to ask about my presence as an observer and answered my questions before I left. This member would also periodically inspect the voting booths.*

The passage below is a description of an incident witnessed by the author that required the intervention of a poll worker. Again, having worked with the model of the *Municipal Council Election Act § 41. Voting booth*, the author was aware that a voting booth must enable secret ballot.

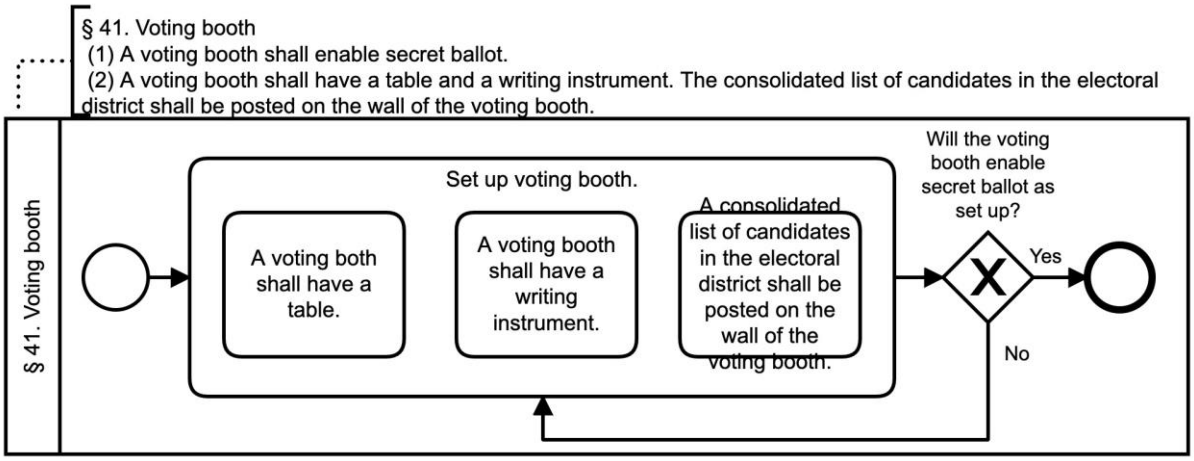


Figure 13: Process model § 41. Voting Booth Shows How a Voting Booth Must be Set up to Enable Secret Ballot.

> *"{...} on two occasions the staff needed to instruct voters not to go into a booth occupied by another individual. Both occasions could be described as a man opening the curtain to check on his female companion. One had already finished voting and might have been wondering what was taking his companion so long, while the second occasion the man left his voting booth and entered the booth of his female companion before returning to his own booth. My assumption is that he had a question and was asking for advice from his companion. On both occasions the voters were approached by a poll worker. I would imagine the voters were told not to impinge on the other's right to privacy because they immediately desisted their behavior."*

The following excerpt is from the author's observation of the counting of the i-votes at the State Electoral Office. Having a model was especially helpful when observing this procedure because of a language barrier for the author since the official proceedings were held Estonian. However, because of the large size of this model, it will not be included in this section, but the reader may refer to the model of *Estonian Municipal Council Election Act §54*[2], along with all the other models of the case study, in the appendix.

> *"{...} The official procedure was held in Estonian so it is possible that I might have missed some information, but one of the officials in charge, did go out of his way, on several occasions, to explain to us what was happening in English.*

According to this official, the first thing that happened was the nullification of the multiple votes, followed by the anonymization of the votes. Everything else that happened appeared to be in accordance with the model of the Riigikogu Election Act §60[1]. Counting of the votes cast using electronic means. Since the proceedings were held in an unfamiliar language to me, having a model that depicted what was happening was a great service to me as an observer."

5.3 Summary of the Case

The first section of this chapter was to give context to the case study by explaining the background behind the initial purpose for the modeling of the Estonian election laws including an overview of the Estonian multichannel elections and the types of voting technology that were within the scope of the observations to be conducted. Then, a description of the case study was given in which the units of analysis were presented. To address the unit of analysis of the BPMN modeling process, the author detailed the method that was developed to efficiently create the process models of the case study. The various steps of the process, managing the text of the law, choosing the modeling software, creating an organizational structure, the process of modeling, and the archival of the models were presented. Finally, a firsthand description of how the author found the use of the process models, the second unit of analysis set forth in the research design, to be helpful when observing an election.

6 Discussion

In this chapter the topics and frameworks presented above will be examined through the lens of the case study presented in Chapter 5. The propositions listed in Chapter 4 will be analyzed for linkages to the initial research question and sub-questions of Chapter 1. Then, possible threats to the validity of the findings of the investigation will be addressed. Finally, the particular challenges to observing i-voting will be addressed.

6.1 Facilitation of Election Observation Using BPMN Models

Chapter 2 demonstrated that the variation between elections and the complexity within any individual election can be extensive, complicating the work of election observers. In Chapter 3, an examination of BPMN was conducted and it was shown to be helpful for making the business processes within different industries more comprehensible. According to PRQ1, creating BPMN models of the election law is a worthwhile option for election observers to consider when looking for ways to enhance the efficiency of preparing for an observation. This proposition to RQ1 is supported by PSQ1, PSQ2, and PSQ3 which stipulate that BPMN, being an ISO standard, is a good choice when seeking to model text that describes a process because the set of elements and basic syntax are approachable and explicit enough for election observers to quickly comprehend.

The preceding proposals to the research question of this thesis are useful considering Nurse et al. 2018 noted a challenge, in the case of Estonia, that observers of the counting of the electronic vote do not always feel they have a full understanding of the EVS [23]. There is a two-day course that is offered by the NEC, but it is not attended by many [23]. Thus, there is room for improvement in this area.

This thesis has argued that the use of BPMN process models for the purposes of election observation can be an effective way to educate election observers. The argumentation follows that the modeling and subsequent publishing of the socio-technical practices surrounding EVSs could

help bring some much-needed clarity to election observers in Estonia and beyond. Aided by the use of BPMN, the rate of acquiring an understanding of the Estonian EVS system could be increased, thereby allowing for a reduced duration of the course offered by the Estonian NEC. If the NEC were to act upon the conclusion of this thesis, the course they offer might be able to provide the same amount of information in a shorter amount of time through the use of BPMN process models. As a result, the number of people interested in participating in this course might increase. Another benefit that might arise from the actionable conclusion of this thesis could be a reduction to the costs of holding said course.

6.2 Threats to Validity

As shown above from the firsthand account of this thesis' author, the BPMN models of the Estonian Municipal Council Election Act proved to be useful for the fulfillment of the project's research goals and some example models would go on to be included in the project's publications [9, 10]. However, there were some matters with the modeling of the case study, that could risk the validity of the modeling if not avoided in the future.

6.2.1 Scope of the Law to be Modeled

Considering the time during the election with which observers have to empirically observe an election is mostly limited to the election period of the elections, it is arguably less impactful to model sections of the election law that do not directly affect the processes and procedures of the election period. Therefore, it might be the case that the modeling of these sections can be avoided and thus conserve resources.

When modeling the election law, the author discovered that certain sections of election laws might not translate well into process models. The best examples would be sections of the law that serve the purpose of defining terms or those that articulate details between different conditions. The reader will note that with both of these examples, there are no real processes to be modeled, they are just declarations. For this reason, certain sections of the law, primarily the sections that were for the definition of terms, could not be modeled and will not be presented in the appendix among the other models of this case study. Other sections, primarily those that were for the articulation

of different conditions were modeled, but the resulting model was not as usable as the original text of the law. To demonstrate this, it is useful to return to the analogy between process models as maps; sometimes it is sufficient to use a pen and paper to write simple directions to the shop down the road. The extra effort of printing out a topographical map on a 3D printer for the same purpose would be wasteful. It is important for election observers carefully to consider the subject matter of each section of the law for the modeler to help narrow the scope of the modeling effort to optimize the use of resources.

Thus, because there are certain sections of the law that are relevant for the purpose of election observation, and there are sections of the law where the use of text is more efficient than the use of a BPMN model, the author proposes that it likely is unnecessary for election observers to have a process model of a law in its entirety. The process modeler of an election law, for the purposes of election observation, could benefit from setting out with a more refined set of sections they intend to model. The author therefore suggests adding two additional steps to the beginning of the modeling process. The first step would be to determine the criteria for whether a section should be modeled. The second step would be excluding the sections of the law that are not relevant according to the criteria. Even if a future modeler were to adopt all the lessons of this case study, the author believes that nothing else could increase their productivity more than reducing the set of sections of the law to be modeled to include only the usable models before modeling ever begins.

6.2.2 Model Maintainability

It is important to recognize that election laws might change, as is certainly the case for Estonia as a relatively young democracy and a pioneer of i-voting. As a result, readers should note that some of the models the author created in 2017 for this case study were already outdated the month after the election, and they have been amended further since that time. This fact raises an interesting point; if election laws are rapidly evolving, as is the case when voting channels are being added to voting systems because of the adoption of NVTs, does the added value of having process models of the election law for election observers justify the upkeep of BPMN models over time? The author contends that the software available for BPMN modeling makes the editing of BPMN models a relatively easy task. The author believes that most edits, especially redactions, would require only a fraction of the time required to make the model in the first place.

Finally, the author will be the first to admit that the models presented in the appendix of this thesis that are a unit of analysis of this case study, are not perfect. There are numerous ways to model a Busine Process in BPMN (for example the use of parallel Gateways verses Multi-Instance Tasks and Sub-Processes). Therefore, even if the models of this case study were proven to be syntactically correct and accurately represent the subject matter, there could be more elegant and efficient ways to model it than the author was capable of. For that reason and to aid further research in the area, the author encourages the improvement of the models presented in this thesis' appendix and has uploaded the files to a publicly accessible website[15] that can be accessed by scanning the QR code at the end of the Appendix 1.

6.2.3 Limitations of the Modeling Standard (BPMN)

The use of BPMN in this case study has resulted with the creation of an extensive number of models of the *Estonian Municipal Council Election Act*. During the investigation the author considered other process modeling tools besides BPMN, but since BPMN has become the *de facto* standard for process modeling [46], it was the clear choice of modeling languages to use. The quote below, from the official BPMN website helps to emphasize how BPMN was an excellent match for making process models that even laypersons in process modeling can easily understand.

> *"The primary goal of BPMN is to provide a notation that is readily understandable by business users, ranging from the business analysts who sketch the initial drafts of the processes to the technical developers responsible for actually implementing them, and finally to the business staff deploying and monitoring such processes."* [61]

Even though BPMN was the clear choice, the limitations of this modeling tool must be assessed to evaluate their threat to the validity of this case study. The main limitation of using BPMN is the potential confusion due to possible ambiguity. For this reason, the author included the entire text

[15] https://www.dropbox.com/sh/f4ctvmt4ysmy9jy/AADWbhbLJ8jStBf-JsBLQpgDa?dl=0

of the section of the law so it could always be referred to if a model's validity was to be called into question.

Some other minor issues with BPMN are the absence of information and organizational layers. For instance, attempts to make process models of how the technology of the Estonian EVS works to better aid election observers, would be affected by these limitations. It is possible to include Data Stores and Data Objects, which the author used to address this limitation, but for use in the modeling of more complex information systems, it might not be adequate.

Finally it is possible to apply BPMN in three ways, "pure description, simulation, and execution of a process" [47]. This case study approached the modeling of the election law from the direction of pure description. However, if laws were able to be modeled to make them machine readable, the fact that BPMN must be converted to BPEL might be considered to be a limitation.

6.2.4 Limitations of the Modeling Software (Camunda Modeler)

Of the possible BPMN modeling software considered, Camunda Modeler was used for the modeling of this case study. This software did exceedingly well for the majority of the modeling needs. However, one limitation of this software was its ability to handle text. The way in which the elements, such as activities were static in size and could only accommodate a limited amount of text in an elegant manner, proved to be a limitation. Also, the titles of the Lanes of a Pool only can contain two lines of text before they begin to overlap the title of the Pool. Lastly, the Text Annotations, were not able to wrap text from one line to the next. A great deal of time was spent working to manually enter line breaks so as to not have confusion arise from partial words at the beginning and ends of the lines of the complete text of the law.

6.3 Challenges of Observing Remote Internet Voting

This investigation has shown that there are a multitude of advantages to i-voting that have been argued, from reducing the effort of the elector to the reduction of administrative burden. However, one area that remains a challenge for the prospects of i-voting is the difficulty to observe the voting process.

An interesting paradox of i-voting in Estonia is that even though i-voting technically is a form of advance voting and the i-voting period lasts for a period of days before election day, because it takes place in an uncontrolled environment it is difficult, if not impossible, to observe voters i-voting. It is possible however, for observers to attend the tabulating of the electronic vote at the SEO on the evening of election day. The other methods of observation available are inspecting the EVS during the pre-election period. Therefore, whereas the majority of election observation occurs during the election period, for i-voting, the majority of the sources for empirical observation are during either the pre-election or post-election periods.

Because there currently is no way for election observers to be able to observe the i-vote in the same way the vote on election day is observed, it is important that election observers take advantage of the potential to observe the administrative processes related to i-voting. However, observation that occurs during the post-election period, such as the analysis of anonymized voting logs, if not made available to election observers before the certification of the vote, it may be impossible for observers to raise objections about how the election period of an i-voting election was conducted. This should be an area for future investigation.

Additionally, one aspect of the Estonian i-voting system is that the software allows the voter to check their own vote and even change their vote as long as the i-voting period has not closed. This is an interesting phenomenon suggesting that the role of observer is paradoxically shifting away from independent observers and into the hands of the individual voters. There is potential as well for this type of technology to enable independent election observers the ability to ensure the integrity of the vote without sacrificing the secret ballot. This is a topic for future investigation.

Remote internet voting is a promising NVT, but its potential can only be realized if it is able to conform to the criteria which are expected of existing voting technologies. The challenges of observing i-voting come from how it differs from traditional balloting. Since voting takes place in an uncontrolled environment and because there are no physical ballots to be counted, two significant opportunities for observation are not possible. Even as the practice of i-voting continues to gain popularity in Estonia, it might be necessary to develop solutions to deficiencies that exist for the observation of i-voting before it can begin to thrive throughout the world.

7 Conclusion and Summary

It has been shown that technology has the potential impact declining turnout rates [62], help reduce the cost of participation [25], increase participation [63], and reduce the hurdles for excluded groups [64]. Thus, as long as there is a digital divide, it is reasonable to conclude that the number of voting channels in democratic elections will increase as election administrators decide to incorporate NVT. As remote i-voting diffuses throughout the world, the resulting increase in the number of voting channels will necessitate the more efficient observation of elections if observers do not intend on spending additional resources, or wish maintain or increase their current capacity to observe elections.

Just as a case study can be a useful data point for the triangulation of research, election observers should be able to use BPMN models as an additional data point for their own triangulation of information when researching the election that they will be observing. If they read something in the law and it doesn't make conclusive sense to them, the process models will give them an alternative data point to use for how to comprehend the law. Similarly, process models should not be the only source of information used by election observers, if they are questioning the meaning behind a process model, it is always possible to read the wording of the law to help give a more complete picture of what to expect.

This case study supports the idea that the modeling of election laws, processes, and procedures, can aid election observation by providing an additional perspective of the details specific to the election to be observed and can be useful to election observers by enhancing their training capacity.

References

[1] F. Fukuyama, “Capitalism & democracy: The missing link,” *J. Democr.*, vol. 3, no. 3, pp. 100–110, 1992.

[2] R. A. Dahl and C. E. Lindblom, *Politics, economics and welfare: planning and politico-economic systems, resolved into basic processes*. Harper & Brothers New York, 1953.

[3] A. R. Ball, “i Peters, Guy B., 2005: Modern Politics and Government.” Palgrave i Macmillan, Basingstoke.

[4] F. Cunningham, *Theories of democracy: a critical introduction*. Psychology Press, 2002.

[5] J. A. Schumpeter, “Capitalism, socialism and democracy (1942),” *J. Econ. Lit.*, vol. 20, p. 1463, 1976.

[6] N. Machiavelli, *The prince*. Hackett Publishing, 2008.

[7] S. D. Hyde, *The Pseudo-Democrat’s Dilemma: Why Election Observation Became an International Norm*. Cornell University Press, 2011.

[8] R. Krimmer, M. Volkamer, and D. Duenas-Cid, “E-voting--an overview of the development in the past 15 years and current discussions,” in *International Joint Conference on Electronic Voting*, 2019, pp. 1–13.

[9] R. Krimmer, D. Duenas-Cid, I. Krivonosova, P. Vinkel, and A. Koitmae, *How Much Does an e-Vote Cost? Cost Comparison per Vote in Multichannel Elections in Estonia*, vol. 11143 LNCS, no. October. Springer International Publishing, 2018.

[10] R. Krimmer, D. Duenas-Cid, and I. Krivonosova, “New methodology for calculating cost-efficiency of different ways of voting: is internet voting cheaper?,” *Public Money Manag.*, vol. 0, no. 0, pp. 1–10, 2020, doi: 10.1080/09540962.2020.1732027.

[11] UNHCR, “International Covenant on Civil and Political Rights.” https://www.ohchr.org/EN/ProfessionalInterest/Pages/CCPR.aspx (accessed Oct. 13, 2020).

[12] ODIHR, *Handbook For the Observation of New Voting Technologies*. 2013.

[13] D. M. Farrell, *Electoral systems: A comparative introduction*. Macmillan International Higher Education, 2011.

[14] D. W. Rae, *The political consequences of electoral laws*. New Haven: Yale University Press, 1967.

[15] R. Krimmer, *The evolution of e-voting: why voting technology is used and how it affects democracy*, no. 19. 2012.

[16] R. J. Rowland, and E. S. Staveley, “Greek and Roman Voting and Elections,” *The Classical World*, vol. 66, no. 6. p. 368, 1973, doi: 10.2307/4347862.

[17] R. Krimmer and M. Volkamer, “Bits or Paper? Comparing Remote Electronic Voting to Postal Voting,” *Egov 2005*, pp. 3–10, 2005.

[18] J. Mohen and J. Glidden, “The case for internet voting,” *Commun. ACM*, vol. 44, no. 1, pp. 72--ff, 2001.

[19] E. Arnold, *History of Voting Systems in California*. California Secretary of State, 1999.

[20] D. Jones and B. Simons, *Broken ballots: Will your vote count?* CSLI Publications Stanford, 2012.

[21] Ü. Madise and T. Martens, “E-voting in Estonia 2005. The first practice of country-wide binding Internet voting in the world,” 2006.

[22] J. Barrat, B. Goldsmith, and J. Turner, “International Experience with E-Voting: Norwegian E-vote Project,” *Int. Found. Elect. Syst.*, no. June, p. 188, 2012.

[23] J. R. C. Nurse *et al.*, “An Assessment of the Security and Transparency Procedural

Components of the Estonian Internet Voting System," in *International Conference on Human Aspects of Information Security, Privacy, and Trust*, 2017, pp. 366–383.

[24] R. M. Alvarez, T. E. Hall, and A. H. Trechsel, "Internet voting in comparative perspective: the case of Estonia," *PS Polit. Sci. Polit.*, pp. 497–505, 2009.

[25] M. Solvak, "Why vote if it takes me more than 30 minutes ? The impact of internet voting on reducing the cost of electoral," pp. 1–19, 2014.

[26] C. Hood and G. Peters, "The middle aging of new public management: Into the age of paradox?," *J. Public Adm. Res. Theory*, vol. 14, no. 3, pp. 267–282, 2004, doi: 10.1093/jopart/muh019.

[27] S. Levinson, "How the United States Constitution Contributes to the Democratic Deficit in America," *Drake L. Rev.*, vol. 55, p. 859, 2006.

[28] A. Downs and others, "An economic theory of democracy," 1957.

[29] R. Krimmer, S. Triessnig, and M. Volkamer, "The development of remote e-voting around the world: A review of roads and directions," in *International Conference on E-Voting and Identity*, 2007, pp. 1–15.

[30] R. M. Alvarez, L. R. Atkeson, and T. E. Hall, *Evaluating elections: A handbook of methods and standards*. Cambridge University Press, 2013.

[31] M. Suksi, "The electoral cycle: On the right to participate in the electoral process," *Elect. Elem. Int. Stand. Elect. Particip.*, pp. 1–42, 2003.

[32] Ernst & Ernst, "Election administration Volume II: Planning Elections," vol. I, p. 49, 1979.

[33] OSCE, *Election Observation Handbook*. 2010.

[34] D. J. Carroll and A. Davis-Roberts, "The Carter Center and Election Observation: An Obligations-Based Approach for Assessing Elections," *Elect. Law J. Rules, Polit. Policy*, vol. 12, no. 1, pp. 87–93, 2013, doi: 10.1089/elj.2013.1215.

[35] C. Center and others, “Declaration of principles for international election observations and code of conduct for international election observers,” *URL https//www. ndi. org/sites/default/files/1923_declaration_102705_0. pdf https//www. ndi. org/dop*, 2005.

[36] E. Bjornlund and E. Bjornlund, *Beyond free and fair: Monitoring elections and building democracy*. Woodrow Wilson Center Press, 2004.

[37] S. D. Hyde, “How international election observers detect and deter fraud,” *Elect. Fraud Detect. Deterring Elect. Manip.*, pp. 201–215, 2008.

[38] M. Solvak and K. Vassil, *E-voting in Estonia: technological diffusion and other developments over ten years (2005-2015)*. Johan Skytte Institute of Political Studies, University of Tartu, 2016.

[39] V. Weerakkody, M. Janssen, and Y. K. Dwivedi, “Transformational change and business process reengineering (BPR): Lessons from the British and Dutch public sector,” *Gov. Inf. Q.*, vol. 28, no. 3, pp. 320–328, 2011, doi: 10.1016/j.giq.2010.07.010.

[40] R. MacIntosh, “BPR: Alive and well in the public sector,” *Int. J. Oper. Prod. Manag.*, vol. 23, no. 3–4, pp. 327–344, 2003, doi: 10.1108/01443570310462794.

[41] S. Dimitrijevic, “Using BPMN for modeling business processes in e-Government - Case study,” *Conf. 1st Int. Conf. Inf. Soc. Technol. Manag. ICIST 2011, Kopaonik, Serbia*, no. March, 2011, [Online]. Available: https://www.academia.edu/35721089/USING_BPMN_FOR_MODELING_BUSINESS_PROCESSES_IN_E-GOVERNMENT_CASE_STUDY.

[42] J. L. Brock Jr, J. P. Finedore, and D. A. Davis, *Business Process Reengineering Assessment Guide*. DIANE Publishing, 1997.

[43] H. Mili, G. Tremblay, G. B. Jaoude, É. Lefebvre, L. Elabed, and G. El Boussaidi, “Business process modeling languages: Sorting through the alphabet soup,” *ACM Comput. Surv.*, vol. 43, no. 1, 2010, doi: 10.1145/1824795.1824799.

[44] B. P. M. Initiative and others, “Business Process Modelling Notation (BPMN). Version 1.0,

May 2004.” .

[45] I. O. for Standardization/International Electrotechnical Commission and others, “ISO/IEC 19510: 2013,” *Inf. Technol. Manag. Gr. Bus. Process Model Not.*, 2013.

[46] F. Bonnet, G. Decker, L. Dugan, M. Kurz, and Z. Misiak, “Making BPMN a true lingua franca,” *BPM Trends*, pp. 1–16, 2014, [Online]. Available: http://www.bptrends.com/bpt/wp-content/uploads/06-03-2014-ART-MakingBPM-a-TrueLinguaFranca-Zbigniew-Misiak-etal.pdf.

[47] M. Chinosi and A. Trombetta, “BPMN: An introduction to the standard,” *Comput. Stand. Interfaces*, vol. 34, no. 1, pp. 124–134, 2012, doi: 10.1016/j.csi.2011.06.002.

[48] Thomas Allweyer, “BPMN 2.0 Modeling,” 2016, [Online]. Available: https://books.google.nl/books?hl=nl&lr=&id=sowaDAAAQBAJ&oi=fnd&pg=PA11&dq=bpmn+an+introduction+to+the+standard&ots=5w51Hp7hyL&sig=h7wxFXs-gS07ZI8RuTsr49HXrrw%0Ahttps://www.itp-commerce.com/bpmn-modeling/bpmn-2-0-modeling/.

[49] R. Shapiro *et al.*, *BPMN 2.0 Handbook Second Edition: Methods, Concepts, Case Studies and Standards in Business Process Modeling Notation (BPMN)*. 2012.

[50] M. Von Rosing, S. A. White, F. Cummins, and H. De Man, “Business process model and notation-BPMN,” *Complet. Bus. Process Handb. Body Knowl. from Process Model. to BPM*, vol. 1, no. January, pp. 429–453, 2014, doi: 10.1016/B978-0-12-799959-3.00021-5.

[51] S. Ainsworth and A. Th Loizou, “The effects of self-explaining when learning with text or diagrams,” *Cogn. Sci.*, vol. 27, no. 4, pp. 669–681, 2003.

[52] R. Müller and A. Rogge-Solti, “BPMN for healthcare processes,” in *Proceedings of the 3rd Central-European Workshop on Services and their Composition (ZEUS 2011), Karlsruhe, Germany*, 2011, vol. 1.

[53] P. Polak, “Improving C2G relation using BPMN diagrams,” *ACM Int. Conf. Proceeding Ser.*, pp. 5–9, 2019, doi: 10.1145/3340017.3340020.

[54] R. K. Yin, “Case study research: Design and methods (Vol. 5),” 2003.

[55] P. Runeson, M. Host, A. Rainer, and B. Regnell, *Case study research in software engineering: Guidelines and examples*. John Wiley & Sons, 2012.

[56] A. Xenakis and A. Macintosh, “Using business process re-engineering (BPR) for the effective administration of electronic voting,” *Electron. J. e-government*, vol. 3, no. 2, pp. 91–98, 2005.

[57] R. of E. Riigikogu, “No Title,” vol. Eesti info, no. Riigi Teataja. I 1998 47, 700, 1998.

[58] W. Drechsler and Ü. Madise, “Electronic voting in Estonia,” in *Electronic voting and democracy*, Springer, 2004, pp. 97–108.

[59] C. Woodard, “Estonia, where being wired is a human right,” *The Christian Science Monitor*, 2003. https://www.csmonitor.com/2003/0701/p07s01-woeu.html (accessed Dec. 11, 2020).

[60] B. Hammersley, “Concerned about Brexit? Why not become an e-resident of Estonia,” *WIRED UK*, vol. 29, 2017.

[61] S. A. White, “Business process modelling notation--OMG final adopted specification,” *BPMN website*, 2006.

[62] P. Norris and others, *Digital divide: Civic engagement, information poverty, and the Internet worldwide*. Cambridge university press, 2001.

[63] K. Vassil and T. Weber, “A bottleneck model of e-voting: Why technology fails to boost turnout,” *New Media Soc.*, vol. 13, no. 8, pp. 1336–1354, 2011, doi: 10.1177/1461444811405807.

[64] P. Norris, “Will new technology boost turnout? Evaluating experiments in e-voting v. all-postal voting facilities in UK local elections,” 2003.

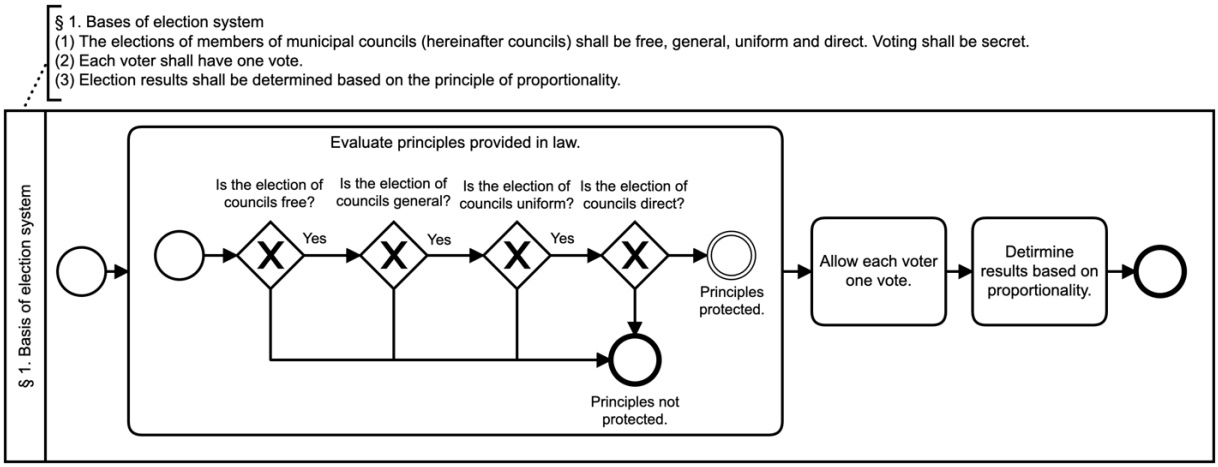
Appendix 1 – BPMN Models of the Estonian Election Laws

List of additional abbreviations and terms

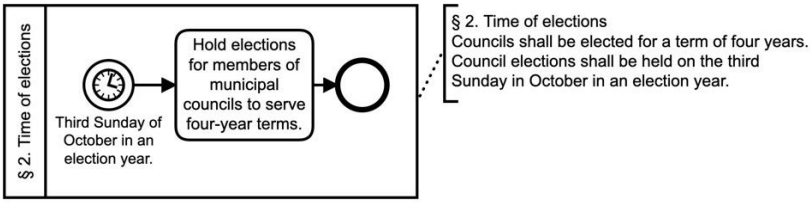
AR	Authorized Representative
EC	Electoral Committee
ECoal	Election Coalition
ED	Election District
EM	Election Manager
EU	European Union
CPotPR	Chief Processor of the Population Registry
HDD	Hard Disk Drive
HoE	Head of Elections
IC	Independent Candidate
LA	Local Authority
LoC	List of Candidates
LoV	List of Voters
MoI	Ministry of the Interior

NEC	National Electoral Committee
PIC	Personal Identification Code
PP	Political Party
PR	Population Register
RMoC	Rural Municipality or City
RMaC	Rural Municipality and City
SEO	State Electoral Office
SWI	Social Welfare Institutions
VD	Voting District
VDC	Voting District Committee

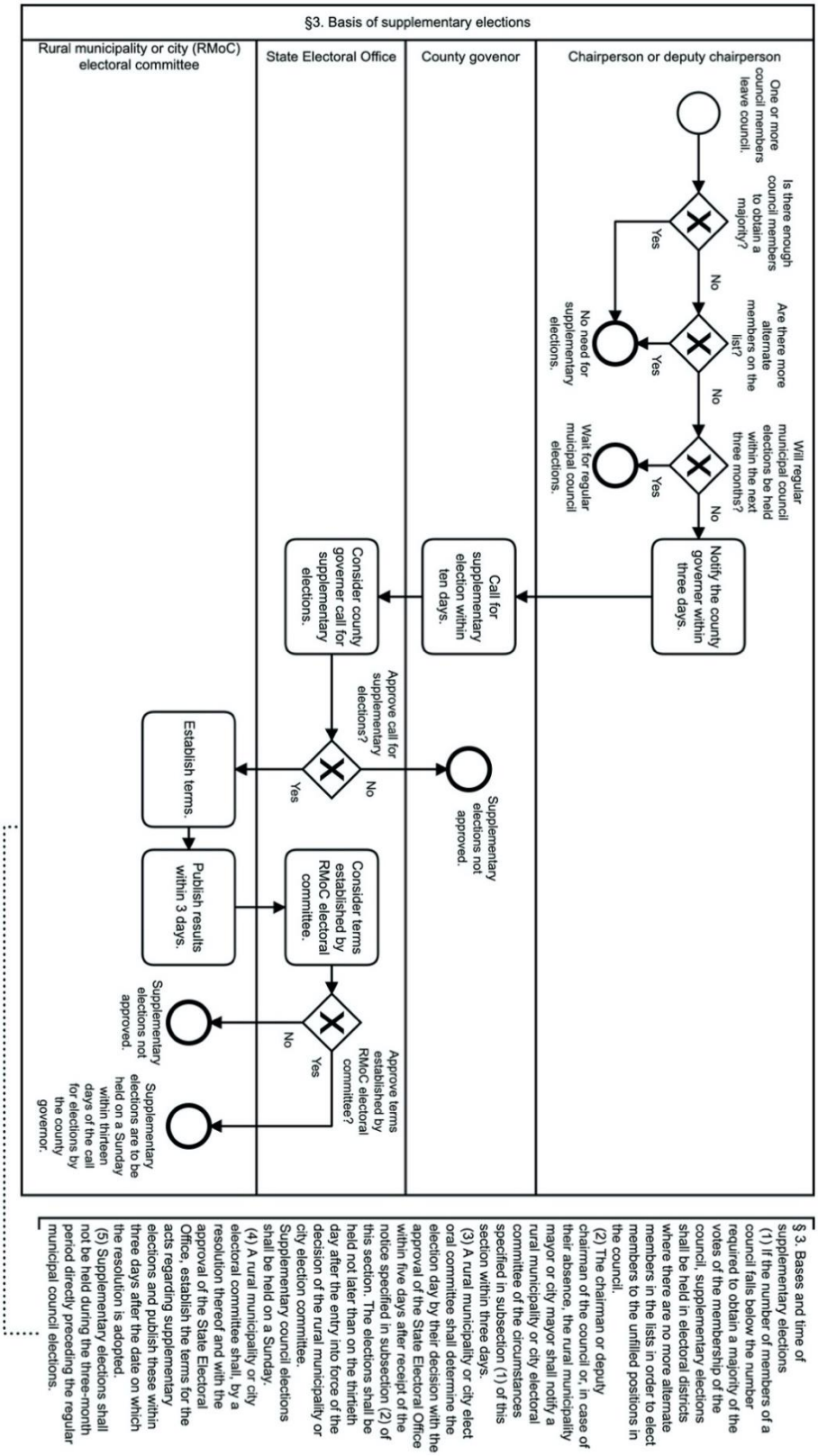
Table of Models



Model 1: § 1. Bases of Elections.



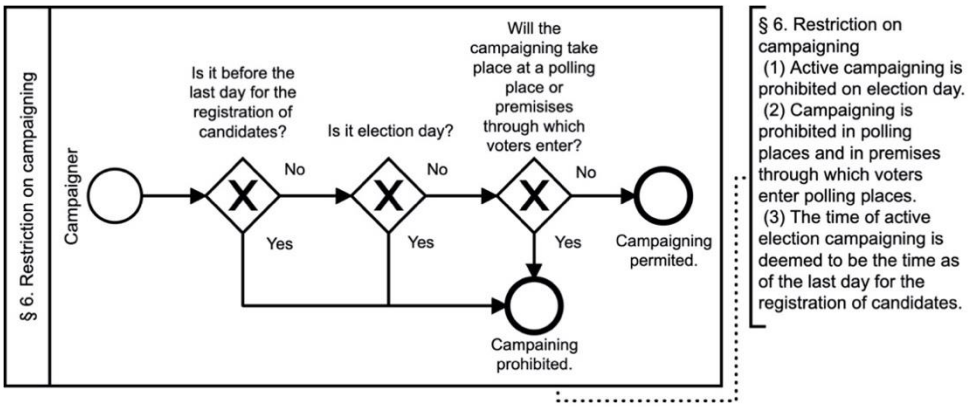
Model 2: § 2. Time of Elections.



Model 3: § 3. Basis of Supplementary Elections.

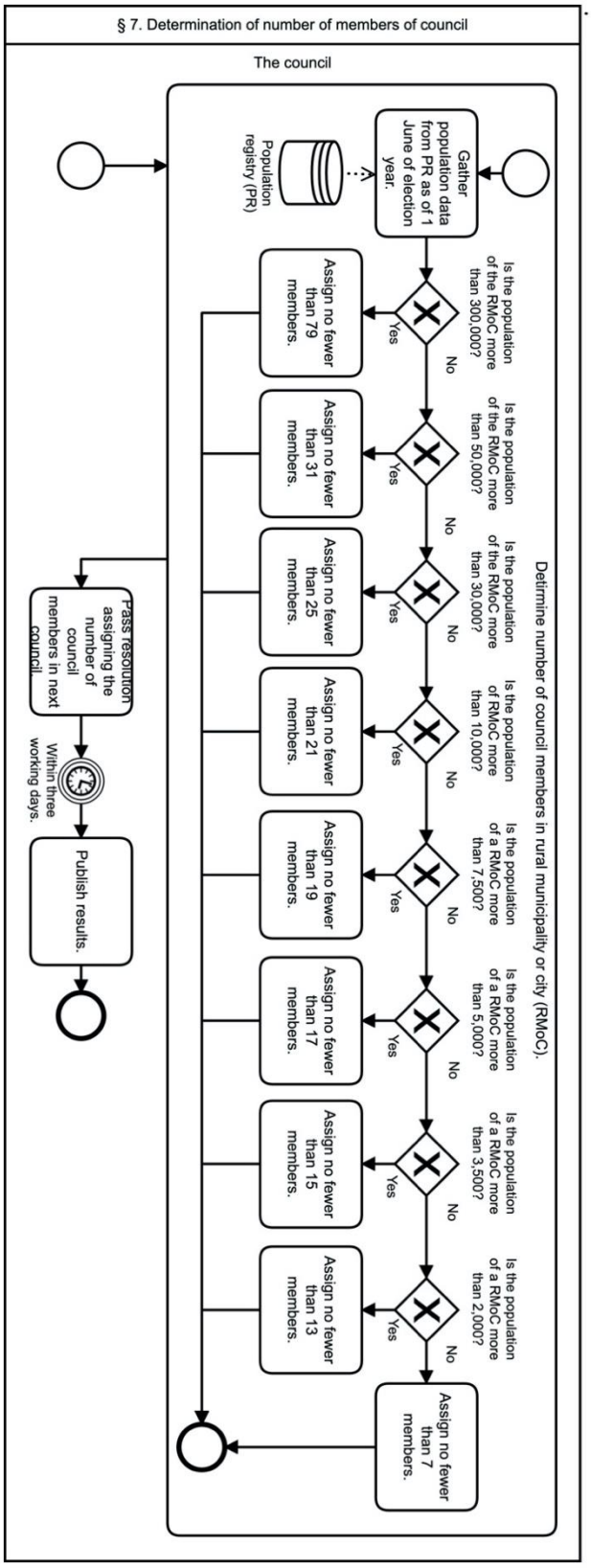
§ 5. Right to vote and stand as candidate
(1) Estonian citizens and citizens of the European Union who have attained 16 years of age by election day and whose permanent residence, i.e. residence the address details of which have been entered in the Estonian population register (hereinafter population register), is located in the corresponding rural municipality or city have the right to vote.
(2) An alien has the right to vote if he or she meets the conditions specified in subsection (1) of this section and:
1) resides in Estonia on the basis of a long-term residence permit or the right of permanent residence.
(3) A person who has been divested of his or her active legal capacity with regard to the right to vote does not have the right to vote.
(4) A person who has been convicted by a court and is serving a sentence in a custodial institution shall not participate in voting.
(5) Every Estonian citizen and citizen of the European Union who has the right to vote, who has attained 18 years of age by the last day for the registration of candidates and whose permanent residence is located in the corresponding rural municipality or city not later than on 1 August of an election year has the right to stand as a candidate.
(6) A person in active service in the Defence Forces or a person who has been convicted of a criminal offence by a court and is serving a prison sentence shall not stand as a candidate for election to a council.

Model 4: § 5. Right to Vote and Stand as Candidate.



Model 5: § 6. Restriction on Campaigning.

§ 7. Determination of number of members of council
(1) The number of members of the next composition of a council shall be determined by a resolution of the council. The number of members of a council shall be odd.
(2) A council shall have at least seven members. The number of council members shall be determined on the basis of the information held in the population register, according to the number of residents in the rural municipality or city as at 1 June of the election year as follows:
1) not less than 13 members for more than 2000 residents;
2) not less than 15 members for more than 3500 residents;
3) not less than 17 members for more than 5000 residents;
4) not less than 19 members for more than 7500 residents;
5) not less than 21 members for more than 10,000 residents;
6) not less than 25 members for more than 30,000 residents;
7) not less than 31 members for more than 50,000 residents;
8) not less than 79 members for more than 300,000 residents.



Model 6: § 7. Determination of Number of Members of Council.

§ 8. Formation of electoral districts

(1) A council shall form one electoral district in the territory of a rural municipality or city. A council shall form eight electoral districts in a local authority with more than 300,000 residents, except in the case specified in the second sentence of subsection (41) of this section.

(2) Several electoral districts may be formed:

1) in local authorities with more than 50,000 residents;

2) in local authorities which are formed due to a merger or division during the past two election cycles;

21) in local authorities to be formed as a result of a merger;

3) in local authorities in which rural municipality or city districts have been formed.

(3) The number of mandates in electoral districts to be formed shall not be less than three.

(31) In the case specified in subsection 2 (2) of this section, electoral districts shall be formed by the merged local authorities or groups of local authorities, and in the case specified in subsection 2 (21), electoral districts shall be formed by the local authorities or groups of local authorities to be merged.

(4) In Tallinn, the council shall form electoral districts by city district.

(41) If no city districts are formed in Tallinn, the electoral districts shall be formed pursuant to the distribution and boundaries of the electoral districts in the previous municipal council elections, in case the electoral districts in Tallinn were formed by city district. If any rural municipality or city merges with Tallinn, it shall form a separate electoral district.

(5) The resolution of a council concerning the formation of electoral districts shall set out the numeration and boundaries of the districts and the number of mandates in each district.

(6) Electoral districts shall be formed not later than on the ninetieth day before election day.

(7) A council shall publish the resolution specified in subsection (5) of this section within three working days as of the day on which the corresponding resolution is adopted.

Model 7: § 8. Formation of Electoral Districts.

§ 9. Distribution of mandates between electoral districts

(1) A council shall distribute the mandates between the electoral districts, based on the number of voters according to the information held in the population register as at 1 June of the election year, as follows:

1) the total number of voters shall be divided by the number of council members;

2) the number of voters in an electoral district shall be divided by the number obtained as a result of the calculation specified in clause 1) of this subsection;

3) each electoral district shall be awarded a particular number of mandates in correspondence with the integer of the number obtained as a result of the calculation made according to clause 2) of this subsection;

4) mandates which are not distributed pursuant to clause 3) of this subsection shall be distributed on the basis of the largest-remainder rule, using the fractions of numbers obtained as a result of the calculation specified in clause 2) of this subsection.

(2) In Tallinn, half of the mandates shall be divided equally among the electoral districts, taking account of the principle that the number of district mandates is the smallest whole number which can be divided by the number of the electoral districts which is at least half of all the mandates. The remaining mandates shall be distributed in accordance with the provisions of subsection (1) of this section, taking into account that the total number of voters shall be divided by the number of the mandates which have not been divided.

Model 8: § 9. Distribution of Mandates Between Electoral Districts.

§ 11. Acts in event of election to council of new local authority

(1) In order for elections of a new local authority to be held, the councils concerned shall, upon agreement, perform the following acts:

1) determine the number of members of the new council based on the provisions of subsections 7 (1) and (2) of this Act and the number of residents in the territory of the new rural municipality or city, according to the information held in the population register as at 1 January of the year in which the number of members is determined;

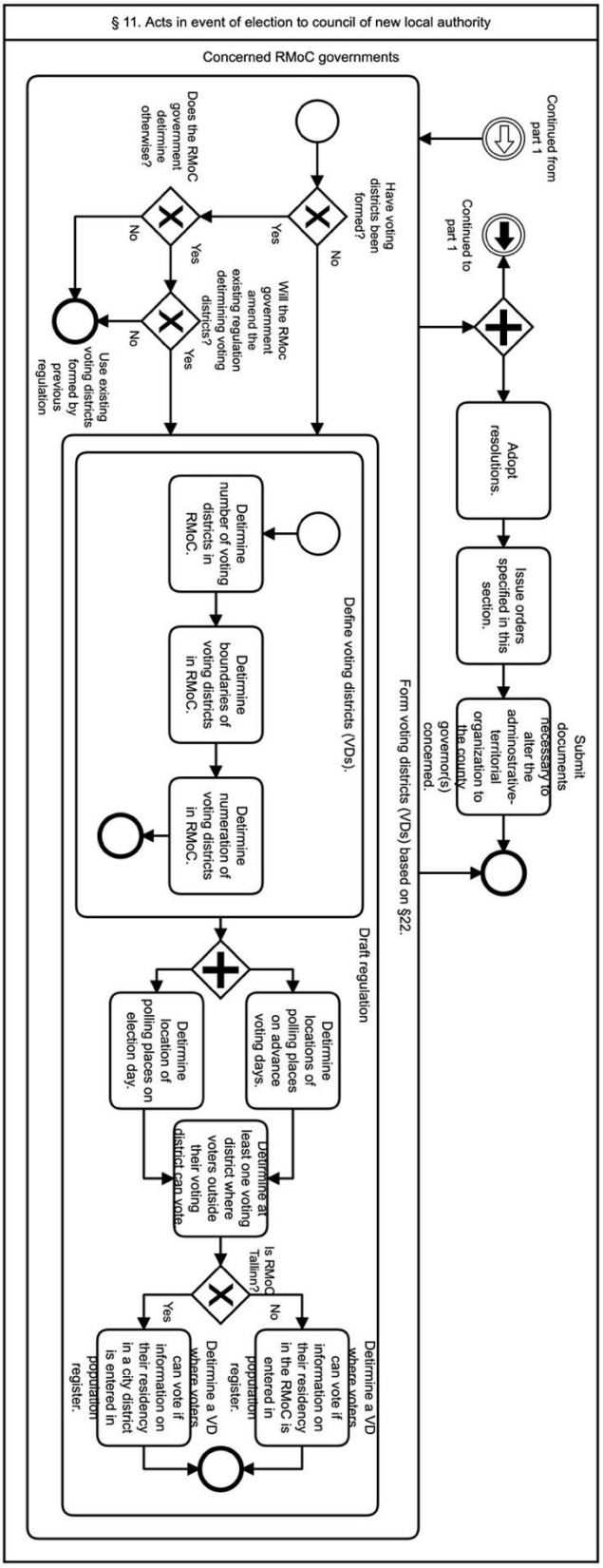
2) form electoral districts in the territory of the new rural municipality or city based on the provisions of subsections 8 (1)–(5) of this Act.

(2) The distribution of mandates shall be based on the provisions of subsections 9 (1) and (2) of this Act and the number of residents in the territory of the new rural municipality or city according to the information held in the population register as at 1 January of the year in which the mandates are distributed.

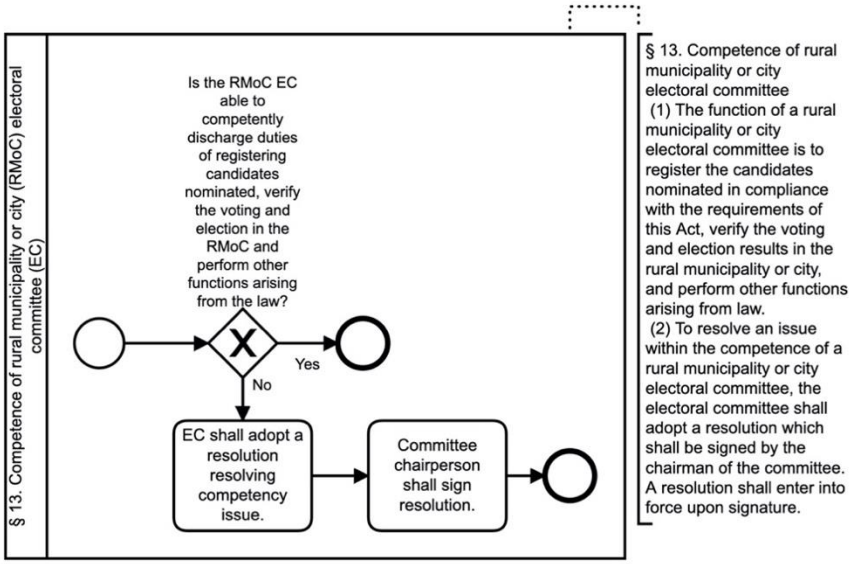
(3) The rural municipality or city governments concerned shall, upon agreement, form voting districts in the territory of the electoral districts based on the provisions of § 22 of this Act.

(4) The rural municipality or city councils and rural municipality or city governments concerned shall adopt the resolutions and issue the orders specified in this section before all the documents which are necessary in order to alter the administrative-territorial organisation are submitted to the county governor or county governors concerned.

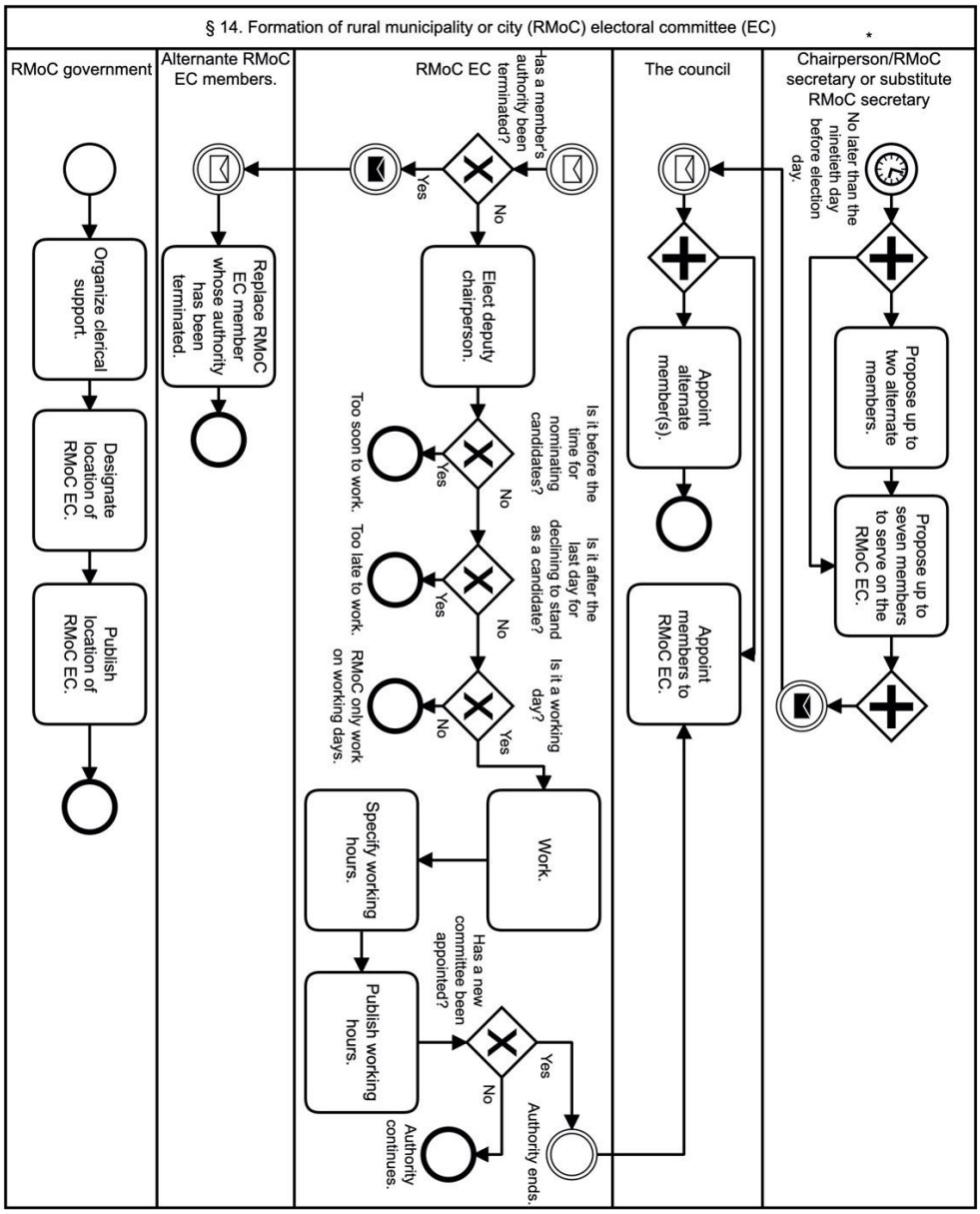
Model 9: § 11. Acts in Event of Election to Council of New Local Authority (Part 1).



Model 10: § 11. Acts in Event of Election to Council of New Local Authority (Part 2).



Model 11: § 13. Competence of Rural Municipality or City Electoral Committee.



§ 14. Formation of rural municipality or city electoral committee

(1) A rural municipality or city electoral committee shall be comprised of up to seven members.

(2) The members of a rural municipality or city electoral committee shall be appointed not later than on the ninetieth day before election day.

(3) The authority of rural municipality and city electoral committees shall continue until the new membership of the committee is appointed.

(4) The chairman of a rural municipality or city electoral committee shall be the corresponding rural municipality or city secretary. If a substitute is appointed for the time of the absence of a rural municipality or city secretary based on subsection 55 (5) of the Local Government Organisation Act, a substitute for a rural municipality or city secretary shall perform the functions of the chairman of a rural municipality or city electoral committee.

(5) The members of the rural municipality or city electoral committee shall be appointed by the council on the proposal of the rural municipality or city secretary.

(6) The council shall also, on the proposal of the rural municipality or city secretary, appoint up to two alternate members who, during the term of the committee and in the order specified by the council, shall replace committee members whose authority has terminated.

(7) The deputy chairman of a rural municipality or city electoral committee shall be elected by the committee from among its members.

(8) Clerical support to a rural municipality or city electoral committee shall be organised by the rural municipality or city government.

(9) A rural municipality or city government shall designate and publish the location of the rural municipality or city electoral committee.

(10) A rural municipality or city electoral committee shall specify and publish its working hours. An electoral committee shall work on each working day for the period from when the time for the nomination of candidates begins to the last day of declining to stand as a candidate.

Model 12: § 14. Formation of Rural Municipality or City Electoral Committee.

§ 15. Member of rural municipality or city electoral committee

(1) An Estonian citizen or a citizen of the European Union who has the right to vote at municipal council elections may be a member of a rural municipality or city electoral committee. The permanent residence of a member of an electoral committee need not be in this rural municipality or city.

(2) The authority of a member of a rural municipality or city electoral committee shall terminate prematurely:

1) due to his or her resignation;

2) due to his or her death;

3) if he or she becomes an authorised representative of a political party, election coalition or an independent candidate;

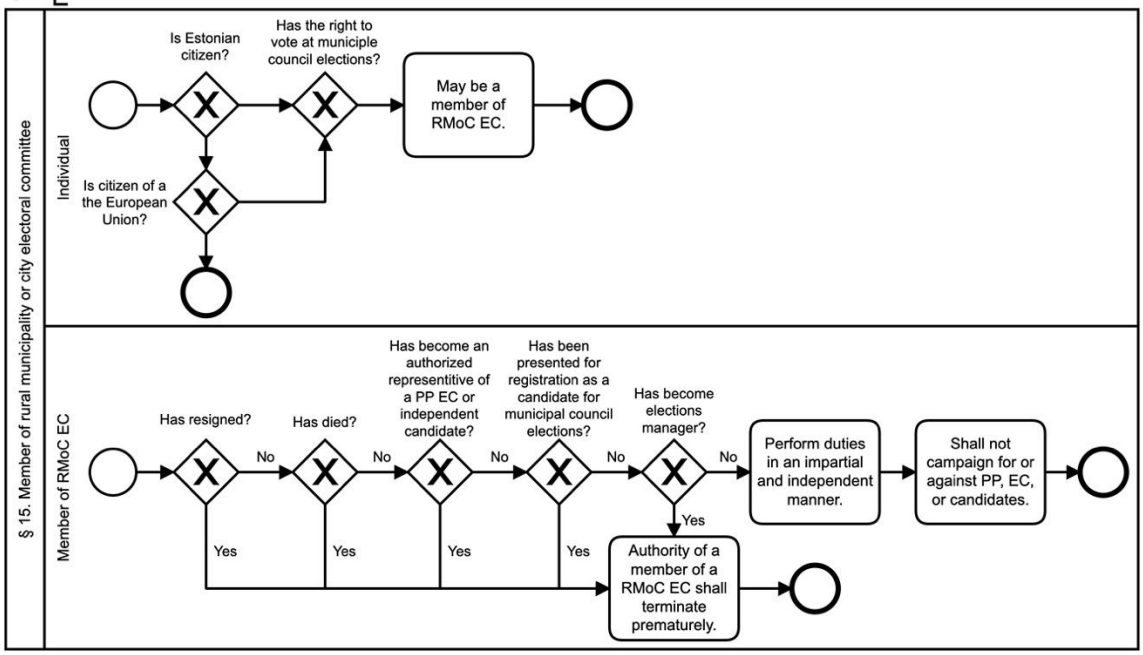
4) if he or she is presented for registration as a candidate for municipal council elections;

5) if he or she becomes the elections manager.

(3) A member of a rural municipality or city electoral committee may be released from his or her duties as a member of an electoral committee by a reasoned resolution of the council which appointed him or her either on the initiative thereof or on the proposal of the electoral committee.

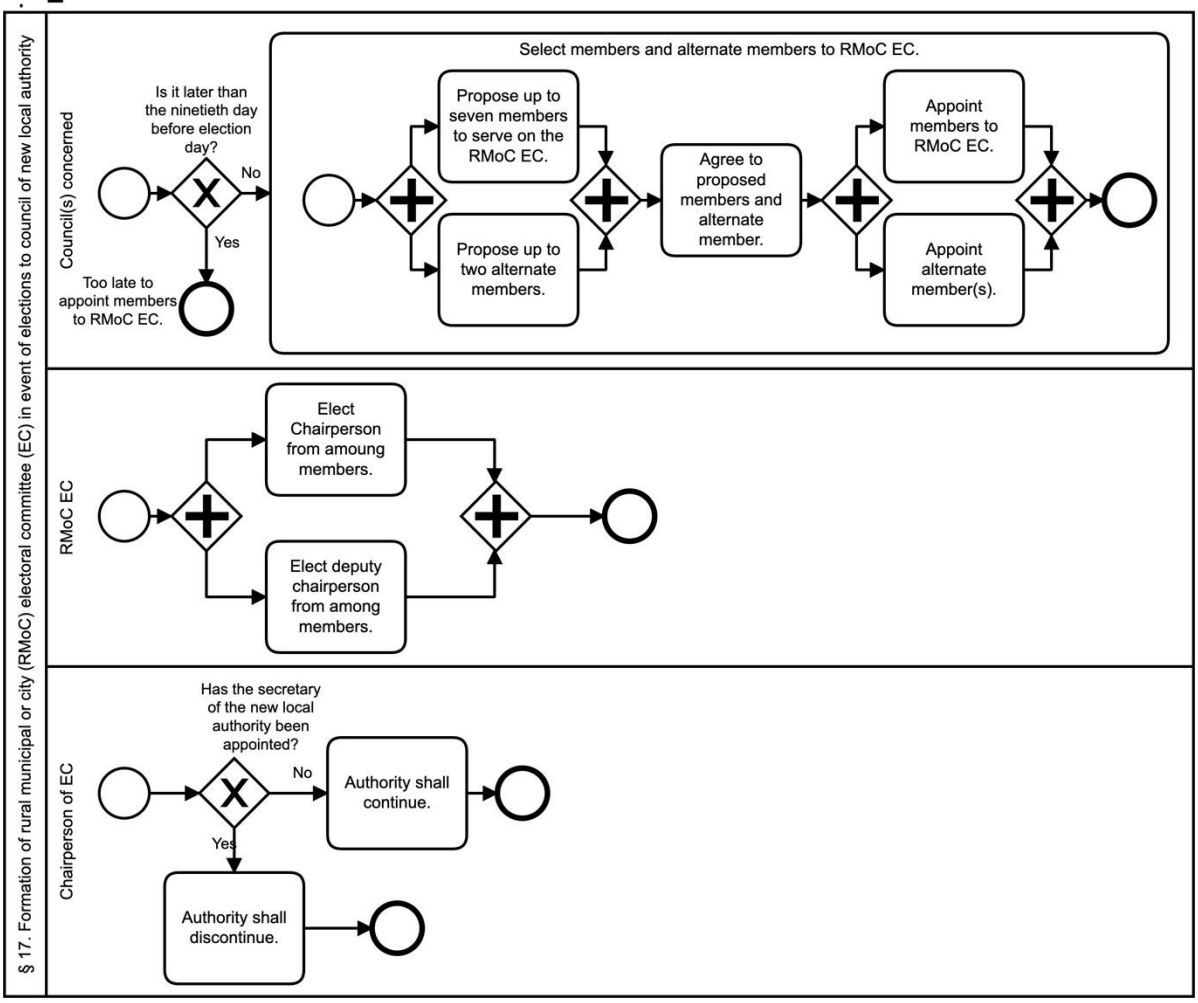
(4) A member of a rural municipality or city electoral committee shall be impartial and independent in the performance of his or her duties.

(5) A member of a rural municipality or city electoral committee shall not campaign for or against political parties, election coalitions or candidates.



Model 13: § 15. Member of Rural Municipality or City Electoral Committee.

§ 17. Formation of rural municipality or city electoral committee in event of elections to council of new local authority
(1) In order for elections to the council of a new local authority to be held, the councils concerned shall, upon agreement, appoint the members and alternate members of the rural municipality or city electoral committee on the proposal of the relevant rural municipality or city secretaries in accordance with the provisions of subsections 14 (1), (2) and (6) of this Act.
(2) The chairman and deputy chairman of a rural municipality or city electoral committee shall be elected by the committee from among its members. The authority of the chairman of the committee shall continue until the rural municipality or city secretary of the new local authority is appointed.
(3) The rural municipality or city councils concerned shall adopt the resolutions specified in subsection (1) of this section before all the documents which are necessary in order to alter the administrative-territorial organisation are submitted to the county governor or county governors concerned.



Model 14: § 17. Formation of Rural Municipality or City Electoral Committee in Event of Elections to Council of New Local Authority.

§ 18. Elections managers

(1) Municipal council elections shall be managed by:

1) the State Electoral Office;

2) county heads of elections;

3) voting district committees.

(2) The procedure for formation of the State Electoral Office and appointment of a county head of elections shall be provided for in the Riigikogu Election Act.

(3) A person managing elections shall not simultaneously be an authorised representative of a political party, election coalition or independent candidate, or a candidate.

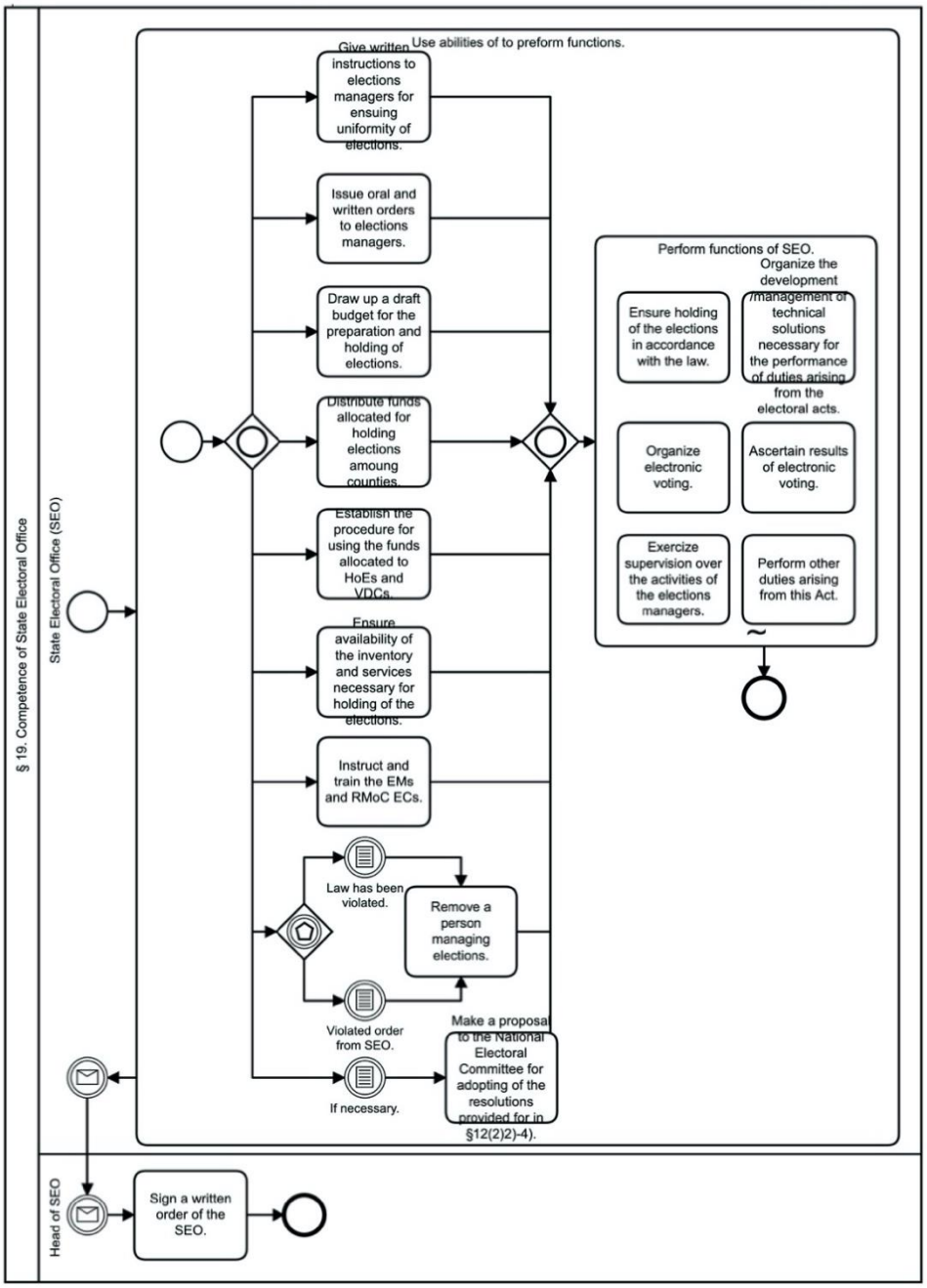
(4) A person managing elections must have the right to vote at municipal council elections and be proficient in Estonian. The permanent residence of a person managing elections need not be in this rural municipality or city.

(5) A person managing elections shall be independent in the performance of his or her duties and he or she shall not campaign for or against political parties, election coalitions or candidates.

(6) A person managing elections shall be entitled to receive remuneration for the performance of duties assigned to him or her.

Model 15: § 18. Election Managers.

§ 19. Competence of State Electoral Office
(1) The function of the State Electoral Office is:
1) to ensure the holding of the elections in accordance with law, to organise electronic voting and ascertain the results of electronic voting;
2) to exercise supervision over the activities of the elections managers;
3) to organise the development and management of the technical solutions necessary for the performance of the duties arising from the electoral acts;
4) to perform other duties arising from this Act.
(2) For the performance of their functions, the State Electoral Office:
1) shall give written instructions to the elections managers for ensuring the uniformity of elections;
2) shall issue oral and written orders to the elections managers, which are mandatory for performance;
3) shall draw up a draft budget for the preparation and holding of the elections;
4) shall distribute among the county heads of elections, upon approval of the National Electoral Committee, the funds allocated for holding of the elections and establish the procedure for using the funds allocated to the county heads of elections and voting district committees;
5) shall ensure the availability of the inventory and services necessary for holding of the elections;
6) shall instruct and train the elections managers and rural municipality and city electoral committees;
7) may remove a person managing elections who has violated the law or an order of the State Electoral Office from the holding of the elections;
8) if necessary, shall make a proposal to the National Electoral Committee for adopting of the resolutions provided for in clauses 12 (2) 2)–4) of this Act.
(3) The Head of the State Electoral Office shall sign a written order of the State Electoral Office. A written order shall enter into force upon signature thereof



Model 16: § 19. Competence of State Electoral Office.

§ 20. Competence of county head of elections

(1) The function of a county head of elections is to instruct voting district committees, and rural municipality and city electoral committees, exercise supervision over their activities and perform other functions arising from this Act.

(2) For the performance of his or her functions, a county head of elections:

1) shall issue oral and written orders to the voting district committees, which are mandatory for performance;

2) shall decide on the costs of a voting district committee based on the amount of the funds allocated by the State Electoral Office;

3) shall enter into contracts with the persons assisting the head of elections;

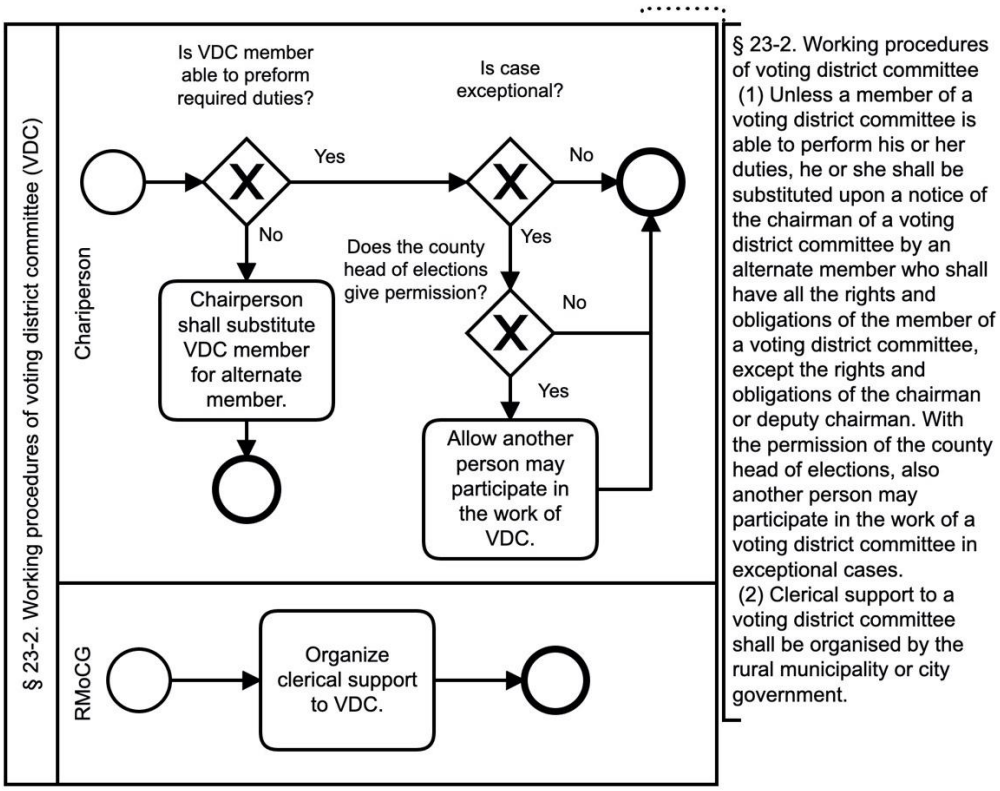
4) may release a member of a voting district committee who has violated the law or an order of the county head of elections from the duties of a voting district committee.

(3) The county head of elections shall sign a written order of the county head of elections. A written order shall enter into force upon signature thereof.

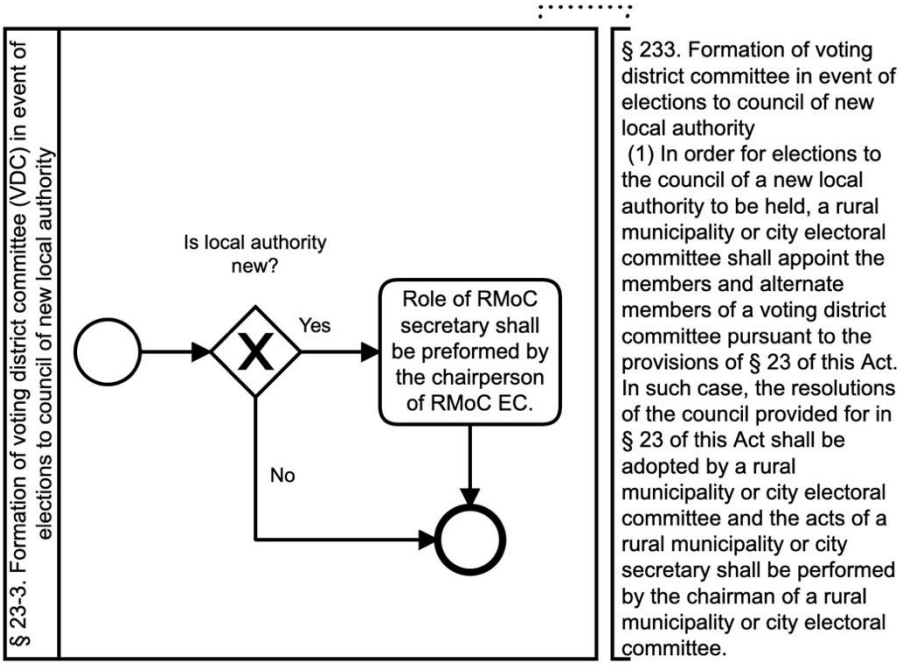
Model 17: § 20. Competence of County Head of Elections.

§ 22. Formation of voting districts
(1) At least one voting district shall be formed within the territory of each rural municipality and city, and of the city district of Tallinn.
(2) The rural municipality or city government shall determine the following by a regulation not later than on the fiftieth day before election day:
1) the number, boundaries and numeration of the voting districts;
2) the locations of polling places on the advance voting days and on the election day;
3) at least one voting district where voters can vote outside the voting district of their residence;
4) a voting district where voters can vote if the information on their residence in the rural municipality or city is entered in the population register to the accuracy of the rural municipality or city, or in Tallinn to t
he accuracy of the city district.
(3) Voting districts are permanent. Voting shall be held in the same voting districts for Riigikogu, municipal council and European Parliament elections and referendums, unless the rural municipality or city government determines otherwise and amends the regulation specified in subsection (2) of this section. To prepare a regulation specified in subsection (2) of this section, the rural municipality or city government shall enter the information set out in same subsection in the population register.
(4) A polling place or polling places of a voting district may be situated in different locations on each day of the advance voting.

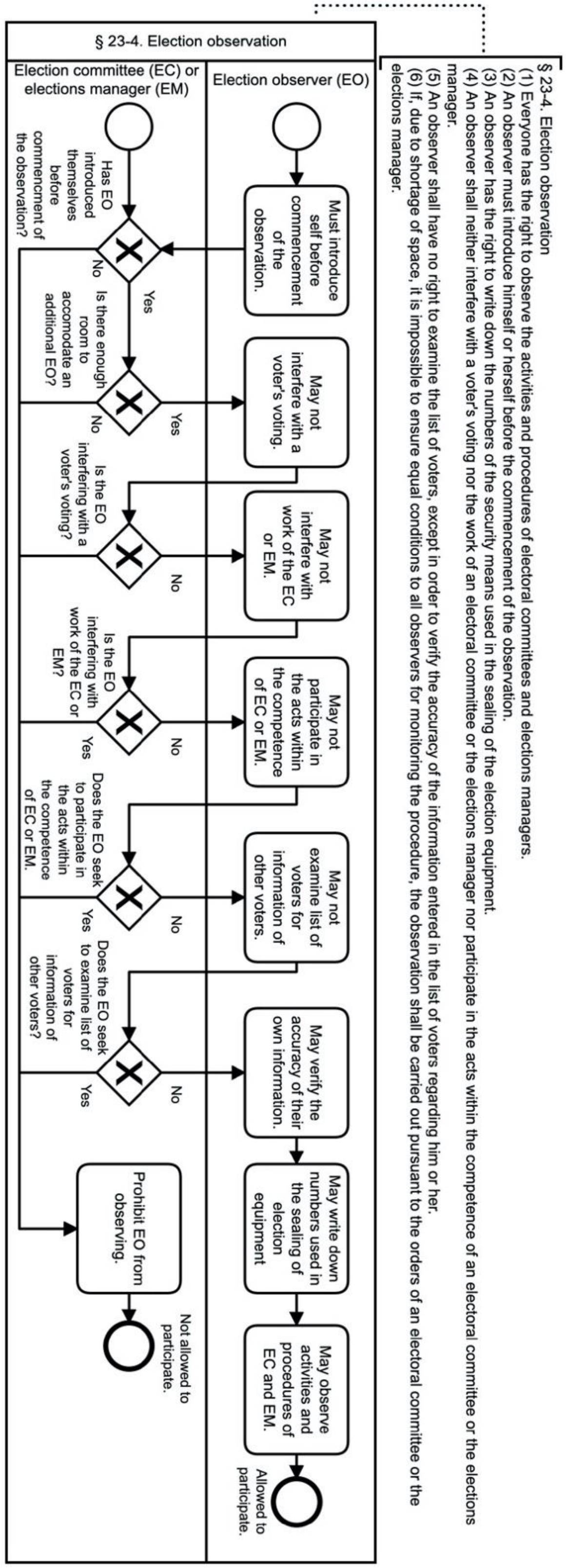
Model 18: § 22. Formation of Voting Districts.



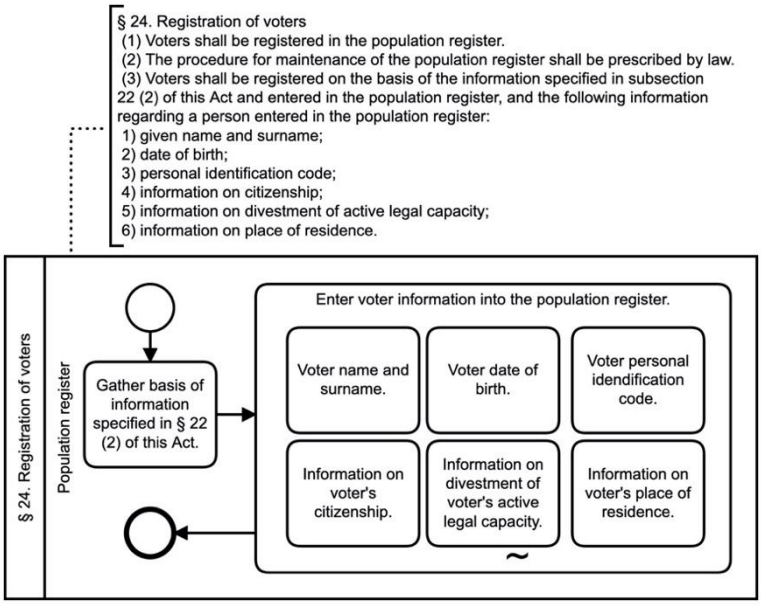
Model 19: § 23^2. Working Procedures of Voting District Committee.



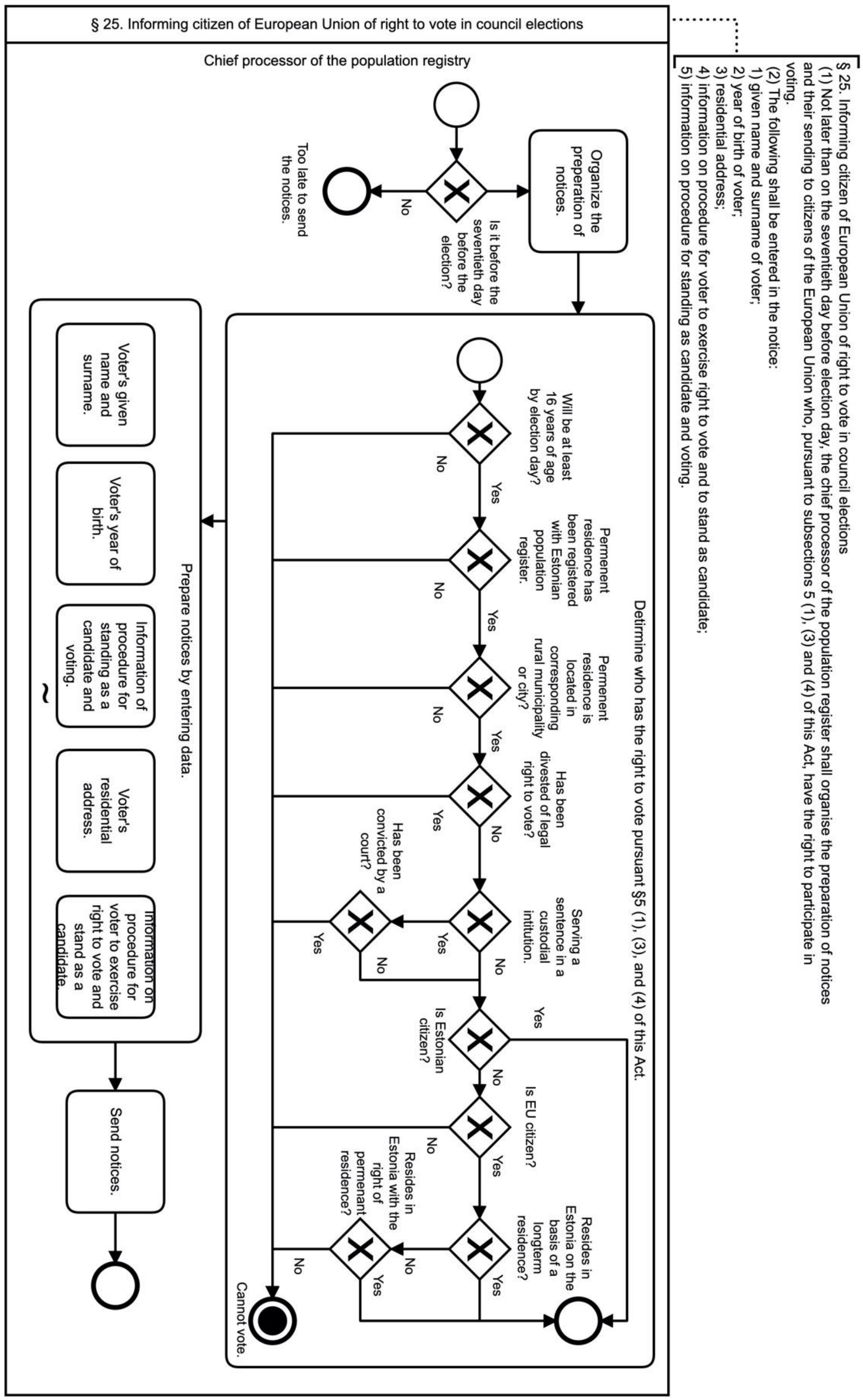
Model 20: § 23^3. Formation of Voting District Committee in Event of Elections to Council of New Local Authority.



Model 21: §23[4]. Election Observation.



Model 22: § 24. Registration of Voters.



Model 23: § 25. Informing Citizens of EU of Right to Vote in Council Elections.

§ 26. Voter's card

(1) The chief processor of the population register shall organise the preparation of voter's cards and their sending to voters not later than on the twentieth day before election day. A voter's card shall not be sent to a voter if the information on his or her residence is entered in the population register on the initiative of a local authority to the accuracy of the rural municipality or city, or in Tallinn to the accuracy of the city district.

(2) The following shall be entered in the voter's card:

1) given name and surname of voter;

2) year of birth of voter;

3) residential address of voter;

4) number and boundaries of electoral district pursuant to subsection 8 (5) of this Act;

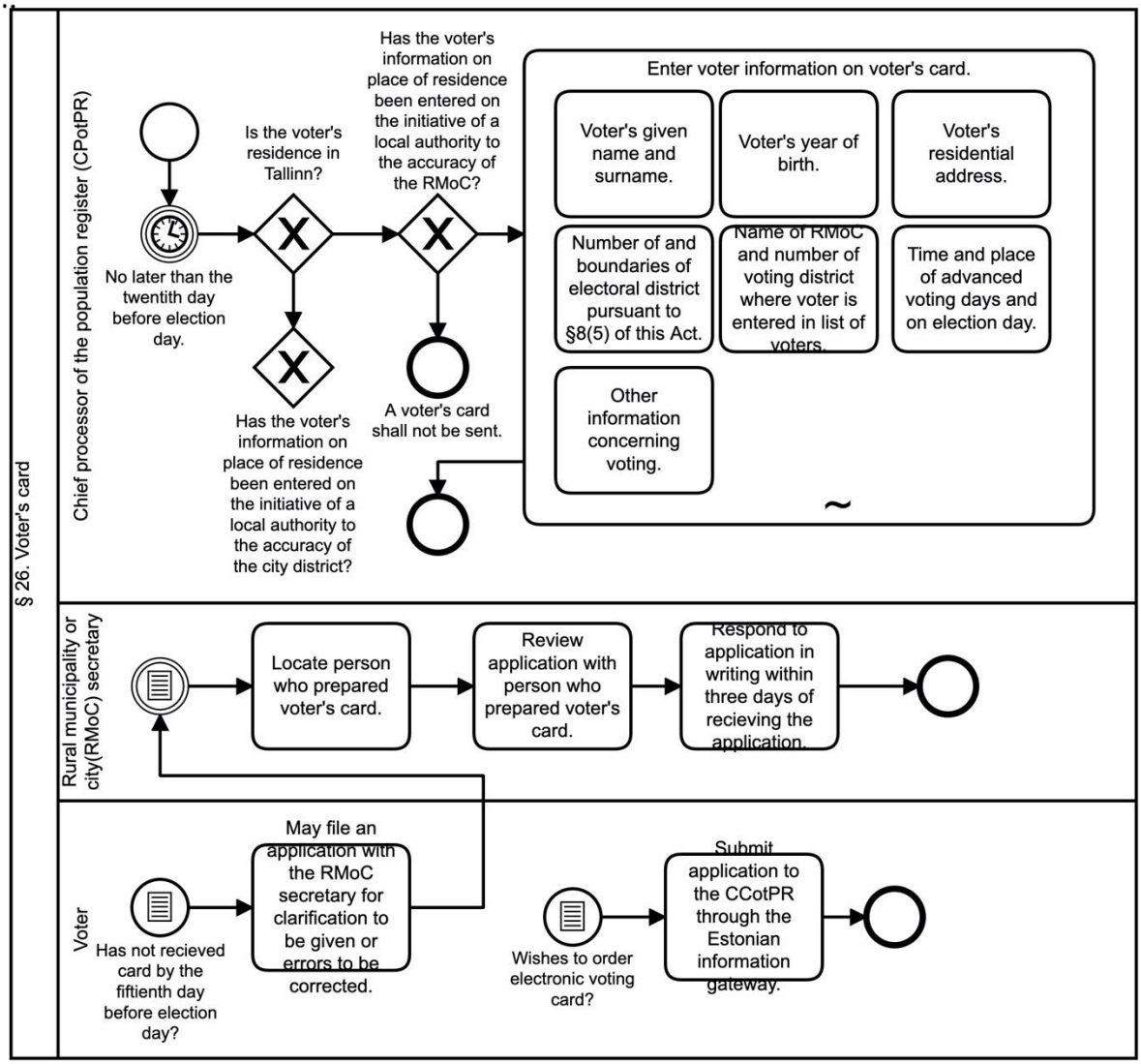
5) name of rural municipality or city and number of voting district where voter is entered in list of voters;

6) time and place of voting on advance voting days and on election day;

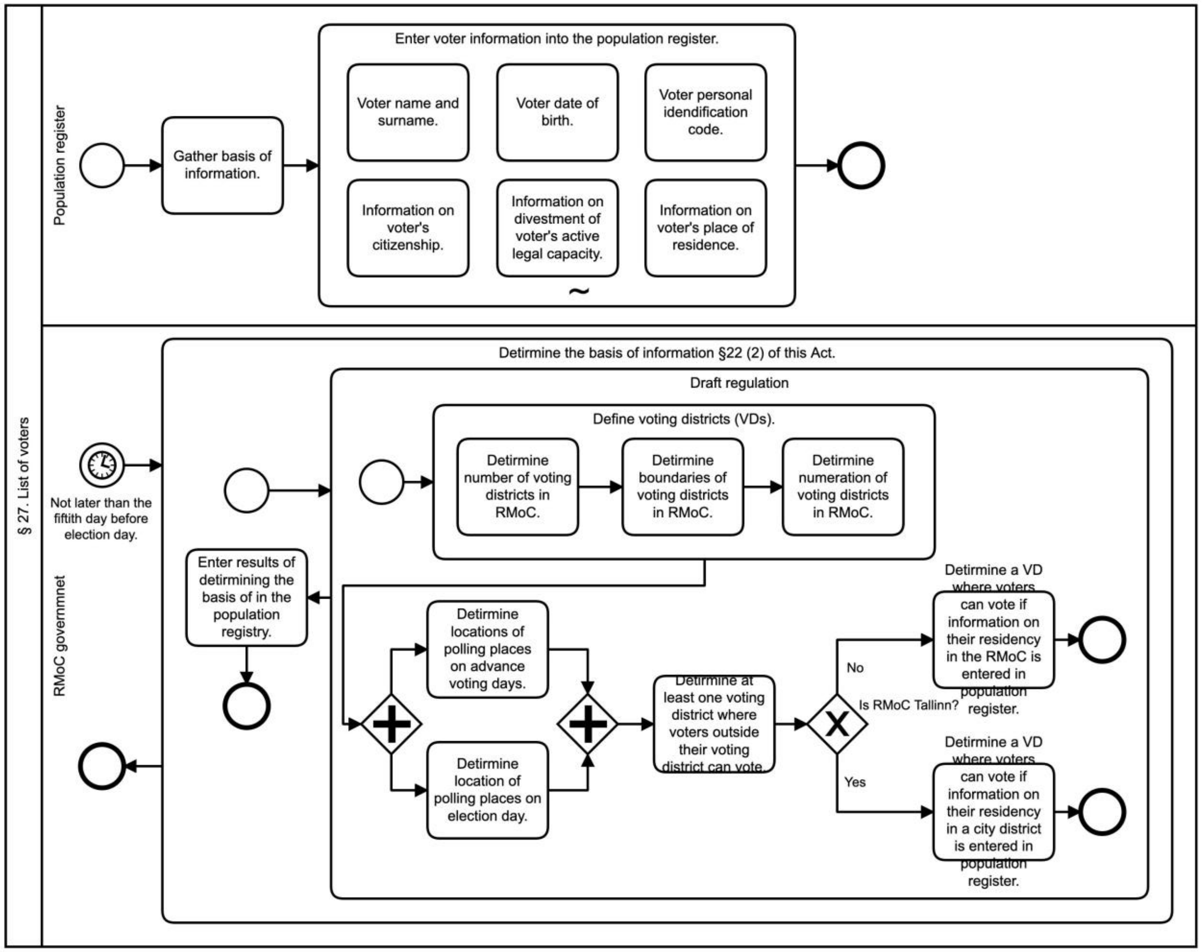
7) other information concerning voting.

(21) A voter may order an electronic voter's card. To order an electronic voter's card, a voter shall submit an application to the chief processor of the population register through the Estonian information gateway. For the following elections and referendums, a voter shall be sent an electronic voter's card without the need to re-submit the application.

(3) A voter who has not received a voter's card on the fifteenth day before election day or whose voter's card contains incorrect in formation may file an application with the rural municipality or city secretary for clarification to be given or errors to be corrected. The rural municipality or city secretary shall promptly review the application together with the person who prepared the voter's card and shall respond to the application in writing within three working days as of receiving the application.



Model 24: § 26. Voter's Card.



§ 27. List of voters

(1) The controller of the population register shall organise the preparation and printing of the list of voters for each voting district on the basis of the information held in the population register and shall organise the delivery of the list of voters to the voting district committees not later than by the seventh day before election day. The electronic lists of voters shall be sent to the State Electoral Office not later than by the thirteenth day before election day.

(2) The basis for the preparation of list of voters shall be the information prescribed in subsection 24 (3), as at the thirtieth day before the day of the referendum. Upon preparation of the list of voters, any changes made to the information specified in clauses 24 (3) 1)–6) later than the thirtieth day before the day of the referendum shall also be taken into account. Any changes made to the residential address and address of the place of stay after the thirtieth day before the day of the referendum shall not be taken into account.

(3) A person shall not be entered in a list of voters if he or she has been convicted of a criminal offence by a court pursuant to information held in the criminal records database and if, as at the thirtieth day before election day, he or she is to be imprisoned until election day.

(4) A voter shall be entered in the list of voters of the voting district in the territory of which his or her residence, as entered in the population register, is located on the thirtieth day before the day of the referendum. If the residential address of the voter is not entered in the population register and there is an address of the place of stay, the voter shall be entered in the list of voters of the voting district in the territory of which his or her place of stay, as entered in the population register, is located on the thirtieth day before the day of the referendum. If the information on the residence of a voter is entered in the population register to the accuracy of the rural municipality or city, or in Tallinn to the accuracy of the city district, the voter shall be entered in the list of voters of a voting district determined pursuant to clause 22 (2) 4) of this Act.

(5) The following information on each voter shall be entered in the list of voters:

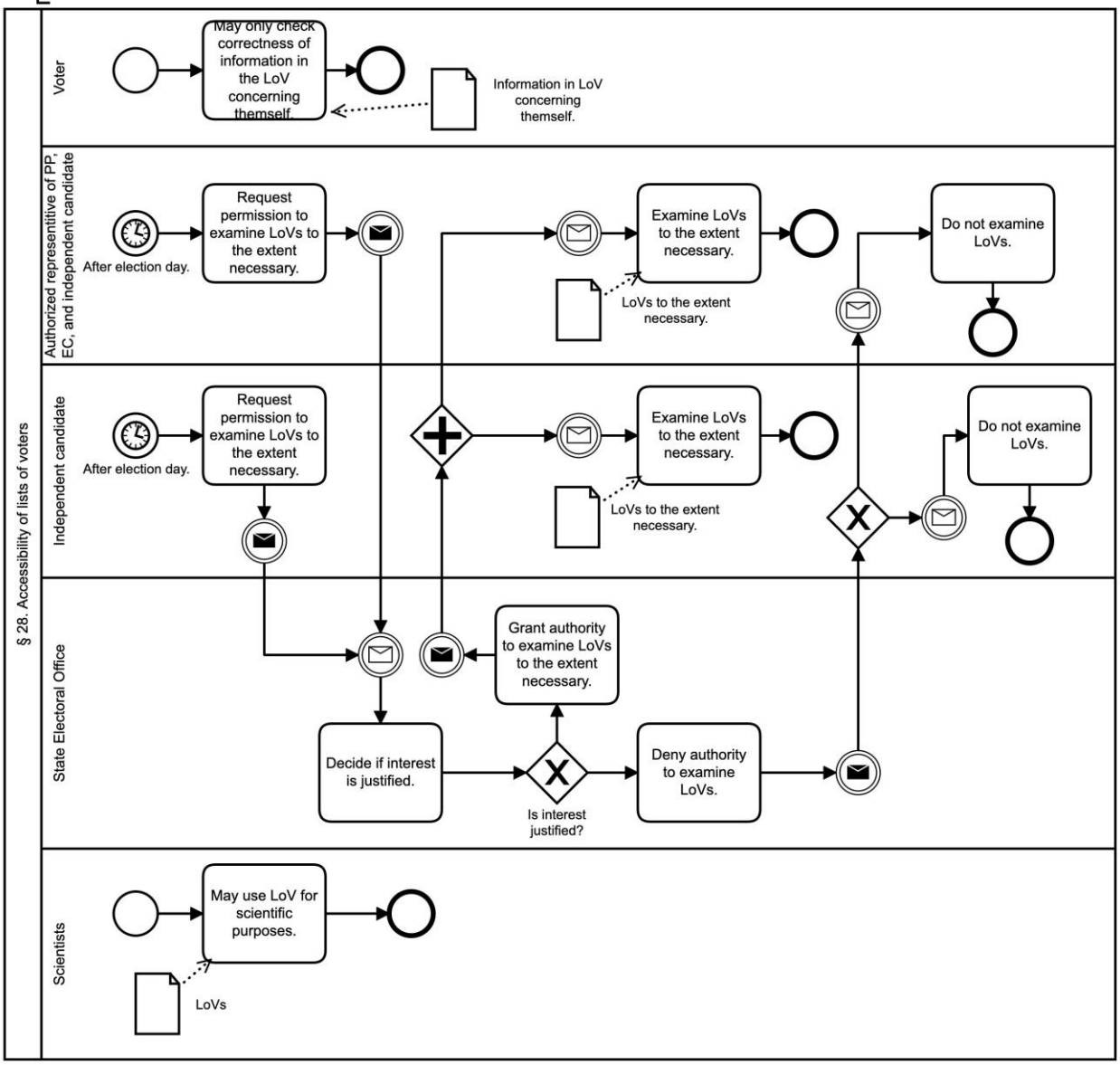
1) given name and surname;
2) personal identification code;
3) residential address or address of the place of stay.

(6) Voters shall be entered in a list of voters in alphabetical order according to their surname.

(7) The person who prepares the list of voters shall sign the list of voters not later than on the seventh day before election day and the chairman of the voting district committee shall sign the list of voters on election day after the close of voting. The Head of the State Electoral Office shall sign the list of voters who voted electronically after the close of voting.

Model 25: § 27. List of Voters.

§ 28. Accessibility of lists of voters
(1) A voter may check the correctness of information entered in the list of voters concerning himself or herself.
(2) After election day, the authorised representatives of political parties and election coalitions, and independent candidates and their authorised representatives may, in the event of justified interest, examine lists of voters to the extent necessary with the permission of the State Electoral Office, and the lists may also be used for scientific purposes.



Model 26: § 28. Accessibility of Lists of Voters.

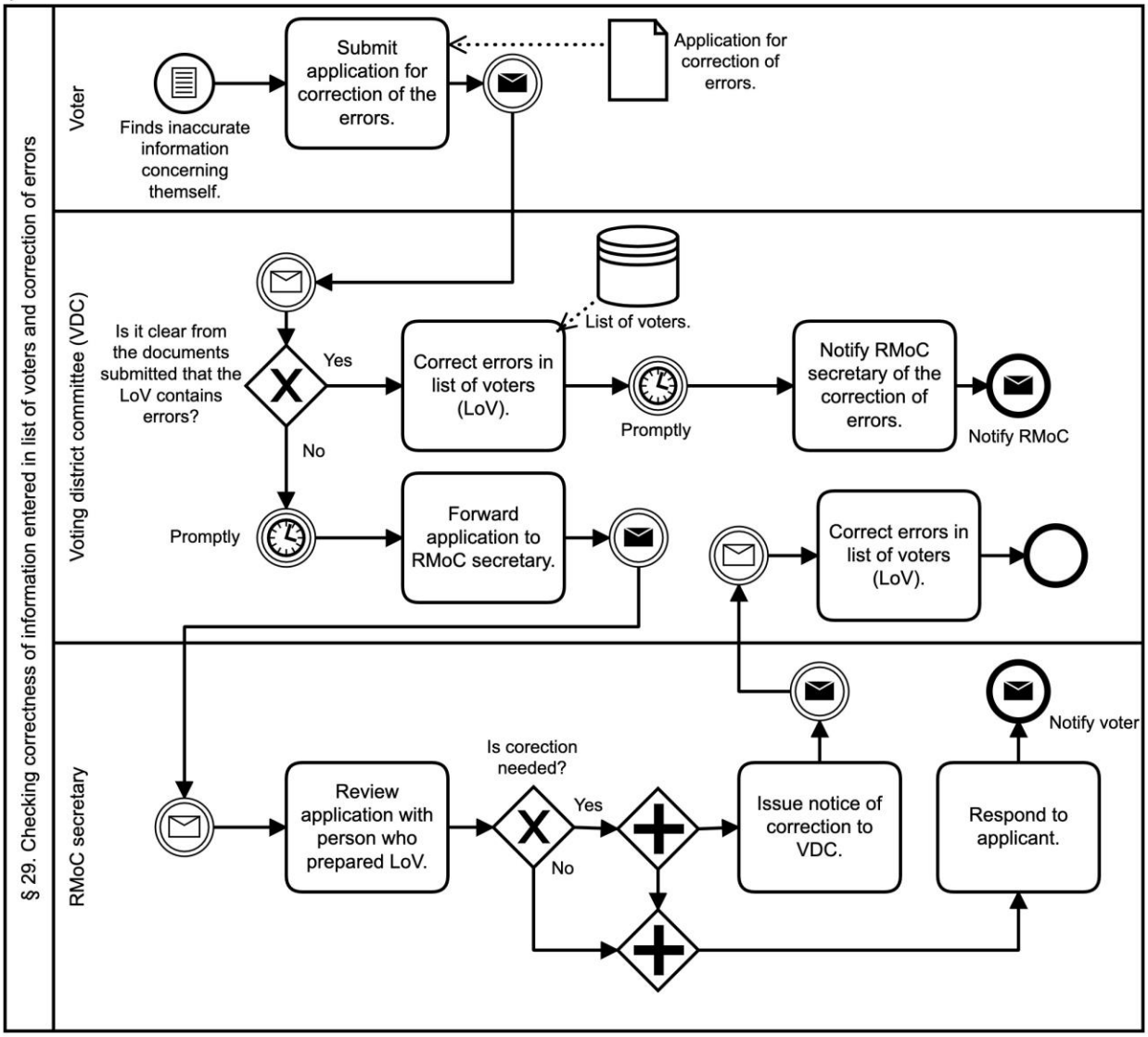
§ 29. Checking correctness of information entered in list of voters and correction of errors

(1) If a voter finds that information entered in the list of voters concerning himself or herself contains errors, he or she shall submit an application for correction of the errors to the voting district committee which shall promptly forward it to the rural municipality or city secretary.

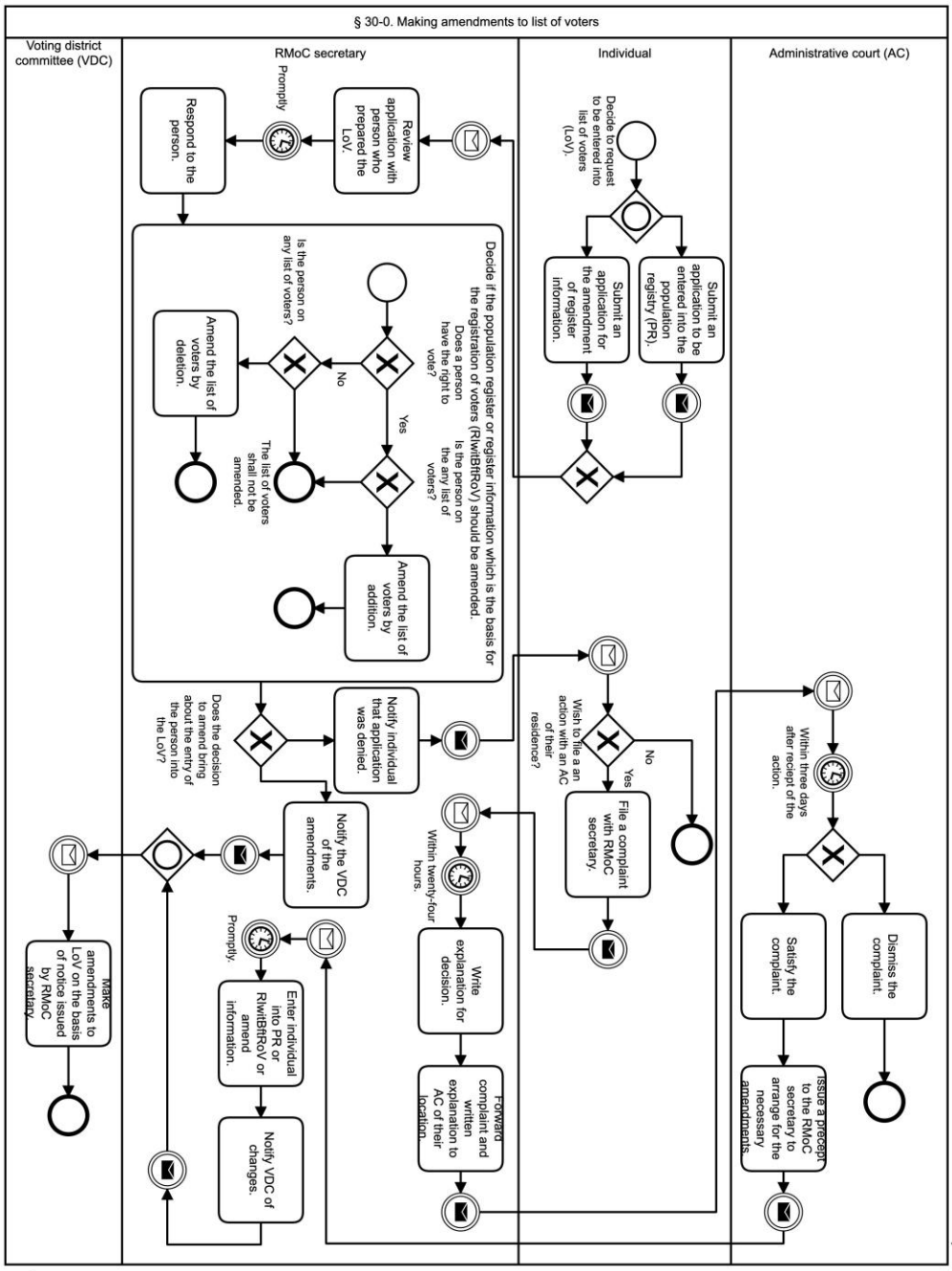
(2) The rural municipality or city secretary shall review the application together with the person who prepared the list of voters and shall respond to the applicant and inform the voting district committee of the results of the review.

(3) The voting district committee shall correct the error in the list of voters on the basis of a notice issued by the rural municipality or city secretary.

(4) If it is clear from the documents submitted to a voting district committee that the information entered in the list of voters contains errors, the voting district committee may correct the errors. The rural municipality or city secretary shall be promptly informed of the correction of errors.

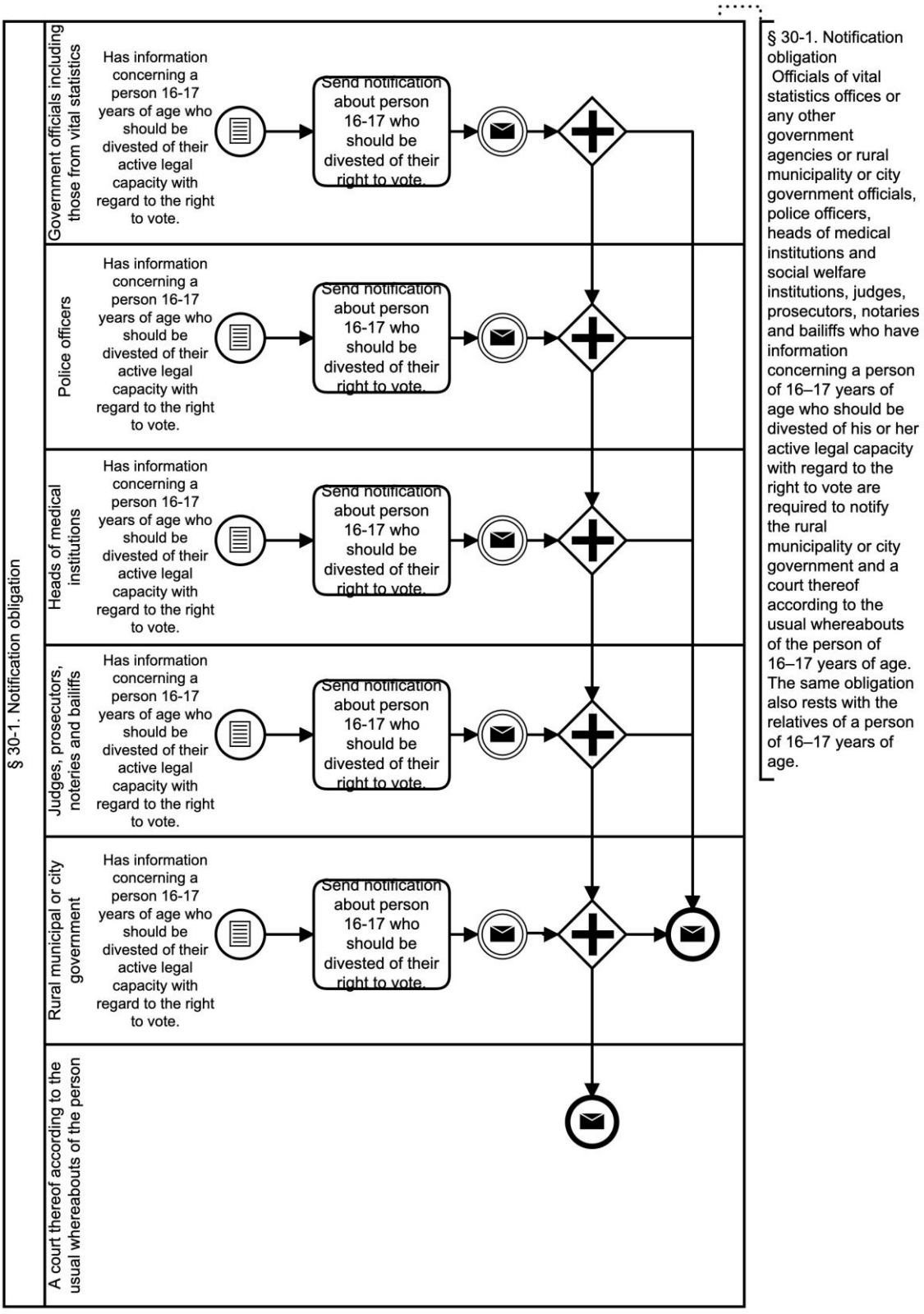


Model 27: § 29. Checking Correctness of Information Entered in List of Voters and Correction of Errors.



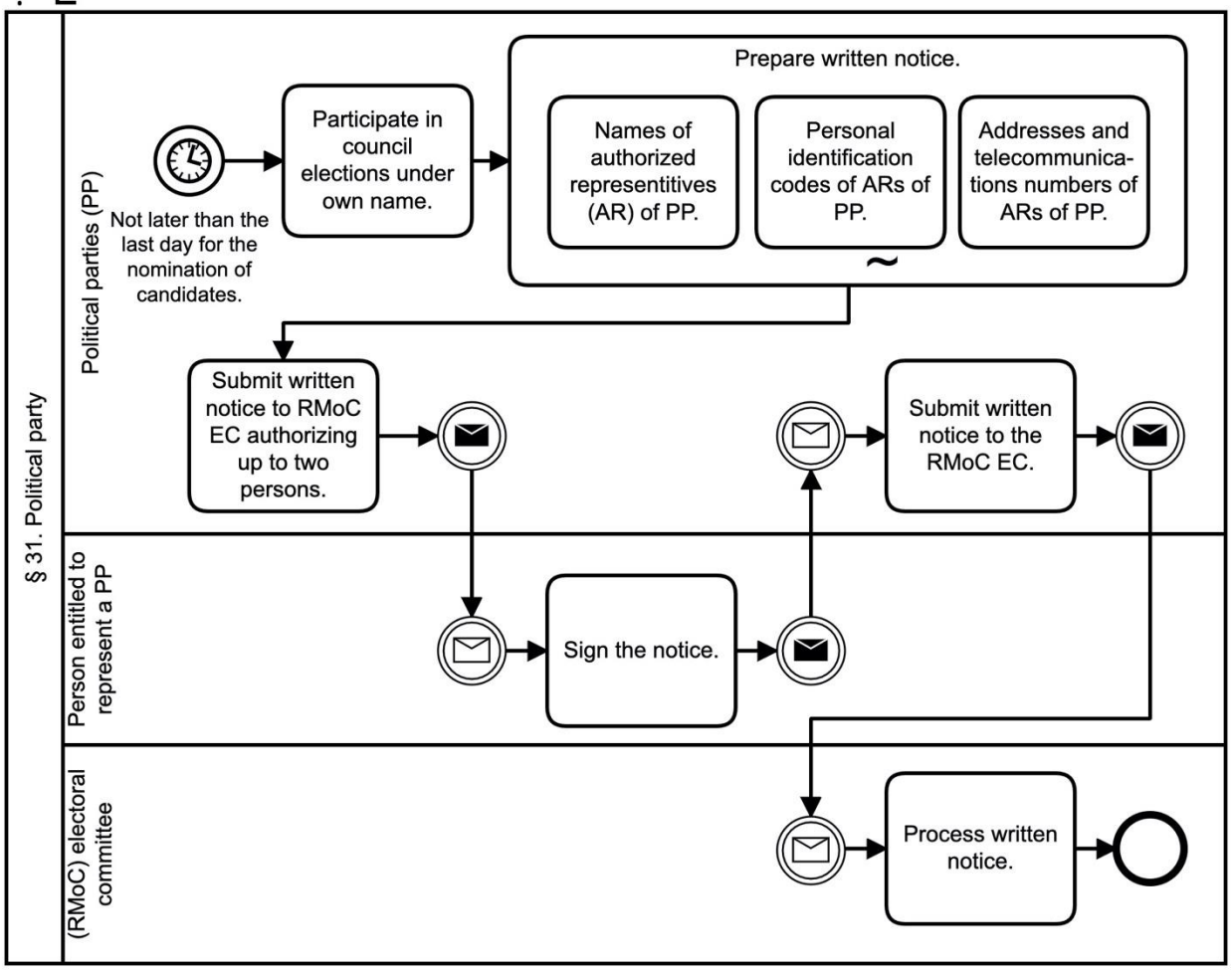
§ 30. Making amendments to list of voters
(1) A list of voters shall be amended only if:
1) a person who has not been entered in any list of voters but who has the right to participate in voting pursuant to this Act is to be entered in the list;
2) a person who does not have the right to participate in voting is to be deleted from the list.
(2) In order to amend a list of voters, a person shall submit an application to be entered in the population register or an application for the amendment of register information which is the basis for the registration of voters to a rural municipality or city secretary. The rural municipality or city secretary shall review the application together with the person who prepared the list of voters and shall promptly respond to the person.
(3) If a person is entered in the population register or if register information which is the basis for the registration of voters is amended such that this brings about the entry of the person in the list of voters, the rural municipality or city secretary shall promptly notify the voting district committee thereof.
(4) A voting district committee shall make amendments to the list of voters on the basis of a notice issued by the rural municipality or city secretary.
(5) If a rural municipality or city secretary denies an application specified in subsection (2) of this section, the applicant may file an action with an administrative court of his or her residence against the act of the rural municipality or city secretary. A complaint shall be filed with the rural municipality or city secretary who shall forward the complaint to the administrative court of his or her location together with a written explanation within twenty-four hours.
(6) The administrative court shall review the action and make a judgment within three working days after the date of receipt of the action.
(7) The administrative court shall make one of the following judgments:
1) to dismiss the complaint;
2) to satisfy the complaint and issue a precept to the rural municipality or city secretary to arrange that the person be entered in the population register or to amend the register information which is the basis for the registration of voters.
(8) If the administrative court satisfies the complaint, the person shall be promptly entered in the population register or the information pertaining to him or her shall be amended and the voting district committee shall be promptly notified thereof.

Model 28: § 30^0. Making Amendments to List of Voters.

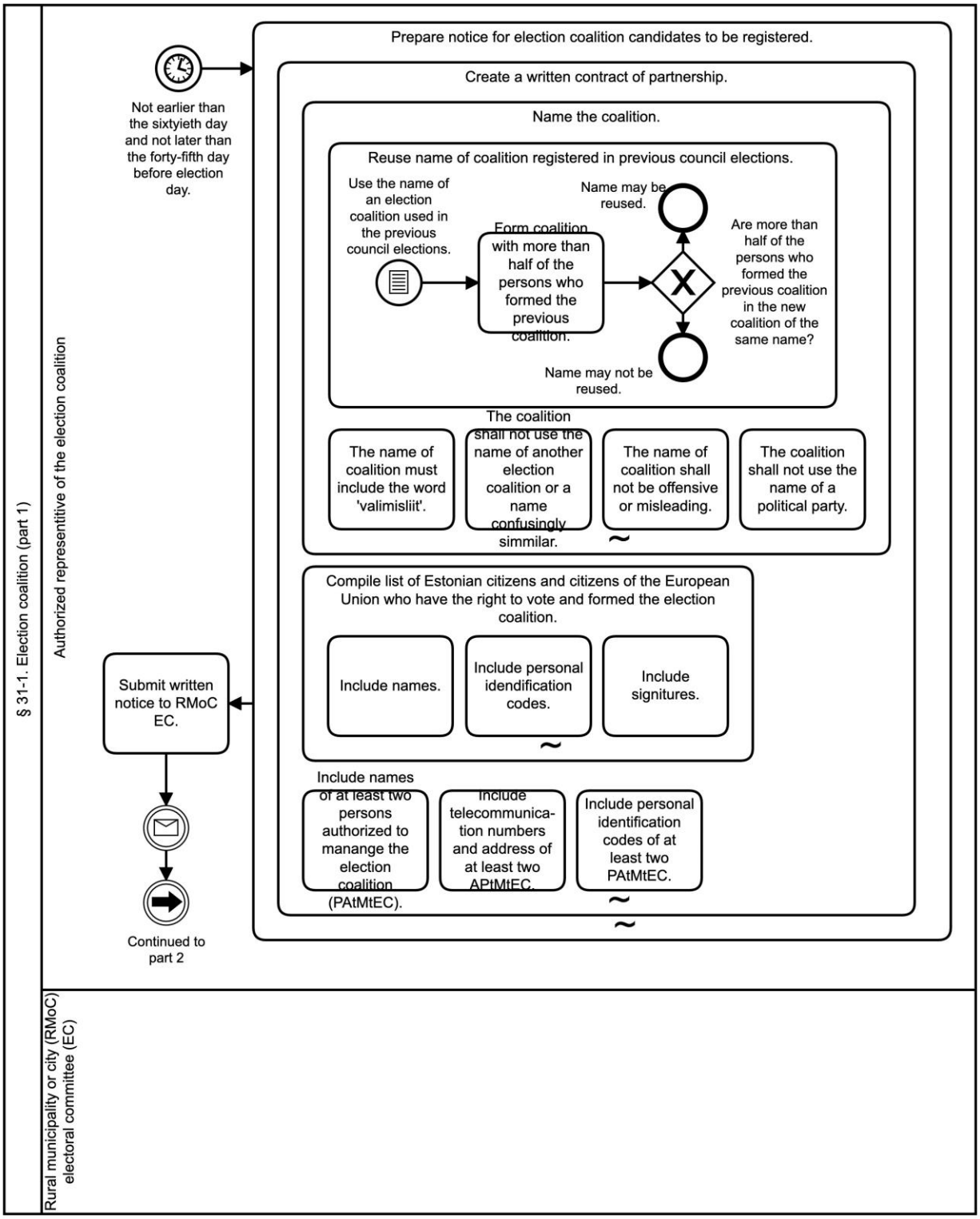


Model 29:§ 30^{1}. Notification Obligation.

§ 31. Political party
(1) Political parties which are entered in the non-profit associations and foundations register not later than on the last day for the nomination of candidates may participate in council elections.
(3) Political parties shall participate in council elections under their own name.
(4) A political party shall, upon nominating candidates, submit a written notice to the rural municipality or city el ectoral committee which sets out the names, personal identification codes, addresses and telecommunications numbers of the authorised representatives of the political party. A person entitled to represent a political party according to the Non-profit Associations Act or the articles of association of the political party shall sign the notice.
(5) A political party may authorise up to two persons to represent the party in a rural municipality or city.



Model 30: § 31. Political Party.



Model 31: § 31[1]. Election Coalition (Part 1).

§ 31-1. Election coalition

(1) An election coalition is a civil law partnership formed by Estonian citizens and citizens of the European Union who have the right to vote, which has been formed on the basis of a written contract and which objective consists in the expression of the political interests of its members and supporters at the local government level.

(2) The name of an election coalition shall contain the word valimisliit [election coalition].

(2) An election coalition shall be presented for registration to the rural municipality or city electoral committee not earlier than on the sixtieth and not later than on the forty-fifth day before election day.

(3) In order for the candidates of an election coalition to be registered, the authorised representative of the election coalition shall submit a notice to the rural municipality or city electoral committee. The notice shall set out the following:

1) name of rural municipality or city forcouncil elections of which election coalition is formed;

2) name of election coalition;

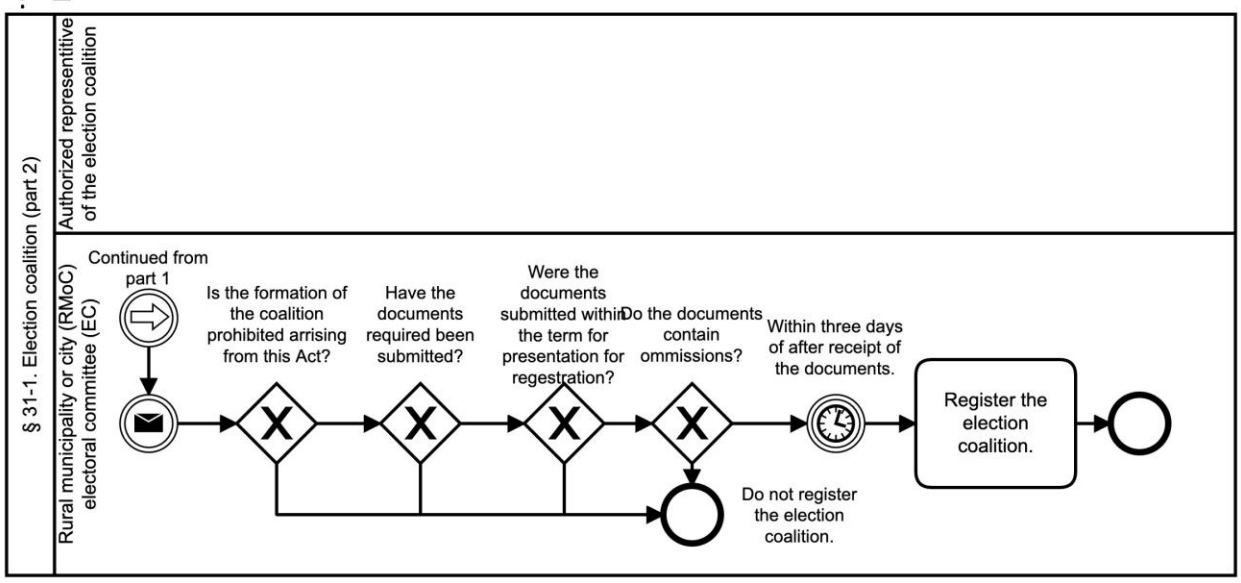
3) written contract of partnership, which contains the names, personal identification codes, addresses and telecommunications numbers of at least two persons authorised to manage the election coalition;

4) names, personal identification codes and signatures of Estonian citizens and citizens of the European Union who have right to vote an d who formed election coalition.

(4) The name of an election coalition shall not be offensive or misleading. The name of an election coalition registered in the previous council elections may be used if more than half of the persons who formed the previous the election coalition also form the new election coalition. It is prohibited to use the name of a political party or another election coalition or a name confusingly similar thereto as the name of an election coalition.

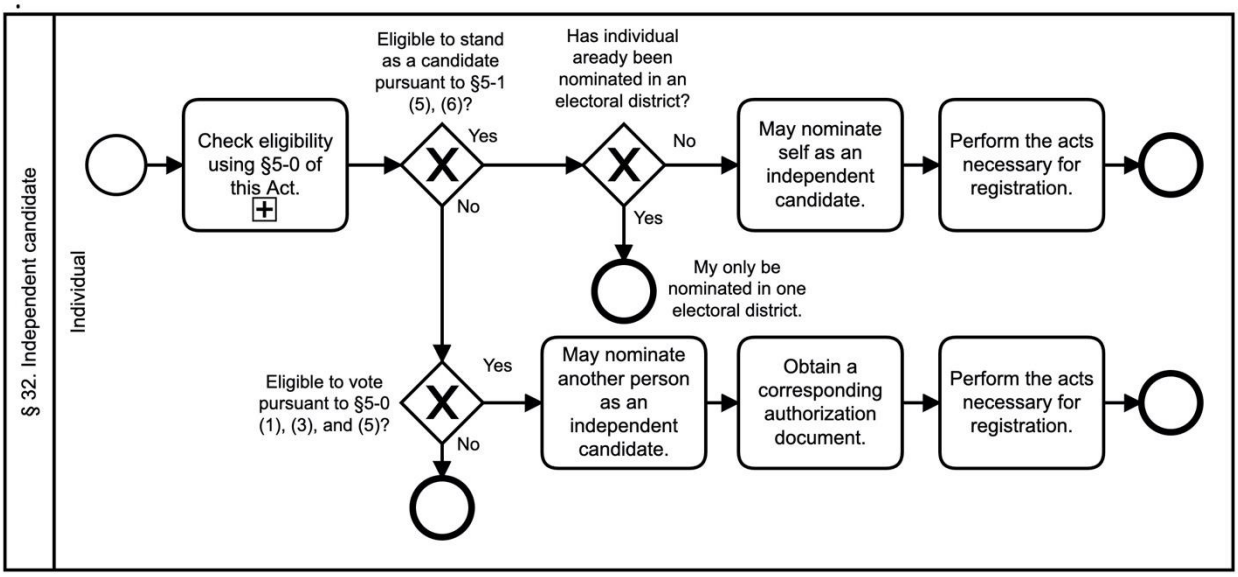
(5) A rural municipality or city electoral committee shall register an election coalition presented for registration according to the requirements within three days after receipt of the documents set out in subsection (4) of this section.

(6) A rural municipality or city electoral committee shall not register an election coalition if the documents set out in subsection (4) of this section are not submitted within the term for presentation for registration thereof or if they contain omissions or errors or if the formation of the election coalition is prohibited arising from this Act.



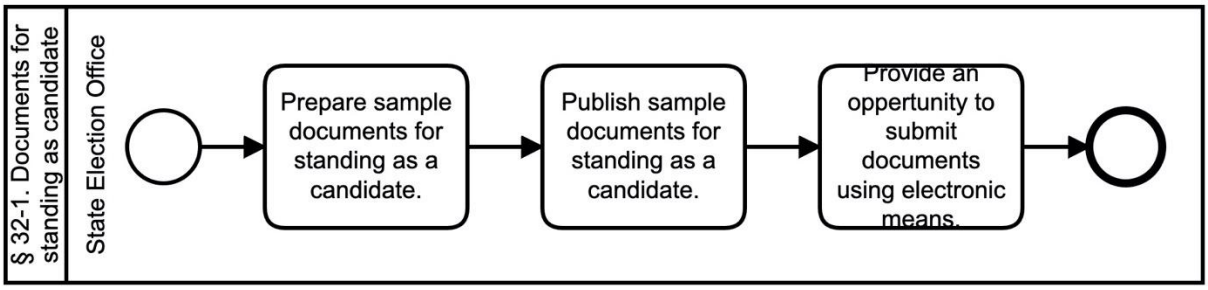
Model 32: § 31[1]. Election Coalition (Part 2).

§ 32. Independent candidate
(1) Every person who has the right to stand as a candidate (subsections 5 (5) and (6)) may nominate himself or herself as an indepe ndent candidate and perform the acts necessary for registration. Every person who has the right to vote pursuant to subsections 5 (1), (3) and (4) of this Act may nominate another person as an independent candidate and perform the acts necessary for registration on the basis of a corresponding authorisation document.
[RT III 2002, 22, 251
- entry into force 15.07.2002 - Judgment No. 3-4-1-7-02 of Constitutional Review Chamber of Supreme Court of 2002.22 declares sub section (1) to be in conflict with §§ 11, 12 and subsection 156 (1) of the Constitution.]
(2) An independent candidate may be nominated in only one electoral district.



Model 33: § 32. Independent Candidate.

§ 321. Documents for standing as candidate
The State Electoral Office shall prepare and publish the sample documents for standing as a candidate and provide an opportunity to submit the documents for standing as a candidate using electronic means.

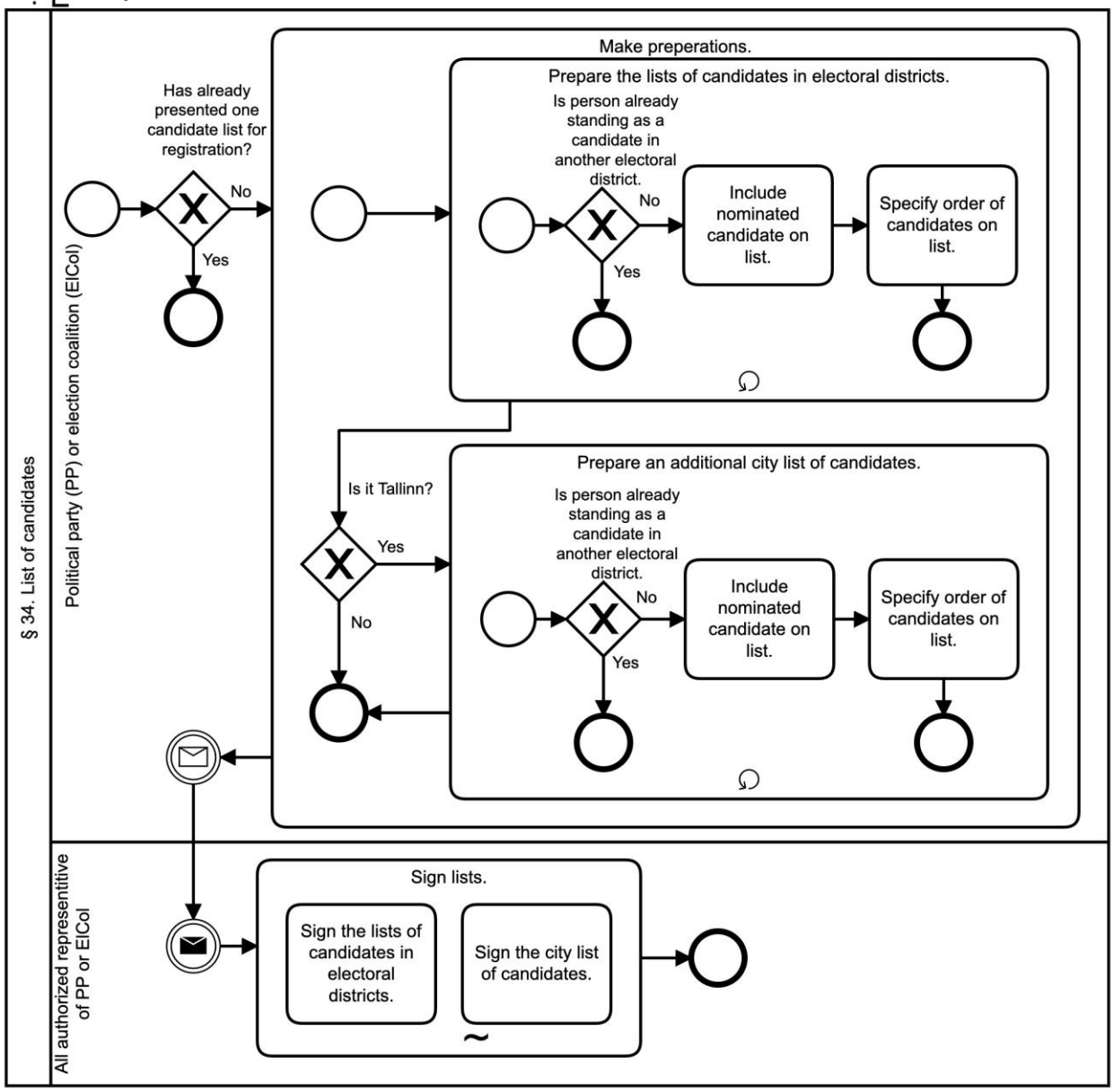


Model 34: § 32^1. Documents for Standing as a Candidate.

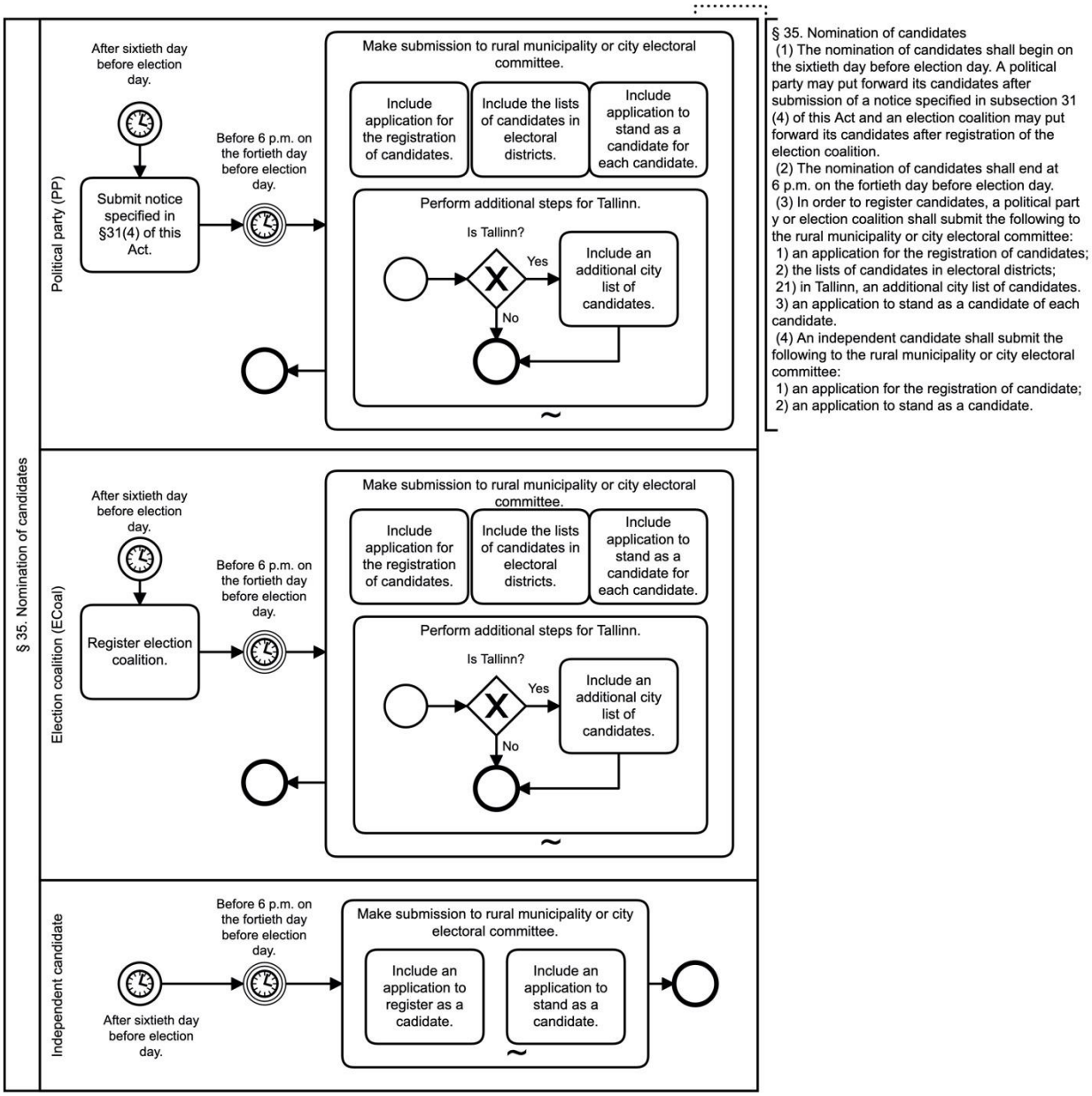
§ 33. Application to stand as candidate
(1) In an application to stand as a candidate, a person shall:
1) express his or her desire to stand as a candidate in the list of a political party or election coalition or to stand as an independent candidate;
2) confirm that he or she complies with the requirements of this Act for candidates standing in council elections;
3) submit the data provided for in subsections (2)–(3) of this section.
(2) A candidate shall submit in an application to stand as a candidate the following information:
1) given name and surname;
2) personal identification code;
3) membership of a political party;
4) residential address;
5) telecommunications numbers;
6) contact details;
7) information concerning the education;
8) place of employment and position.
(3) A citizen of the European Union shall additionally enter data on citizenship in an application to stand as a candidate.
(4) The State Electoral Office shall publish the information provided for in clauses (2) 1), 3), 6), 7) and 8) and subsection (3) of this section.
(5) A candidate shall use only his or her given name and surname as his or her name when standing as a candidate.
(6) A candidate shall sign an application to stand as a candidate.

Model 35: § 33. Application to Stand as a Candidate.

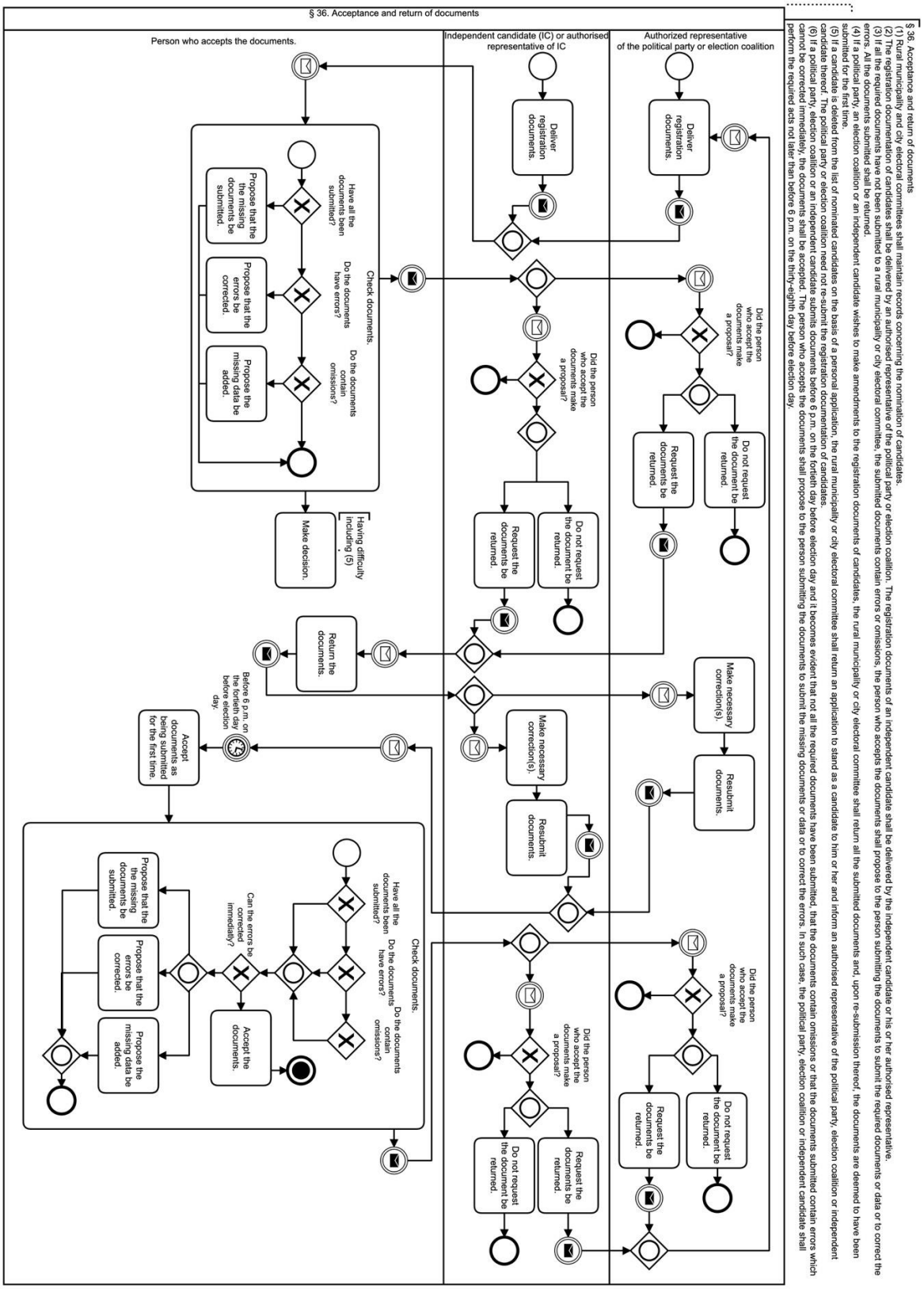
§ 34. List of candidates
(1) A political party or an election coalition shall prepare the following:
1) the lists of candidates in electoral districts;
2) in Tallinn, an additional city list of candidates.
(2) A nominated candidate shall be included in both lists specified in subsection (1) of this section.
(3) A person may stand as a candidate in only one electoral district.
(4) A person may stand as a candidate in one list of candidates prepared by a political party or election coalition. A person who is nominated as an independent candidate shall not stand in a list of candidates.
(5) A political party or election coalition may present only one candidate list for registration in an electoral district.
(6) The order of the candidates in a list of candidates shall be specified by the political party or election coalition.
(7) All the authorised representatives of a political party or election coalition shall sign the lists of candidates in electoral districts and the city list of candidates.



Model 36: § 34. List of Candidates.



Model 37: § 35. Nomination of Candidates.



§ 36. Acceptance and return of documents

(1) Rural municipality and city electoral committees shall maintain records concerning the nomination of candidates.

(2) The registration documentation of candidates shall be delivered by an authorised representative of the political party or election coalition. The registration documents of an independent candidate shall be delivered by the independent candidate or his or her authorised representative.

(3) If all the required documents have not been submitted to a rural municipality or city electoral committee, the submitted documents contain errors or omissions, the person who accepts the documents shall propose to the person submitting the documents to submit the required documents or data or to correct the errors. All the documents submitted shall be returned.

(4) If a political party, an election coalition or an independent candidate wishes to make amendments to the registration documents of candidates, the rural municipality or city electoral committee shall return all the submitted documents and, upon re-submission thereof, the documents are deemed to have been submitted for the first time.

(5) If a candidate is deleted from the list of nominated candidates on the basis of a personal application, the rural municipality or city electoral committee shall return an application to stand as a candidate to him or her and inform an authorised representative of the political party, election coalition or independent candidate thereof. The political party or election coalition need not re-submit the registration documentation of candidates.

(6) If a political party, election coalition or an independent candidate submits documents before 6 p.m. on the fortieth day before election day and it becomes evident that not all the required documents have been submitted, that the documents contain omissions or that the documents submitted contain errors which cannot be corrected immediately, the documents shall be accepted. The person who accepts the documents shall propose to the person submitting the documents to submit the missing documents or data or to correct the errors. In such case, the political party, election coalition or independent candidate shall perform the required acts not later than before 6 p.m. on the thirty-eighth day before election day.

Model 38: § 36. Acceptance and Return of Documents.

§ 37. Registration of candidates

(1) The rural municipality or city electoral committee shall, after expiry of the term for the nomination of candidates but not later than on the thirty-fifth day before election day, register all persons nominated in accordance with the requirements of this Act in the order of their nomination.

(2) Each candidate shall be assigned a registration number. Registration numbers shall begin at 101 and be assigned to the candidates by lists of political parties and independent candidates. Independent candidates shall be assigned a registration number after each list of candidates of political parties and election coalitions has been assigned a registration number. The order in which numbers are assigned to the political parties, election coalitions and independent candidates shall be decided by lot.

(3) If, within the term specified in subsection 36 (6) of this Act, the person submitting the documents has failed to submit the missing documents or data or to correct the errors in the documents for standing as a candidate, an electoral committee shall not register:

1) any of the candidates nominated by a political party or election coalition if a document specified in clauses 35 (3) 1), 2) or 21) of this Act is missing or it contains material deficiencies;
2) a candidate who documents or data are missing or whose documents contain material deficiencies;
3) a candidate who does not comply with the requirements prescribed in subsections 5 (5) and (6) of this Act.

(4) A rural municipality or city electoral committee shall adopt a reasoned resolution on failure to register a candidate.

(5) A rural municipality or city electoral committee shall revoke a resolution to register a candidate if:

1) the candidate declines to stand as a candidate on the basis of a written application which may be submitted by him or her within three days after registration;
2) the candidate dies;
3) it is established that the candidate does not comply with the requirements prescribed in subsections 5 (5) or (6) of this Act.

(6) A rural municipality or city electoral committee shall register a person who was not registered previously after the term specified in subsection (1) of this section if the committee finds that the person complies with the requirements prescribed in subsections 5 (5) and (6) of this Act or if the resolution not to register the candidate is revoked by a resolution of the National Electoral Committee or a judgment of the Supreme Court.

(7) A resolution on registration may be revoked and a person who was not registered may be registered not later than by the thirteenth day before election day.

Model 39: § 37. Registration of Candidates.

§ 39. Consolidated list of candidates in electoral district and list of candidates to all councils

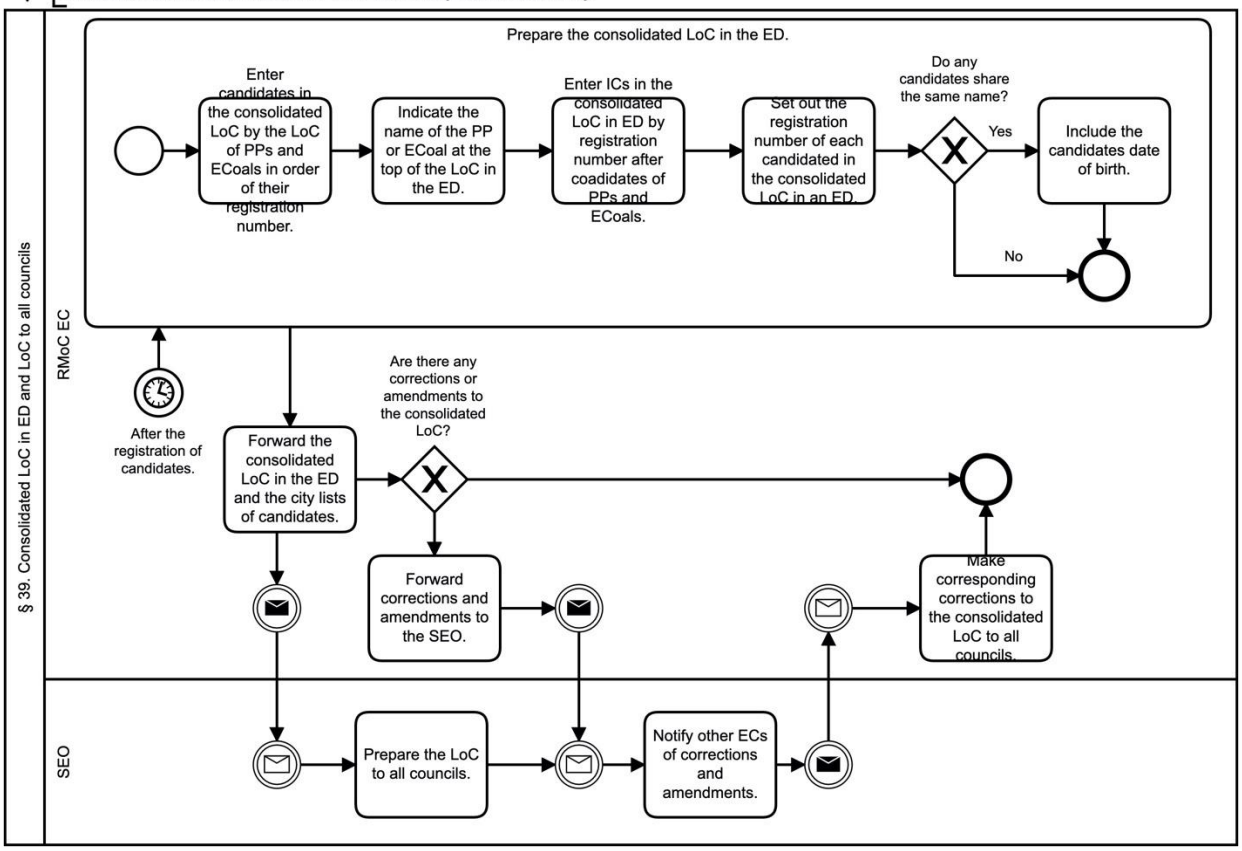
(1) After the registration of candidates, the rural municipality or city electoral committee shall prepare the consolidated list of candidates in the electoral district.

(2) Candidates shall be entered in the consolidated list of candidates in an electoral district by the lists of candidates of political parties and election coalitions in the electoral district in the order of their registration numbers. The name of the political party or election coalition which puts forward the list shall be indicated at the top of the list of candidates in the electoral district. Independent candidates shall be entered in the consolidated list of candidates in an electoral district in the order of their registration numbers after the lists of candidates of political parties and election coalitions in the electoral district.

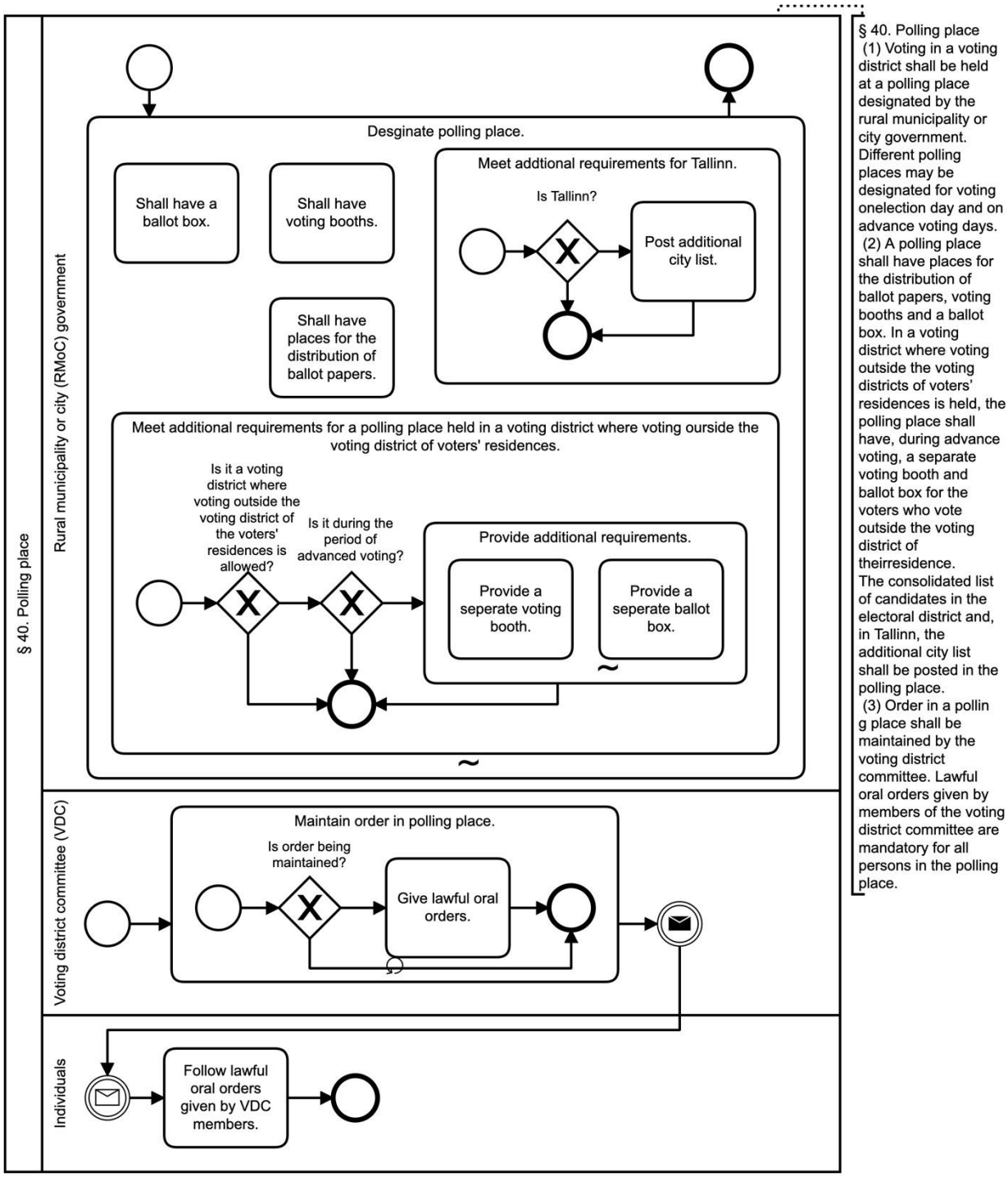
(3) The registration number and name of each candidate shall be set out in the consolidated list of candidates in an electoral district. If several candidates with the same name stand in one electoral district, their dates of birth shall also be set out in the consolidated list.

(4) A rural municipality or city electoral committee shall forward the consolidated lists of candidates in the electoral district and the city lists of candidates. The State Electoral Office shall prepare the list of candidates to all councils.

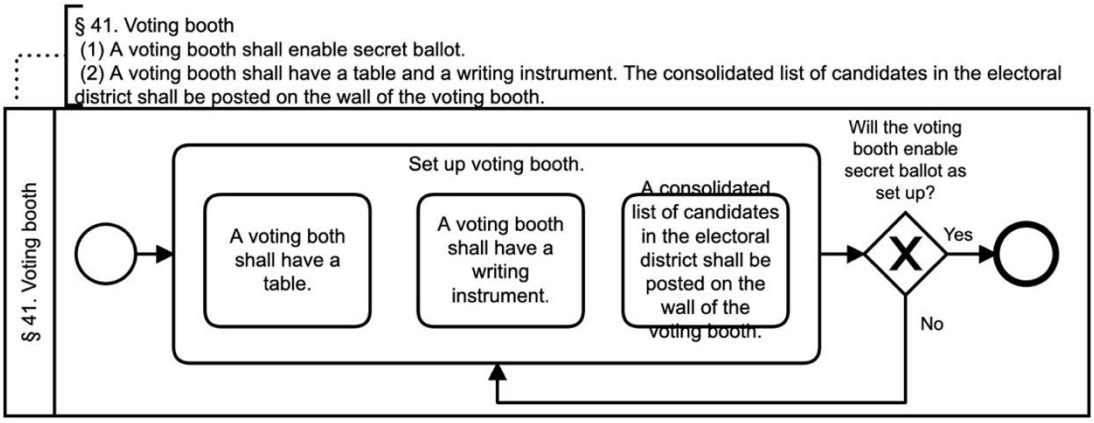
(5) A rural municipality or city electoral committee shall notify the State Electoral Office promptly of all corrections and amendments to the consolidated list of candidates in the rural municipality or city or the city list of candidates. The State Electoral Office shall notify other electoral committees of such corrections and amendments. The electoral committees shall make the corresponding corrections and amendments to the consolidated list of candidates to all councils. The lists of candidates shall not be amended after the thirteenth day before election day.



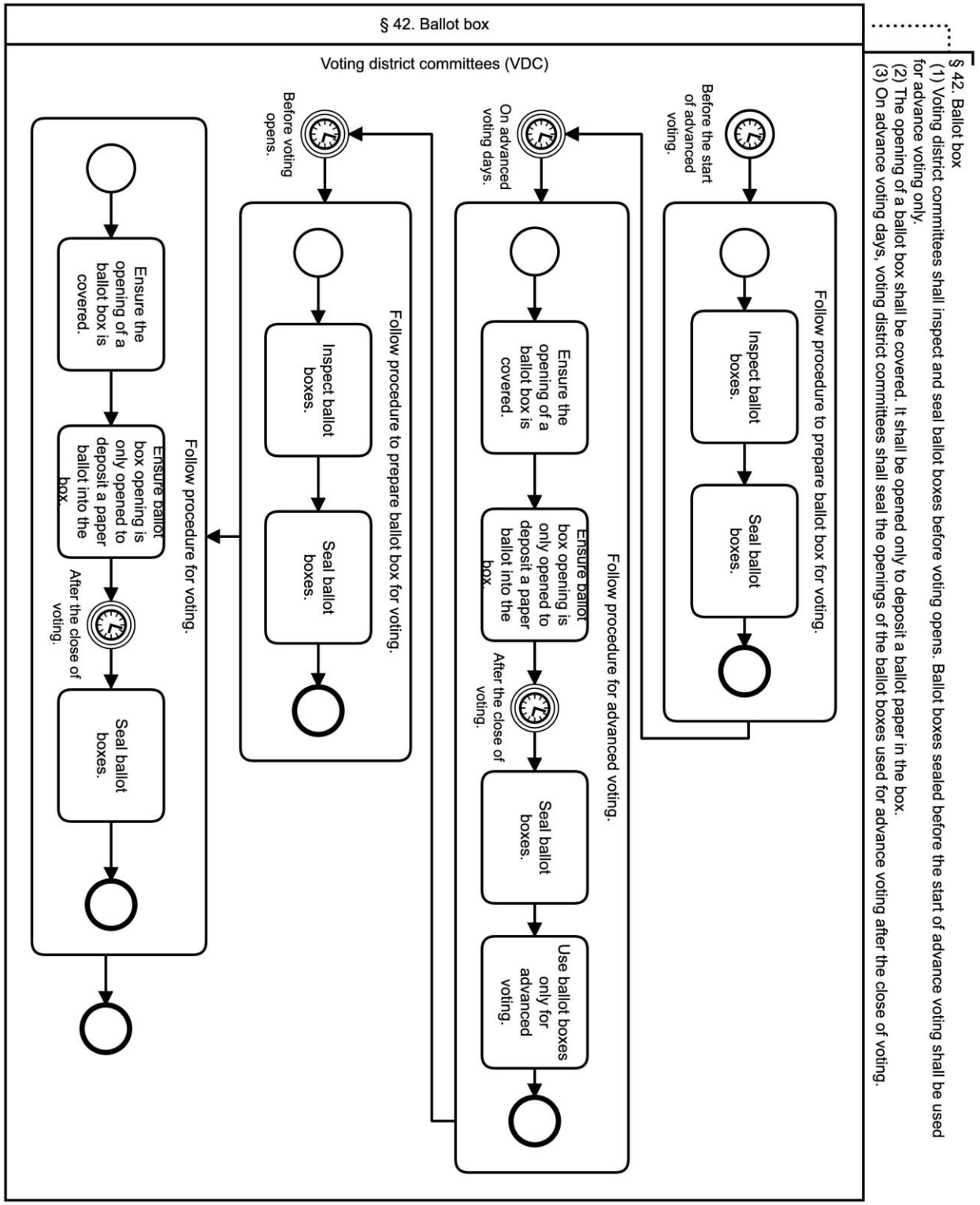
Model 40: § 39. Consolidated List of Candidates in Electoral District and List of All Candidates to All Councils.



Model 41: § 40. Polling Place.



Model 42: § 41. Voting Booth.



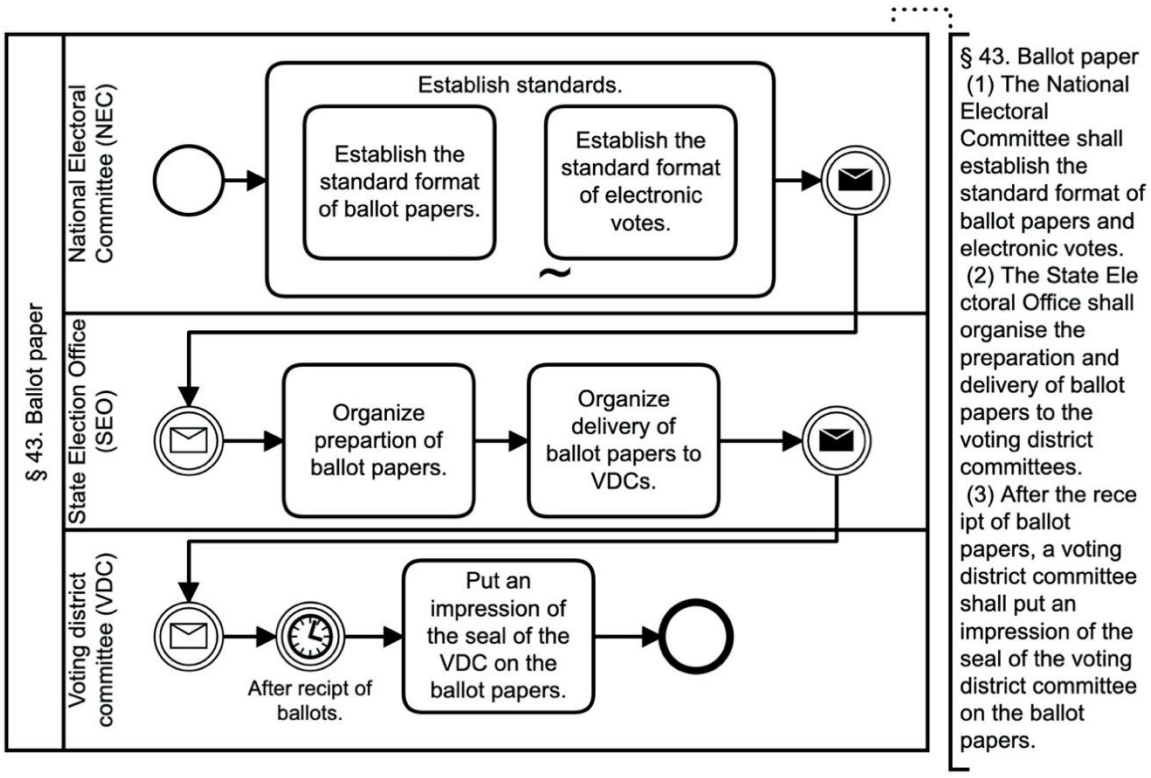
§ 42. Ballot box

(1) Voting district committees shall inspect and seal ballot boxes before voting opens. Ballot boxes sealed before the start of advance voting shall be used for advance voting only.

(2) The opening of a ballot box shall be covered. It shall be opened only to deposit a ballot paper in the box.

(3) On advance voting days, voting district committees shall seal the openings of the ballot boxes used for advance voting after the close of voting.

Model 43: § 42. Ballot Box.



Model 44: § 43. Ballot Paper.

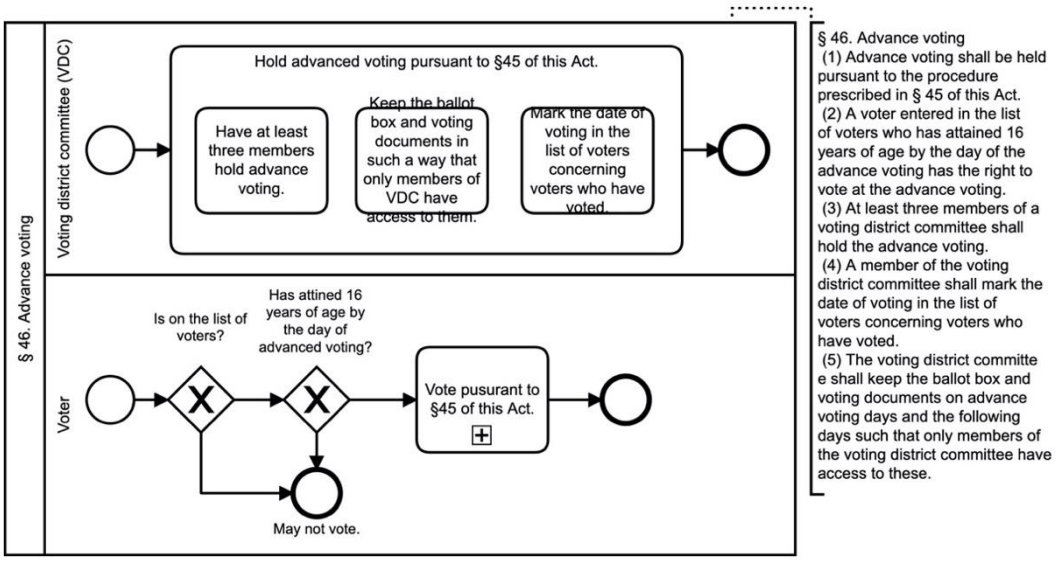
§ 44. Time of voting
(1) Voting on election day shall open at 9 a.m. and close at 8 p.m.
(2) Advance voting shall be held:
1) from the tenth day to the seventh day before election day in a voting district designated by the county head of elections. Voting shall open at 12 a.m. and close at 8 p.m.;
2) from the sixth day to the fourth day before election day, in all voting districts. Voting shall open at 12 a.m. and close at 8 p.m. Voting at the location of a voter, in custodial institutions, hospitals and twenty-four hour social welfare institutions shall be organised between 9 a.m. and 8 p.m.;
3) from the tenth day to the fourth day before election day by electronic means. Voting shall open at 9 a.m. on the tenth day before election day and shall last twenty-four hours a day until the close of voting at 6 p.m. on the fourth day before election day.
(3) Home voting shall be held on election day in the cases prescribed by this Act.

Model 45: § 44. Time of Voting.

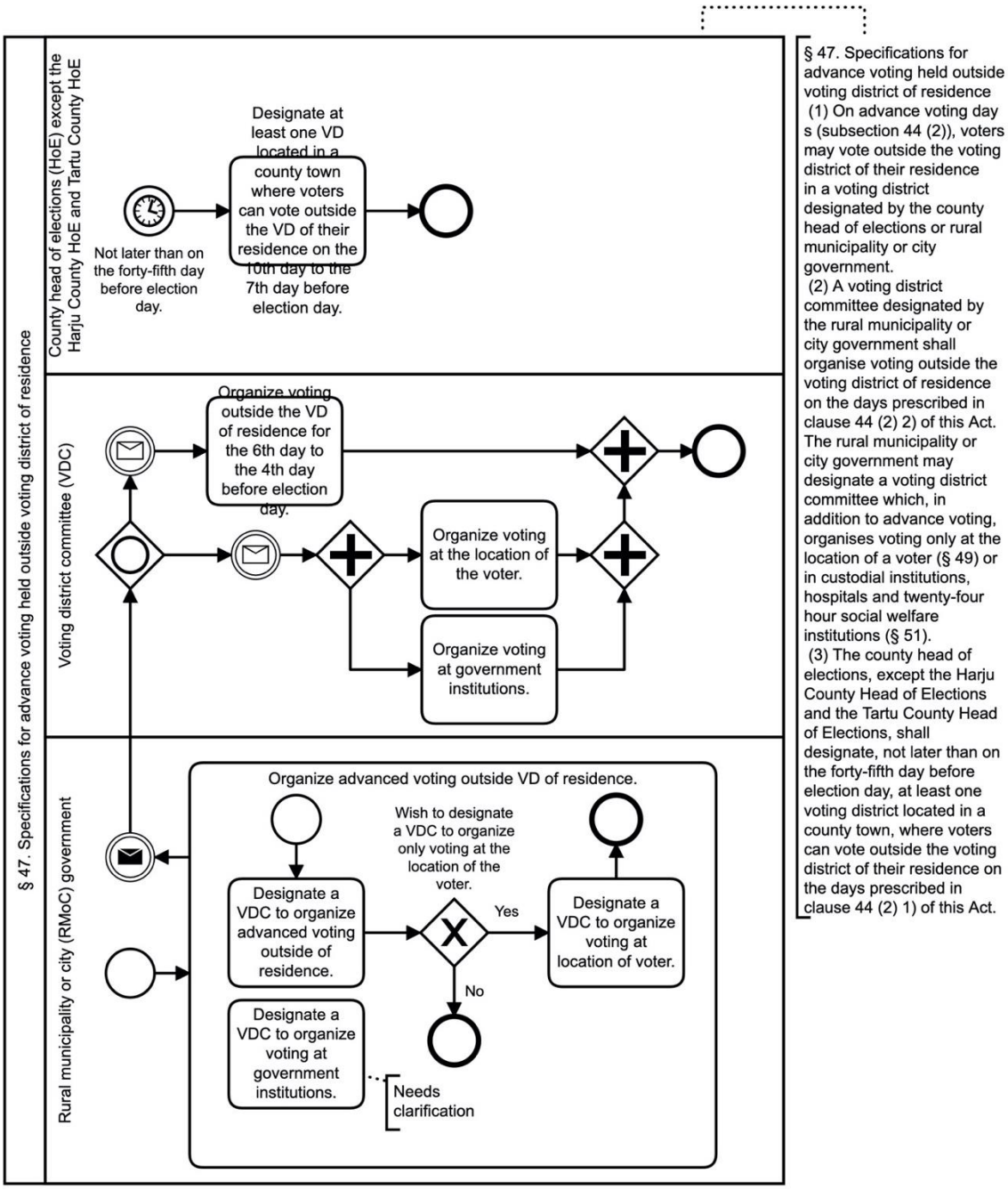
§ 45. Voting

(1) A voter shall vote in the voting district in which he or she is entered in the list of voters, except in the cases prescribed in §§ 47-51 and Chapter 71 of this Act.
(2) In order to receive a ballot paper, a voter shall present an identity document to the voting district committee. The voter shall sign the list of voters against receipt of the ballot paper.
(3) The voter shall complete the ballot paper in a voting booth.
(4) The voter shall write the registration number of the candidate in the electoral district of his or her residence for whom he or she wishes to vote in the designated space on the ballot paper.
(5) The voter shall complete the ballot paper himself or herself. If he or she is unable to complete the ballot paper himself or herself due to a physical disability, another voter, but not a candidate in the election district of his or her residence, may do so at his or her request and in his or her presence.
(6) The voter shall not take the ballot paper out of the polling place. If the voter spoils the ballot paper, he or she has the right to receive another ballot paper from the voting district committee. The voter shall return the spoilt or unused ballot paper to the voting district committee.
(7) After completing the ballot paper, the voter shall fold the ballot paper and hand it to a member of the voting district committee who shall put an impression of the seal of the voting district committee on the outside of the folded ballot paper.
(8) The voter shall deposit the ballot paper in the ballot box himself or herself. If a voter, due to physical disability, is unable to deposit the ballot paper in the ballot box himself or herself, another voter may do so at his or her request in the presence of the voter.

Model 46: § 45. Voting.



Model 47: § 46. Advance Voting.



Model 48: § 47. Specifications for Advance Voting Held Outside of Voting District of Residence.

§ 48. Advance voting held outside voting district of residence in polling place

(1) A voter who wishes to vote in a polling place outside the voting district of his or her residence shall present an identity document to a member of the voting district committee and he or she shall be entered in the list of voters voting outside the voting district of their residence.

(2) The member of the voting district committee shall issue to the voter a ballot paper, two envelopes and the consolidated list of candidates in the electoral district of the residence of the voter. The voter shall sign the list of voters voting outside the voting district of their residence against the receipt of a ballot paper.

(3) The voter shall complete the ballot paper pursuant to the provisions of subsections 45 (3)–(6) of this Act.

(4) The voter shall place the ballot paper in one of the envelopes given by the member of the voting district committee. The voter shall place the envelope in the other envelope given to him or her by the member of the voting district committee. The voter or the member of the voting district committee shall write the name, personal identification code and residential address of the voter on the outer envelope. The voter shall deposit the envelope in the ballot box prescribed for the ballot papers of voters who vote outside the voting district of their residence.

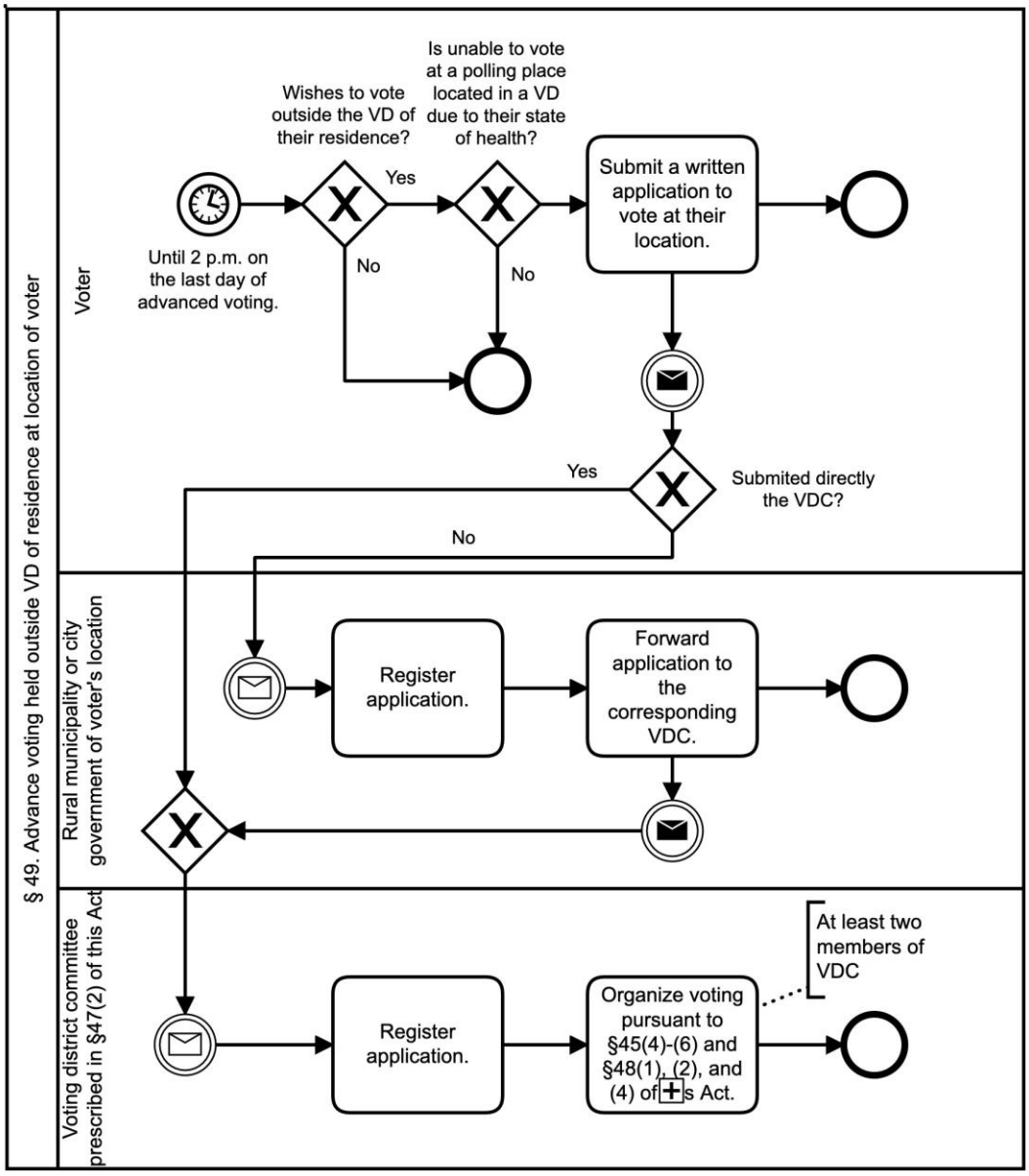
Model 49: § 48. Advance Voting Held Outside Voting District of Residence in Polling Place.

§ 49. Advance voting held outside voting district of residence at location of voter

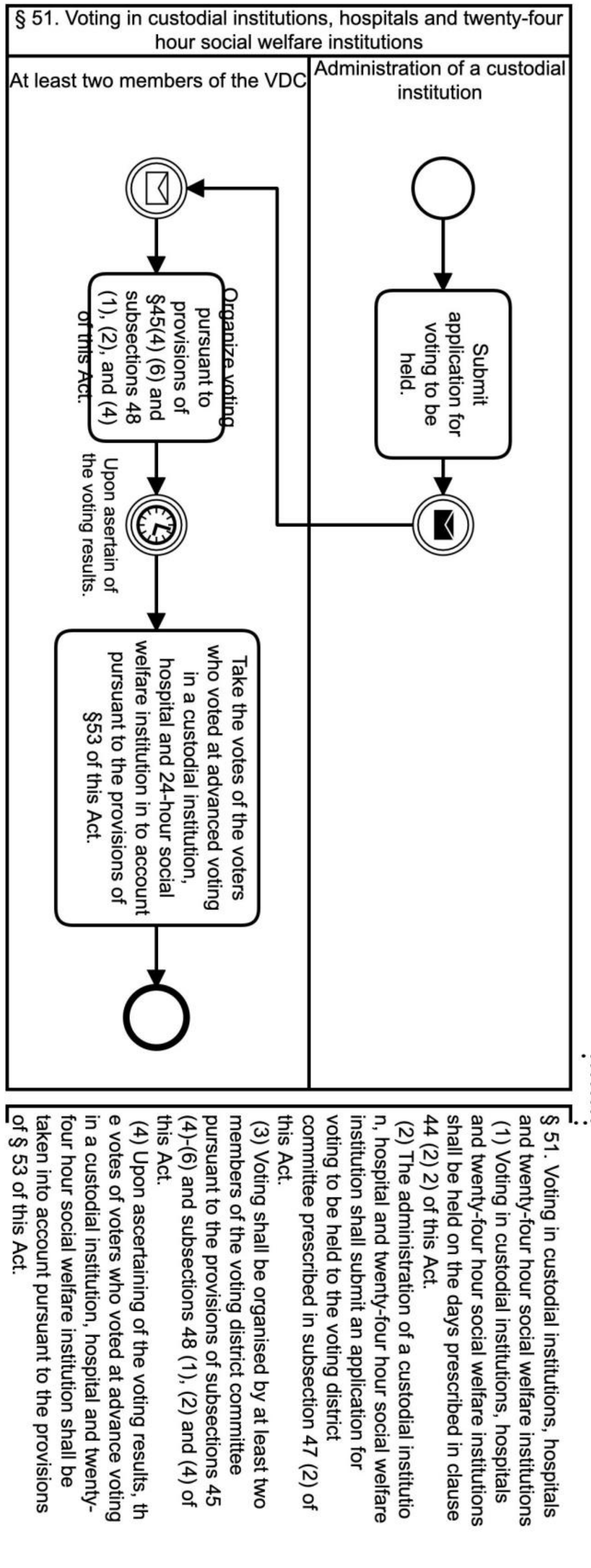
(1) If a voter who wishes to vote outside the voting district of his or her residence is unable to vote at a poll ing place located in a voting district due to his or her state of health or for another good reason, he or she may, until 2 p.m. on the last day of advance voting, submit a written application to vote at his or her location to the rural municipality or city government of his or her location or to a voting district committee prescribed in subsection 47 (2) of this Act. The voting district committee shall register the application. The rural municipality or city government shall register the application and forward it to the corresponding voting district committee.

[RT I, 01.11.2012, 1 - entry into force 11.11.2012]

(2) Voting shall be organised by at least two members of the voting district committee pursuant to the provisions of subsections 45 (4)–(6) and subsections 48 (1), (2) and (4) of this Act.



Model 50: § 49. Advance Voting Held Outside Voting District of Residence at Location of Voter.



Model 51: § 51. Voting in Custodial Institutions, Hospitals, and Twenty-Four-Hour Social Welfare Institutions.

§ 54. Ascertaining of voting results in voting district committee

(1) A voting district committee shall open the ballot boxes after the close of voting. More than one-half of the members of the voting district committee shall be present at the opening.

(2) Before the ballot boxes are opened, the voting district committee shall count and cancel all ballot papers that were not issued to voters and all spoiled ballot papers returned by voters. Ballot papers shall be cancelled by cutting off a corner of the ballot paper.

(3) Before the ballot boxes are opened, the division committee shall use the polling lists to verify the number of voters entered in the lists and count the signatures in the polling lists given in receipt of a ballot paper to verify the number of voters who were given a ballot paper, and shall enter these numbers in a standard format record.

(4) When a ballot box is opened, the condition of the impression of the seal on the box shall be inspected.

(5) An impression of the seal of the voting district committee shall be put on the outside of ballot papers of home voters, and the ballot papers shall be placed among the ballot papers of voters who voted at the polling place.

(6) The impression of the seal of the voting district committee shall be affixed to the outside of ballot papers of voters who voted outside the voting district of their residence, and these ballot papers shall be placed together with the ballot papers of persons who voted at the advance voting among the ballot papers of persons who voted on election day.

(7) On the basis of the ballot papers in the ballot box, the voting district committee shall verify the number of persons who participated in the voting, the number of invalid ballot papers and the number of votes cast for candidates, political parties and election coalitions, and shall enter these numbers in a standard format record.

(8) A ballot paper is deemed to be invalid if:

1) it does not bear two impressions of the seal of the voting district committee,

2) no candidate registration number or more than one candidate registration number has been written on the ballot paper;

3) the candidate whose number is written on the ballot paper is not standing in the electoral district;

4) the candidate registration number written on the ballot paper has been corrected, or

5) the candidate registration number written on the ballot paper is illegible.

(9) If no candidate registration number has been written on a ballot paper but the will of the voter is clear and unambiguous, the ballot paper is deemed to be valid.

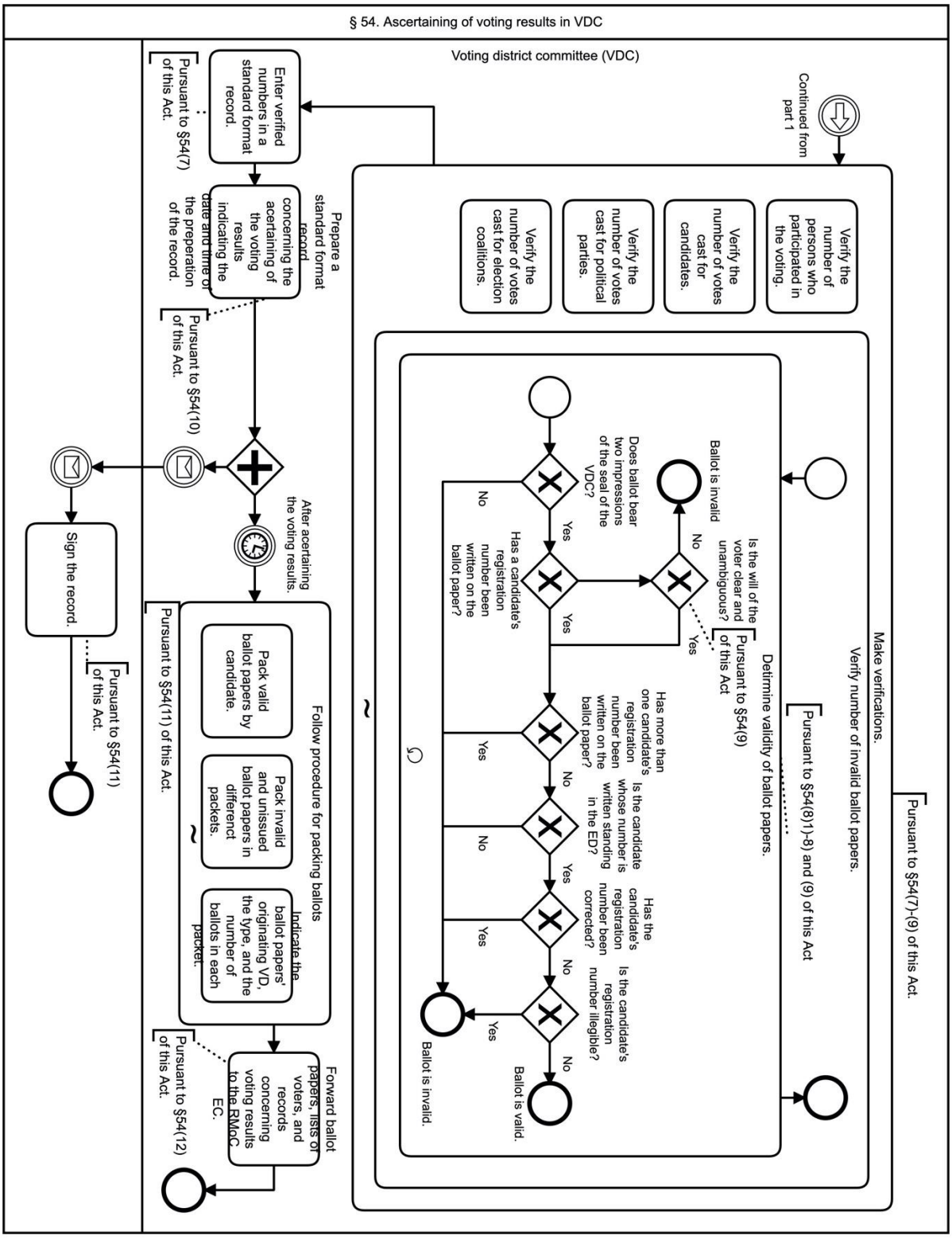
(10) A standard format record shall be prepared concerning the ascertaining of the voting results. The chairman of the committee shall sign the record. The date and time of preparation of the record shall be indicated in the record.

(11) After ascertaining of the voting results, valid ballot papers shall be packed by candidate and invalid ballot papers, ballot papers which were not issued to voters and spoiled ballot papers returned by voters shall be packaged in separate packets. The voting district from which the ballot papers originate and the type and number of ballot papers in the packet shall be noted on each packet. The chairman of the voting district committee shall sign the notation.

(12) Ballot papers, lists of voters and records concerning voting results shall be promptly forwarded to the a rural municipality or city electoral committee.

(13) Voting results shall be ascertained publicly in a voting district committee.

Model 52: § 54. Ascertaining of Voting Results and Election Results (Part 1).



Model 53: § 54. Ascertaining of Voting Results and Election Results (Part 2).

§ 54-2. Counting of votes cast using electronic means

(1) The State Electoral Office shall ascertain the results of electronic voting after 7 p.m. on election day.

(2) At least three persons designated by the Head of the State Electoral Office and at least one-half of the members of the National Electoral Committee shall be present at the counting of votes.

(3) Prior to the counting of electronic votes, the State Electoral Office:

1) shall annul the electronic votes, which have been changed by the ballot papers when voting;

2) shall separate the electronic votes subject to counting from the personal data of the voters.

(4) To count the electronic votes, the members of the National Electoral Committee and the State Electoral Office shall use the means of access provided for in subsection 483 (3) of the Riigikogu Election Act, which ensure access to the vote-opening key.

(5) The State Electoral Office shall verify the following for each voting district:

1) the number of voters who participated in electronic voting;

2) the number of invalid electronic votes;

3) the number of electronic votes annulled on the basis of clause (3) 1) of this section;

4) the number of electronic votes cast for candidates, political parties and election coalitions.

(6) An electronic vote which does not contain the registration number of the candidate in the electoral district of the residence of the voter or which is not in conformity with the standard format established by the National Electoral Committee shall be null and void.

(7) Counting of votes cast using electronic means shall be public. Persons who are present at the counting of votes shall follow the oral orders of the persons designated by the Head of the State Electoral Office.

Persons who are present at the counting of votes shall not bring any means of communication into the room where the votes are counted or leave the room before 8 p.m.

(8) The voting results shall not be disclosed before 8 p.m.

(9) The State Electoral Office shall enter the voting results in the election information system immediately.

(10) The Head of the State Electoral Office shall sign the results of electronic voting after the verification of the integrity of the data of the electronic voting system.

Model 54: § 54^2 Counting of Votes Case Using Electronic Means.

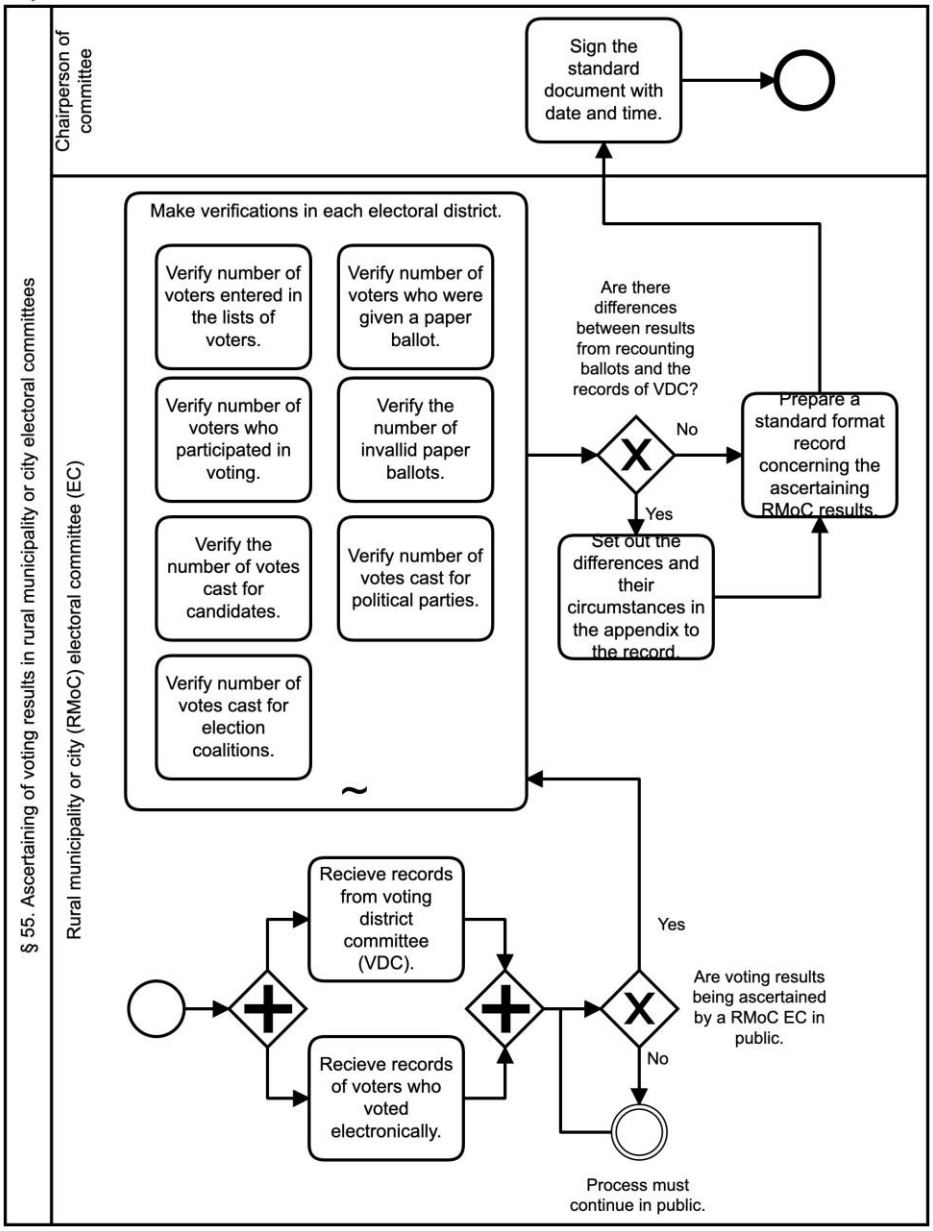
§ 55. Ascertaining of voting results in rural municipality or city electoral committees

(1) On the basis of the records received from the voting district committees and the voting results of voters who voted electronically, the rural municipality or city electoral committee shall verify the number of voters entered in the lists of voters, the number of voters who were given a ballot paper, the number of voters who participated in voting, the number of invalid ballot papers and the number of votes cast for candidates, political parties and election coalitions in each electoral district. The result obtained shall be checked by recounting the ballot papers.

(2) If the numbers obtained by recounting the ballot papers are different from the numbers in the records of a voting district committee, the rural municipality or city electoral committee shall set out the differences and the circumstances which caused such differences in the appendix to the record. Records of the voting district committee shall not be amended. The rural municipality or city electoral committee shall adopt a decision concerning the final voting results.

(3) A rural municipality or city electoral committee shall prepare a standard format record concerning the ascertaining of the voting results in the rural municipality or city which shall be signed by the chairman of the committee. The date and time of preparation of the record shall be indicated therein.

(5) Voting results shall be ascertained in a rural municipality or city electoral committee in public.



Model 55: § 55. Ascertaining of Voting Results in Rural Municipality or City Electoral Committees.

§ 56. Ascertaining of election results

(1) A simple quota shall be calculated for each electoral district, which shall be obtained by dividing the number of valid votes cast in the electoral district by the number of mandates in the district.

(2) A candidate in favour of whom the number of votes cast exceeds or equals the simple quota is elected.

(3) Mandates which are not distributed in the electoral district on the basis of a simple quota shall be distributed as list mandates between the political parties and election coalitions whose candidates collectively receive at least 5 per cent of the votes in the correspondi
ng rural municipality or city.

(4) In order to distribute list mandates, the candidates shall be ranked in the lists of candidates in electoral districts according to the number of votes cast for each candidate. If at least two candidates receive an equal number of votes, the candidate who is further toward
s the bottom of the list shall be ranked ahead. The votes cast for candidates standing in the list of candidates of the same political party or election coalition in an electoral district shall be totalled.

(5) The list mandates shall be distributed using the d'Hondt distribution method with the distribution series of 1, 2, 3, 4, etc. In calculating the comparative figure for each political party or election coalition, as many first elements of the series shall be omitted as the num
ber of mandates obtained by the political party or election coalition in the corresponding electoral district on the basis of the simple quota. If the comparative figures of at least two political parties or election coalitions are equal, the mandate shall be received by the
political party or election coalition whose candidates were positioned further toward the bottom in the consolidated list of candidates.

(6) The candidate who is further towards the top of the list shall be given the list mandate in a list of candidates in an electoral district where the candidates are re-ranked (subsection (4)). Upon the distribution of mandates, the candidates who were elected on the basis
of a simple quota shall be omitted.

(7) No political party or election coalition shall be given more mandates than there are candidates in the list of candidates in an electoral district.

(8) If a candidate of a political party or election coalition dies after the start of advance voting, the votes cast for him or her shall be retained by that political party or election coalition. If an independent candidate dies after the start of advance voting, the votes cast for h
im or her shall not be taken into account in the ascertaining of the election results.

(9) If only independent candidates are in the consolidated list of candidates in an electoral district, the candidates who receive the greatest number of votes shall be elected. If at least two candidates receive an equal number of votes, the candidate who was positioned f
urther toward the bottom in the consolidated list of candidates in an electoral district shall be elected.

(10) If, after the distribution of mandates on the basis of a simple quota and as list mandates, some of the mandates have not been distributed, the candidates who receive the greatest number of votes from among the remaining candidates shall be elected.

(11) A rural municipality or city electoral committee shall prepare a record concerning the election results which shall be signed by the chairman of the committee. The date and time of preparation of the record shall be indicated therein.

(12) Election results shall be ascertained in a rural municipality or city electoral committee in public.

Model 56: § 56. Ascertaining of Election Results.

§ 56[1]. Ascertaining of election results in Tallinn

(1) A simple quota shall be calculated for each electoral district, which shall be obtained by dividing the number of valid votes cast in the electoral district by the number of mandates in the district.

(2) A candidate in favour of whom the number of votes cast exceeds or equals the simple quota is elected.

(3) In the lists of candidates of those political parties or election coalitions in an electoral district whose candidates receive at least 5 per cent of the votes in a rural municipality or city, the candidates shall be ranked according to the number of votes cast for each candidate. The votes cast for candidates standing in the list of candidates of the same political party or election coalition in an electoral district shall be totalled. A political party or an election coalition shall be given as many mandates as the number of times by which the number of votes it receives in the electoral district exceeds the simple quota. Mandates obtained pursuant to subsection (2) of this section are also deemed to be mandates of a political party or election coalition. The candidates who are further towards the top of the list shall be elected. If at least two candidates receive an equal number of votes, the candidate who is positioned further towards the top of the city list of candidates shall be elected.

(4) Mandates which are not distributed in electoral districts on the basis of a simple quota shall be distributed as compensation mandates between the political parties or election coalitions whose candidates collectively receive at least 5 per cent of the votes in the rural municipality or city.

(5) Compensation mandates shall be distributed using the d'Hondt distribution method with the distribution series of 1, 2, 3, 4 etc. In calculating the comparative figure for each political party or election coalition, as many first elements of the series shall be omitted as the number of mandates obtained by the political party or election coalition in the electoral districts. If the comparative figures of at least two political parties or election coalitions are equal, the mandate shall be received by the political party or election coalition whose candidates were positioned further toward the bottom in the consolidated list of candidates in an electoral district.

(6) In the city list of candidates, the candidate who is further towards the top of the list shall be given a compensation mandate. Upon the distribution of mandates, the candidates who were elected in electoral districts shall be omitted.

(7) In the event of an equal number of votes, the candidate who is further towards the top of the submitted list shall be given a compensation mandate.

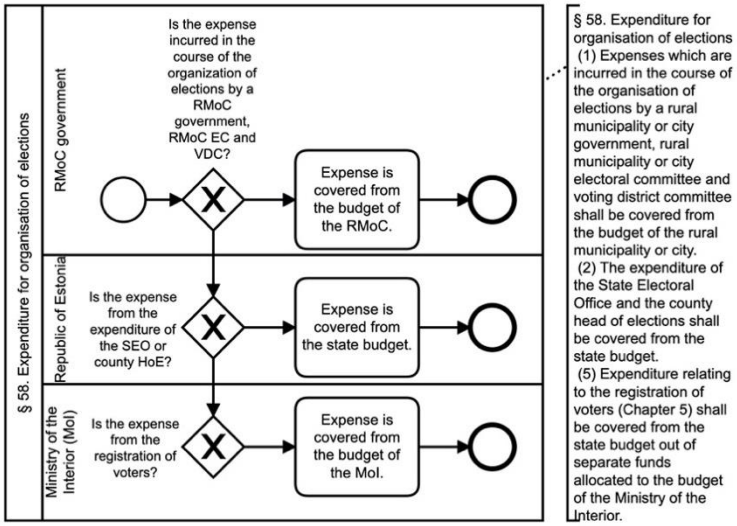
(8) No political party or election coalition shall be given more mandates than there are candidates in its list of candidates.

(9) If a candidate of a political party or election coalition dies after the start of advance voting, the votes cast for him or her shall be retained by that political party or election coalition. If the registration decision of an independent candidate is annulled or an independent candidate dies, votes cast in favour of the candidate shall not be taken into account in the ascertaining of election results.

(10) A rural municipality or city electoral committee shall prepare a record concerning the election results which shall be signed by the chairman of the committee. The date and time of preparation of the record shall be indicated therein.

(11) Election results shall be ascertained in a rural municipality or city electoral committee in public.

Model 57: § 56[1]. Ascertaining of Election Results in Tallinn.



Model 58: § 58. Expenditure for Organization of Elections.

§ 62. Notice concerning deficiency in electoral management

(1) A person who finds that the elections manager has infringed his or her rights or otherwise violated the law, may submit a notice concerning a deficiency in electoral management (hereinafter notice concerning deficiency).

(2) A notice concerning deficiency shall be submitted immediately, but not later than on the third day as of the violation specified in subsection (1) of this section.

(3) A notice concerning deficiency shall be submitted to the State Electoral Office, which shall organise the review of the notice and responding thereto.

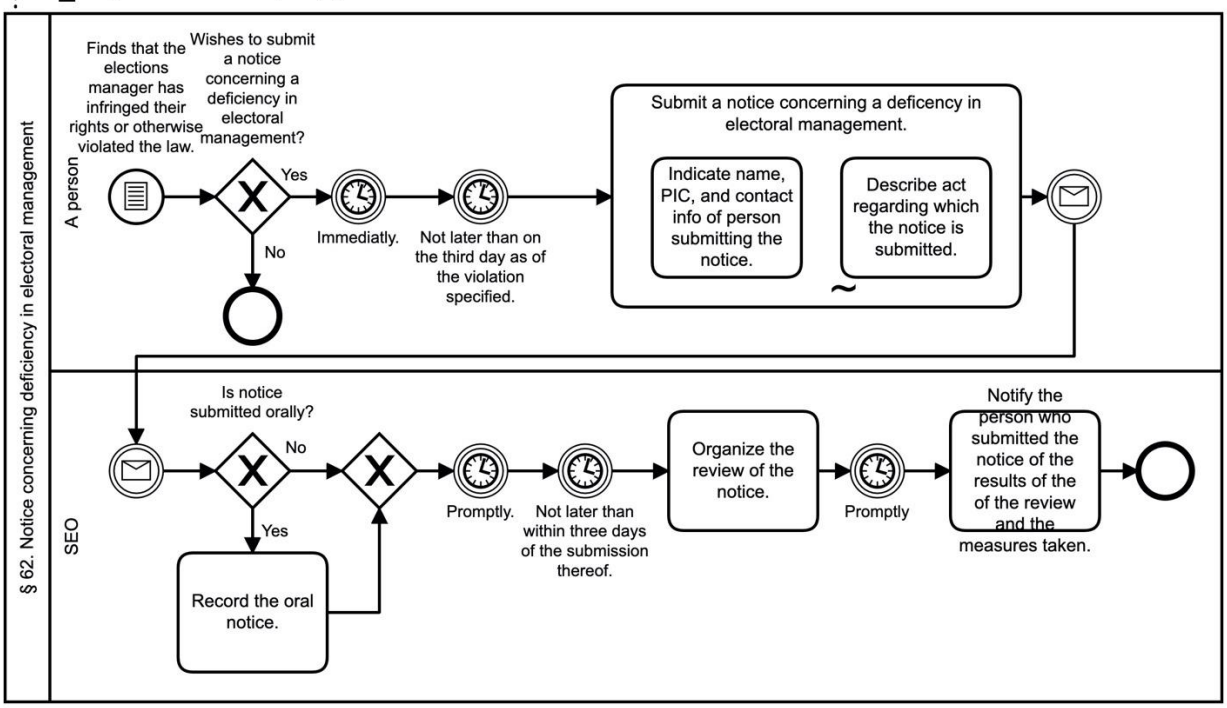
(4) A notice concerning deficiency shall:

1) indicate the name, personal identification code and data on the telecommunications of the person submitting the notice;

2) describe the act regarding which the notice is submitted.

(5) A notice concerning deficiency shall be submitted orally or in writing. An oral notice shall be recorded by the State Electoral Office.

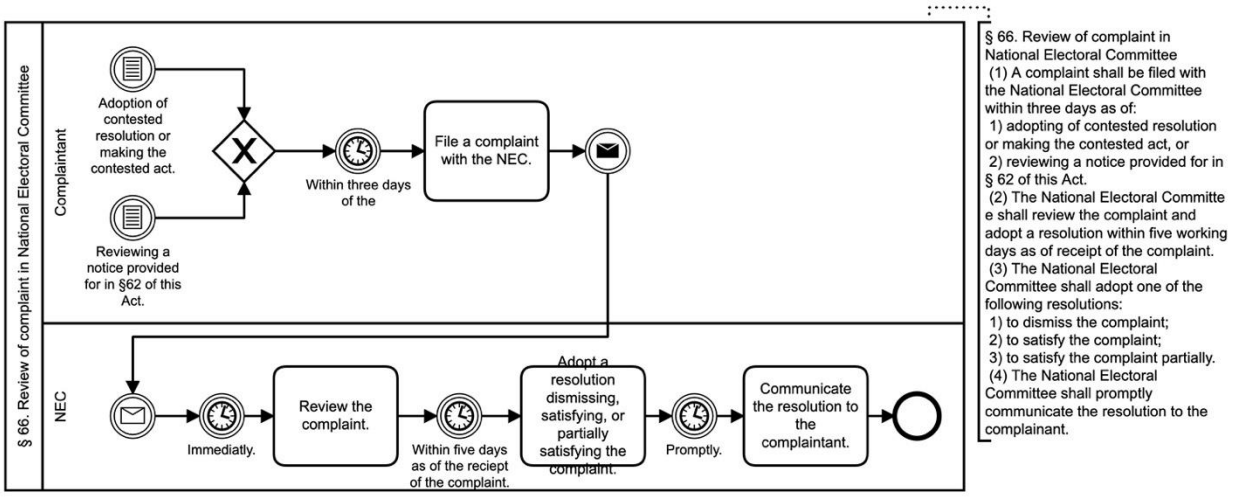
(6) A notice concerning deficiency shall be reviewed promptly, but not later than within three days as of the submission thereof. The person submitting the notice shall be promptly notified of the results of the review and the measures taken.



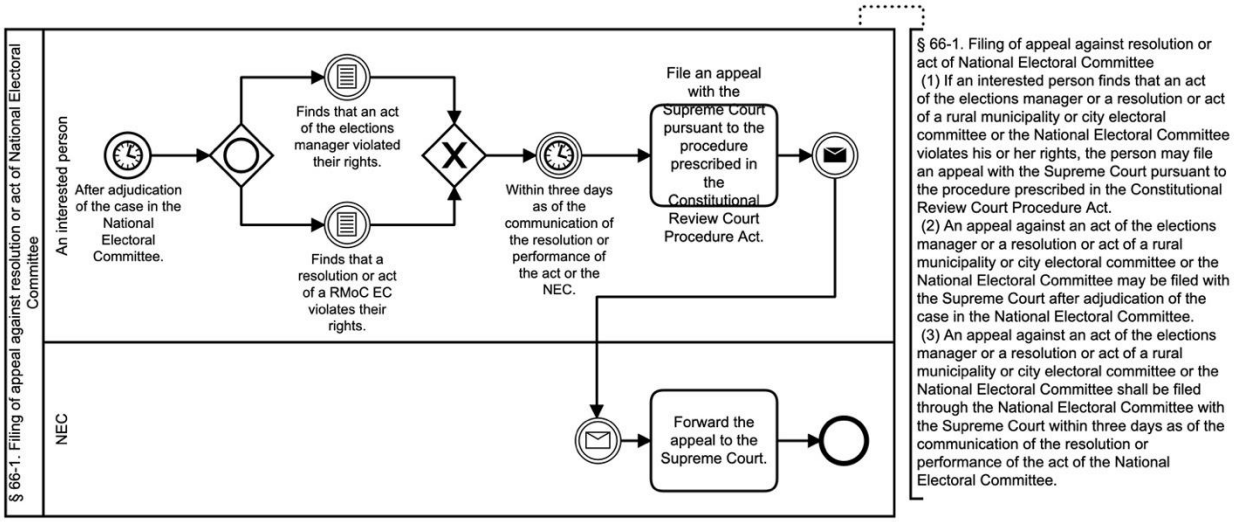
Model 59: § 62. Notice Concerning Deficiency in Electoral Management.

§ 65. Requirements for complaint
(1) A complaint shall be prepared in writing and shall set out the following:
1) the name, personal identification code or in the absence thereof date of birth, or registry code, address and data on the telecommunications of the complainant;
2) the name, address and data on the telecommunications of the representative of the complainant if the complainant has a representative;
3) information concerning the contested resolution or the description of the contested act;
4) the reasons why the complainant finds that the contested resolution or act violates the rights of the person;
5) the reasons why the complainant finds that the contested resolution or act is not lawful;
6) how and when the complainant became aware of the contested resolution or act;
7) a request for restoration of the term for filing a complaint and the reasons why the term was allowed to expire, if the complaint is filed after the expiry of the term for filing the complaint;
8) the date of submission of a complaint.
(2) A complaint shall be signed by the complainant. A complaint filed by a political party or election coalition shall be signed by an authorised representative of the political party or election coalition.
(3) If a complaint does not meet the requirements prescribed in subsections (1) and (2) of this section or if a complaint has been submitted in violation of the procedure prescribed in § 64 and subsection 66 (1) of this Act, the National Electoral Committee may dismiss the complaint. In case of dismissal of the complaint, the National Electoral Committee may forward the complaint to the State Electoral Office for responding pursuant to the procedure provided for in subsection 62 (6) of this Act. If the complainant has allowed the time limit for submitting the complaint to expire with good reason, the National Electoral Committee shall restore the time limit on the basis of his or her reasoned request.

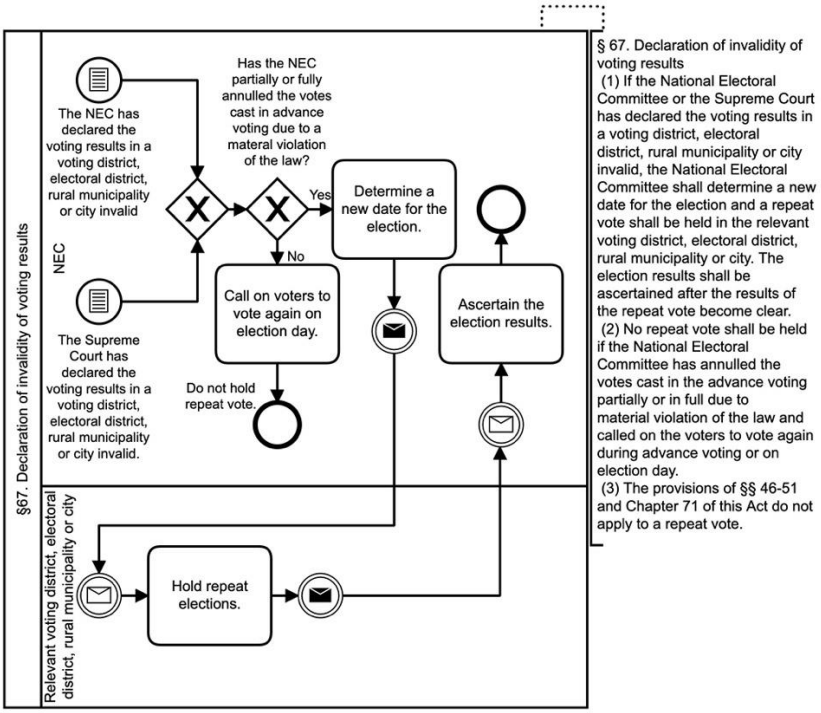
Model 60: § 65. Requirements for Complaint.



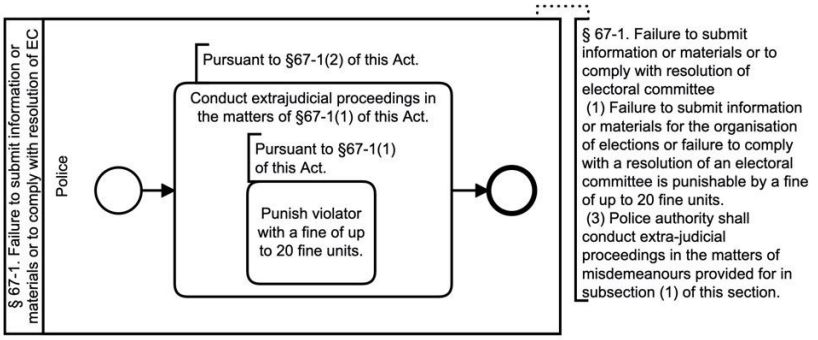
Model 61: § 66. Review of Complaint in National Electoral Committee.



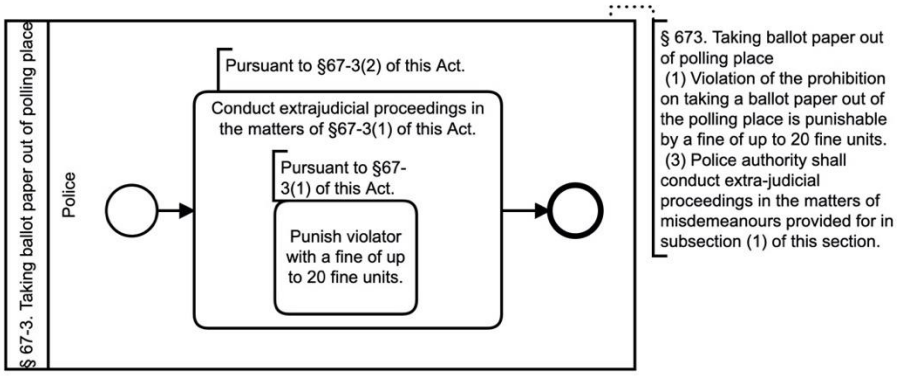
Model 62: § 66^1. Filing of Appeal Against Resolution or Act of National Electoral Committee



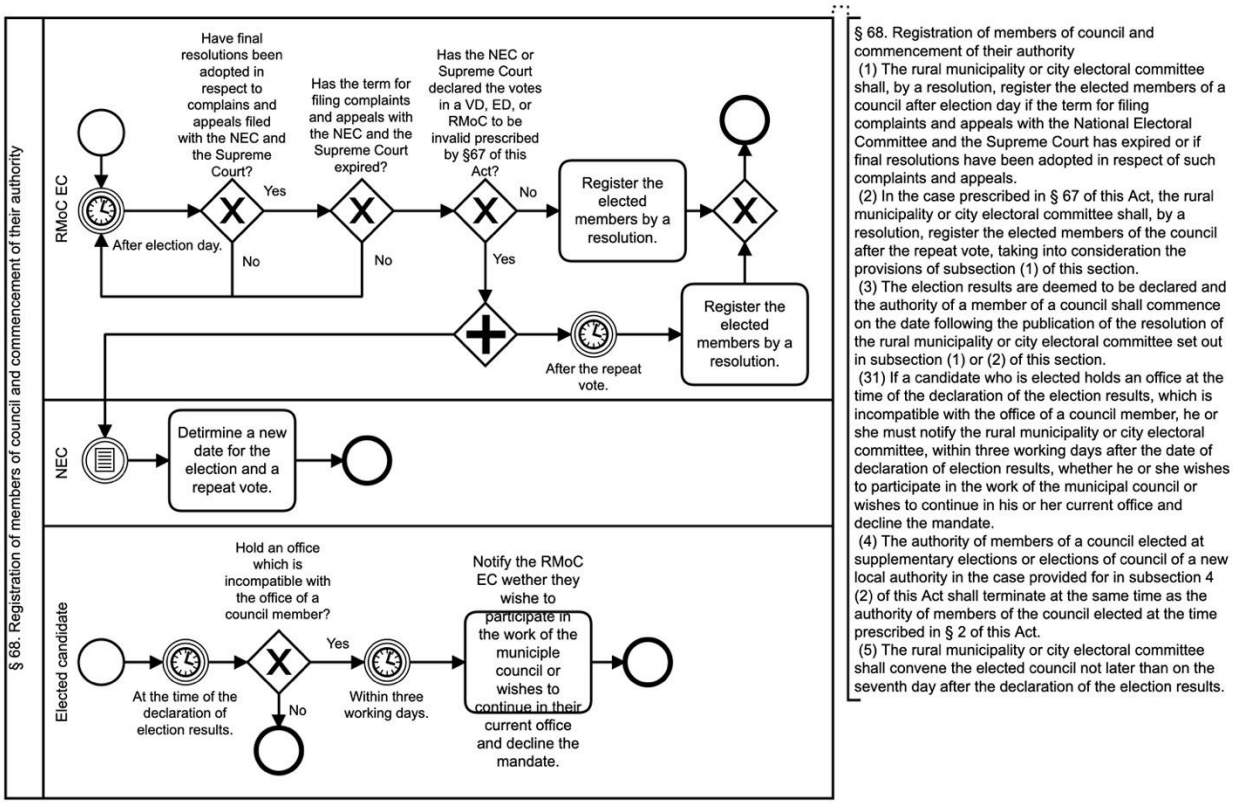
Model 63: § 67. Declaration of Invalidity of Voting Results.



Model 64: §67[1]. Failure to Submit Information or Materials to Comply with Resolution of Electoral Committee.

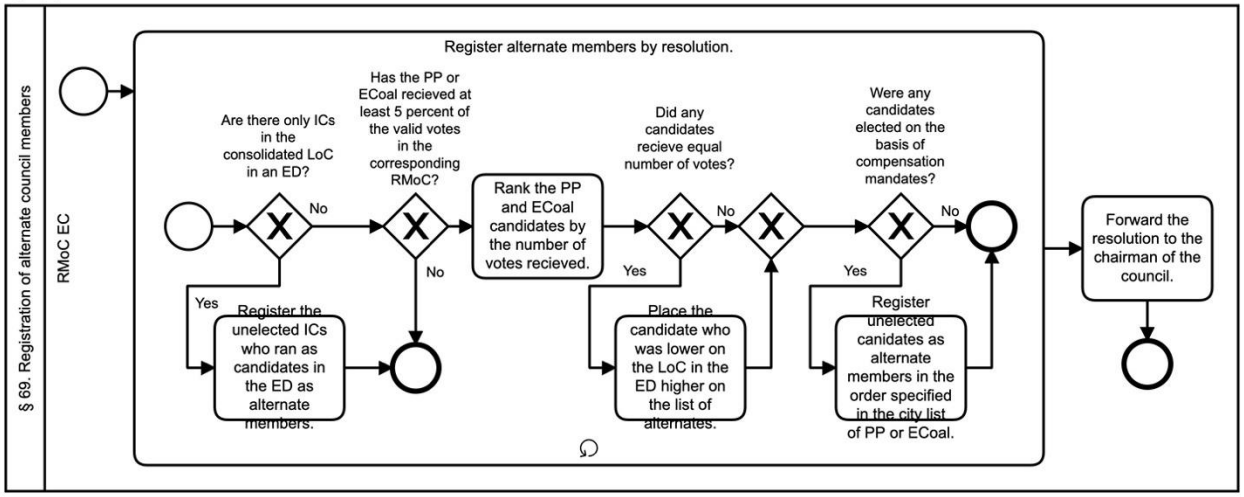


Model 65: § 67[3]. Taking Ballot Paper out of Polling Place.



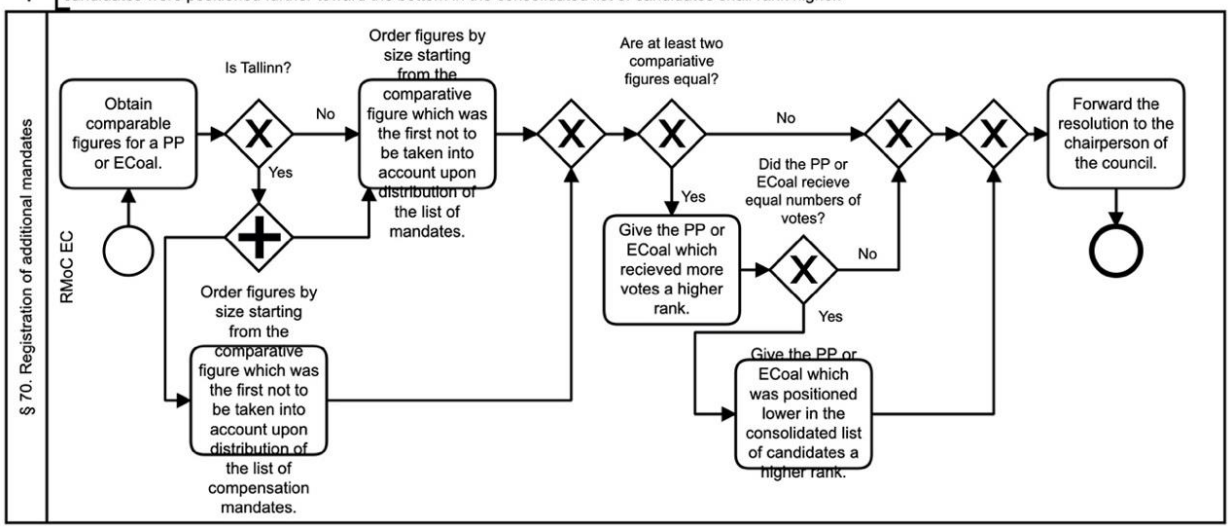
Model 66: § 68. Registration of Members of Council and Commencement of Their Authority.

§ 69. Registration of alternate council members
(1) The rural municipality or city electoral committee shall register the alternate members of a council by a resolution. The rural municipality or city electoral committee shall forward the resolution to the chairman of the council.
(2) The alternate members shall be registered by electoral district to the political parties and election coalitions whose candidates have collectively received at least 5 per cent of the valid votes in the corresponding rural municipality or city. If only independent candidates are in the consolidated list of candidates in an electoral district, the unelected independent candidates who ran as candidates in the electoral district shall be registered as alternate members.
(3) Candidates shall be registered, by each electoral district, to political parties and election coalitions as alternate members for candidates who were elected in electoral districts and shall be ranked according to the number of votes received. If candidates receive an equal number of votes from voters, the candidate who was positioned further towards the bottom of the list of candidates in the electoral district of a political party or election coalition shall be positioned ahead.
(4) Unelected candidates shall be registered as alternate members for candidates who were elected on the basis of compensation mandates in the order specified in the city list of the political party or election coalition.

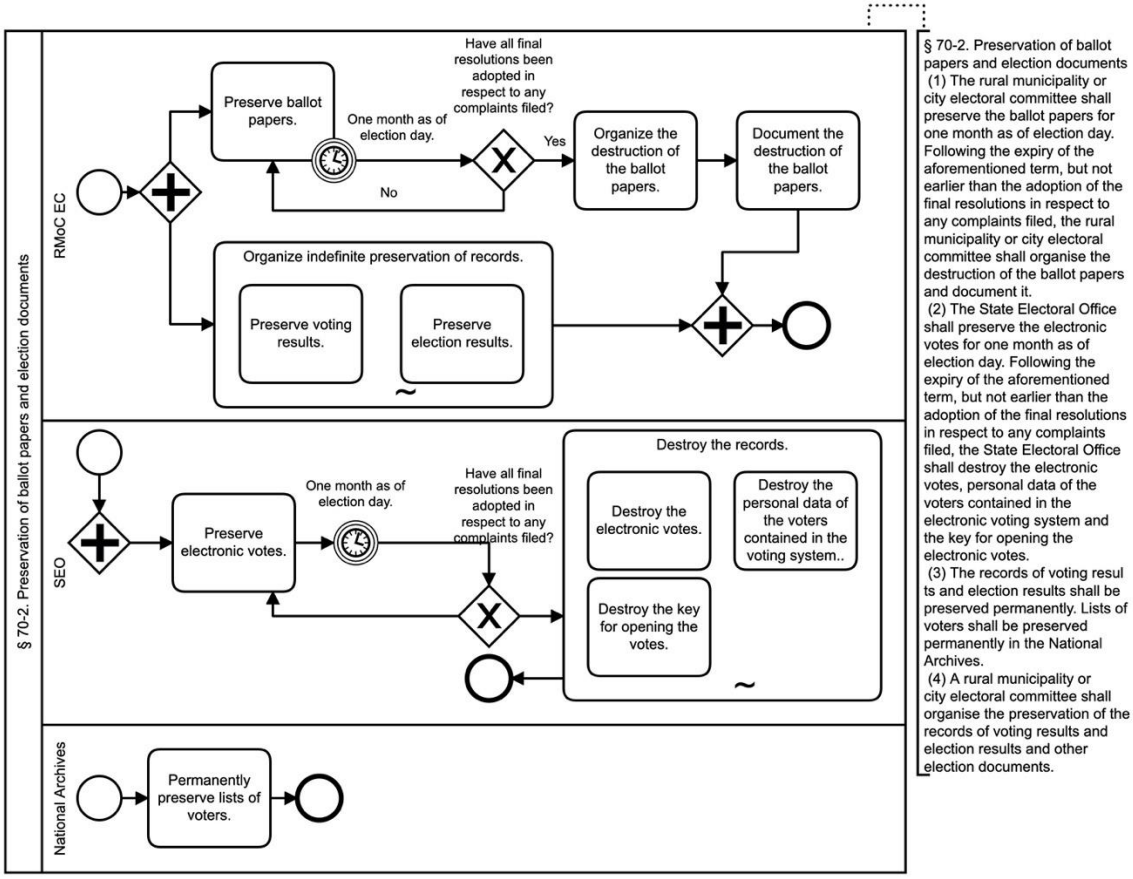


Model 67: § 69. Registration of Alternate Council Members.

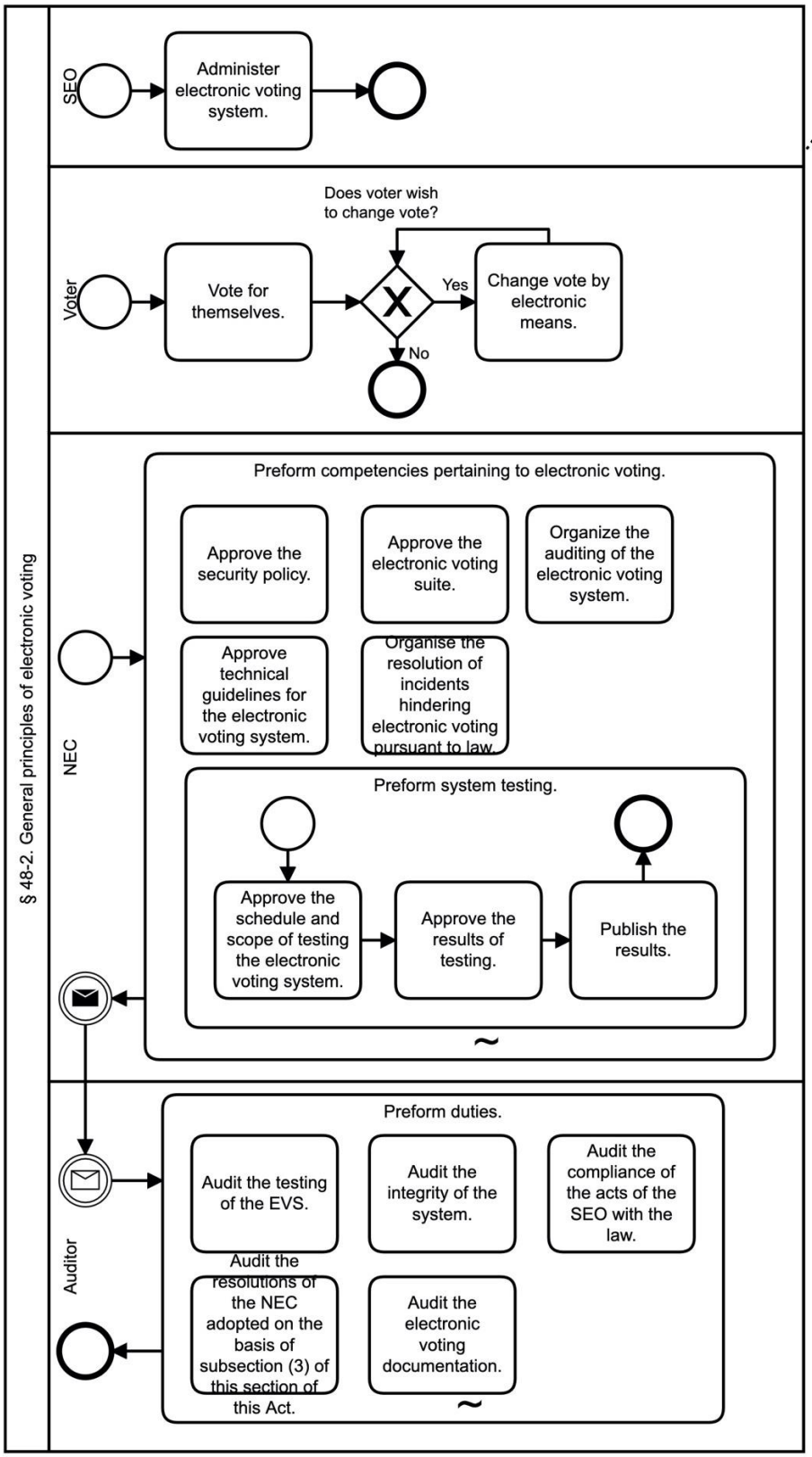
§ 70. Registration of additional mandates
(1) The table of comparative figures of political parties and election coalitions which is approved by a resolution of the relevant rural municipality or city electoral committee shall be the basis for the distribution of additional mandates. The rural municipality or city electoral committee shall forward the resolution to the chairman of the council.
(2) The table of comparative figures shall set out the comparative figures obtained for a political party or election coalition in size order, starting from the comparative figure which was the first not to be taken into account upon distribution of the list mandates (subsection 56 (5)) or upon distribution of compensation mandates in Tallinn (subsection 561 (5)).
(3) If at least two comparative figures are equal, the comparative figure of the political party or election coalition which received more votes from voters shall receive a higher ranking. If the number of votes cast to political parties or election coalitions is equal, the political party or election coalition whose candidates were positioned further toward the bottom in the consolidated list of candidates shall rank higher.



Model 68. § 70. Registration of Additional Mandates.



Model 69: § 70^2. Preservation of Ballot Papers and Election Documents.



§ 482. General principles of electronic voting

(1) The electronic voting system administered by the State Electoral Office shall be used in electronic voting.

(2) A voter shall vote himself or herself. Under the conditions prescribed in this Act, a voter may change his or her vote cast by electronic means.

(3) The National Electoral Committee shall establish by a resolution:

1) the technical requirements for ensuring the general principles of the organisation of electronic voting;

2) the description of the organisation of electronic voting.

(4) The State Electoral Office shall:

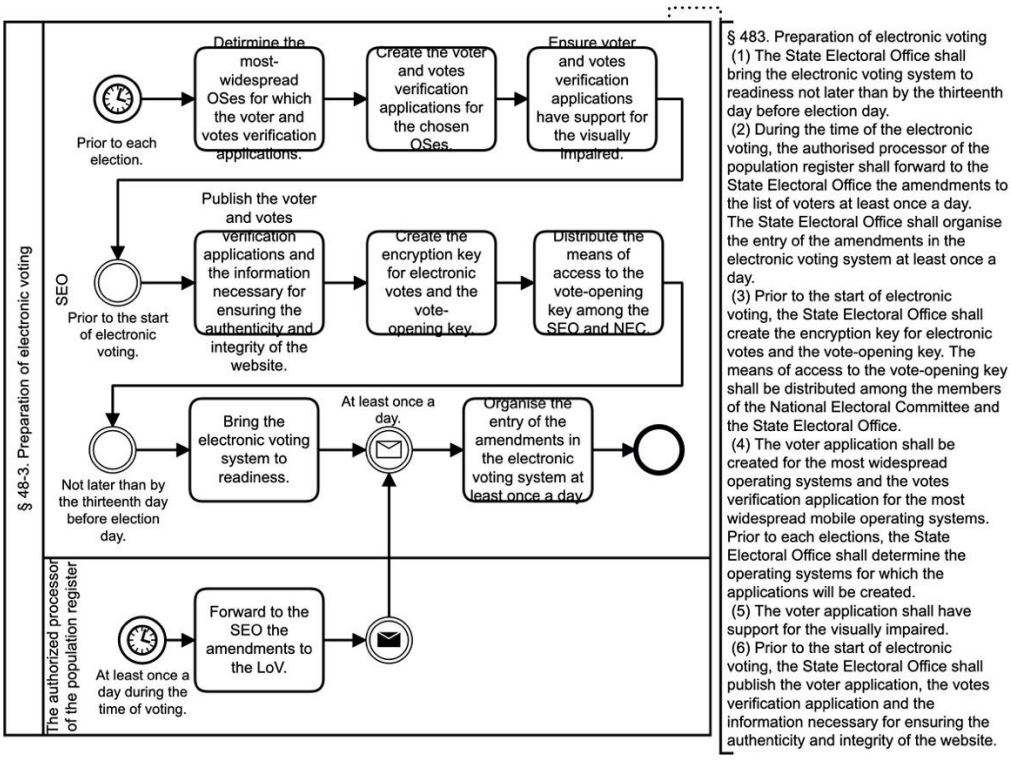
1) approve the information security policy of the the electronic voting system, the electronic voting protocol suite and the technical guidelines for the electronic voting system;

2) organise the resolution of incidents hindering electronic voting pursuant to law;

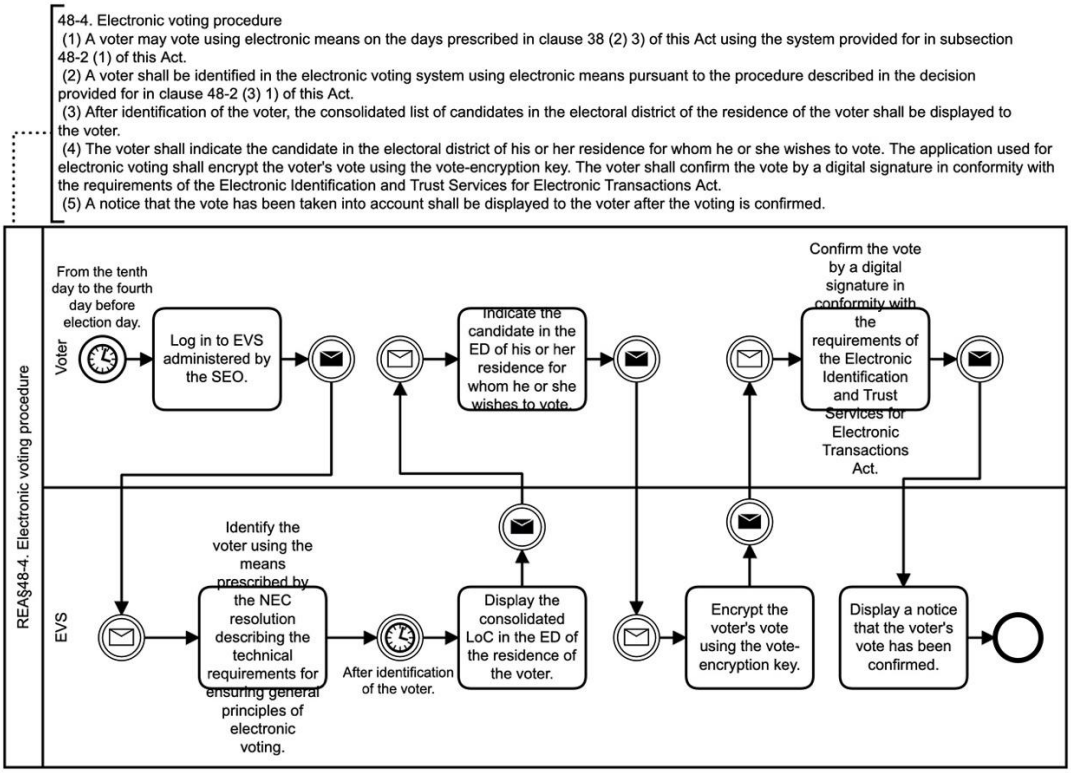
3) approve the schedule and scope of testing the electronic voting system and the results of the testing and publish a report on the results;

4) organise the auditing of the electronic voting system in the course of which an information systems auditor shall audit the testing of the electronic voting system, the integrity of the system and the compliance of the acts of the State Electoral Office with the law, the resolutions of the National Electoral Committee adopted on the basis of subsection (3) of this section and the electronic voting documentation.

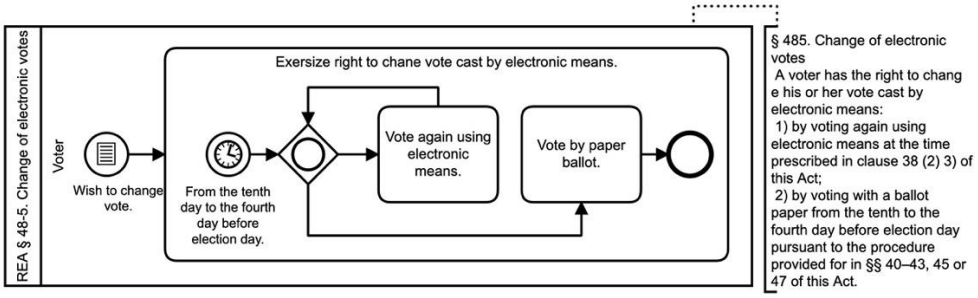
Model 70: Riigikogu Election Act § 48^2. General Principles of Electronic Voting.



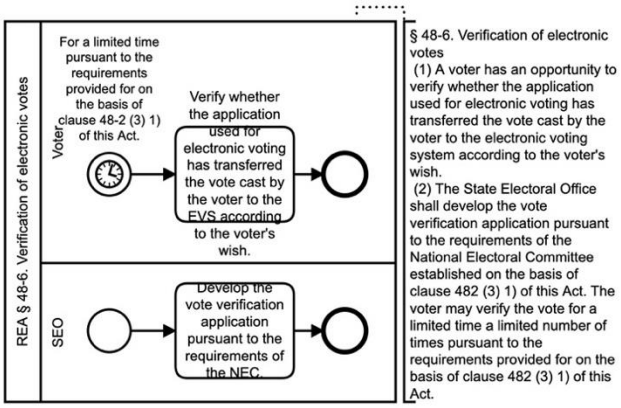
Model 71: Riigikogu Election Act § 48^3. Preparation of Electronic Voting.



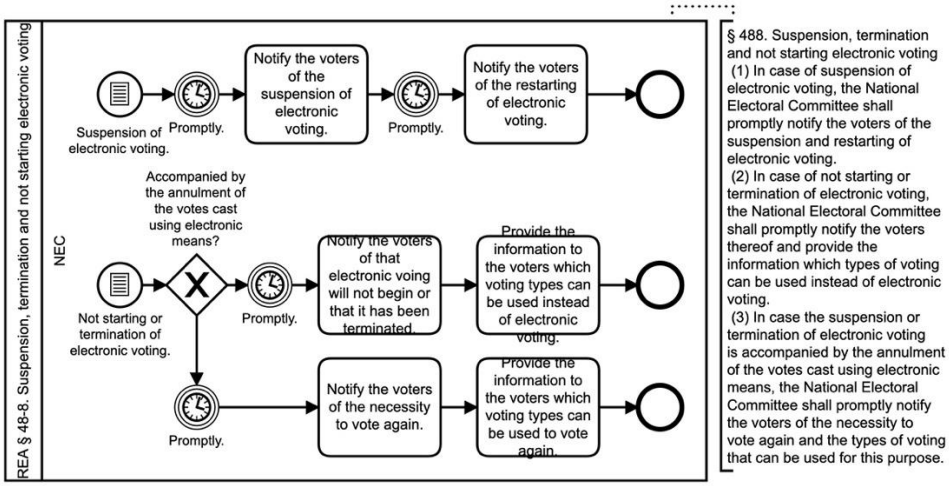
Model 72: Riigikogu Election Act § 48[4]. Electronic Voting Procedure.



Model 73: Riigikogu Election Act § 48[5]. Change of Electronic Votes.



Model 74: Riigikogu Election Act § 48^6. Certification of Electronic Votes.



Model 75: Riigikogu Election Act § 48^8. Suspension, Termination and Not Starting Electronic Voting.

Scanning the following QR code will give access the files used for the modeling found in this thesis at the URL:

https://www.dropbox.com/sh/f4ctvmt4ysmy9jy/AAD5uVrC2O57lD_An3T4a1mYa/Estonian%20Municipal%20Council%20Election%20Act%20(2017)?dl=0&subfolder_nav_tracking=1

Figure 14: QR Code for Easy Access to the Process Model Files Found in this Thesis.

Appendix 2 – Non-Exclusive Licence for Reproduction and Publication of a Graduation Thesis[16]

I, Roy Breckenridge Shuyler,

1. Grant Tallinn University of Technology free licence (non-exclusive licence) for my thesis "Aiding Election Observation Using BPMN: A Case Study of the 2017 Estonian Municipal Council Elections", supervised by Prof. Dr. Dr. Robert Krimmer and Prof. Dr. David Dueñas-Cid
   1.1. to be reproduced for the purposes of preservation and electronic publication of the graduation thesis, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright;
   1.2. to be published via the web of Tallinn University of Technology, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright.
2. I am aware that the author also retains the rights specified in clause 1 of the non-exclusive licence.
3. I confirm that granting the non-exclusive licence does not infringe other persons' intellectual property rights, the rights arising from the Personal Data Protection Act or rights arising from other legislation.

17.12.2020

16 The non-exclusive licence is not valid during the validity of access restriction indicated in the student's application for restriction on access to the graduation thesis that has been signed by the school's dean, except in case of the university's right to reproduce the thesis for preservation purposes only. If a graduation thesis is based on the joint creative activity of two or more persons and the co-author(s) has/have not granted, by the set deadline, the student defending his/her graduation thesis consent to reproduce and publish the graduation thesis in compliance with clauses 1.1 and 1.2 of the non-exclusive licence, the non-exclusive license shall not be valid for the period.

Acknowledgements

There are many people to whom I owe a debt of gratitude for their selfless contributions towards my completion of this thesis, and with this page I would like to try to thank some of them.

First, I would like to thank the Estonian Research Council for funding the research of which I was honored to take part and led to the models found in this thesis.

To my supervisors Robert Krimmer and David Dueñes-Cid, thank you for including me in the research project. I was honored to work with you as a student and as a collaborator on the research project, and it also ending up making an interesting thesis topic. Your wisdom and supportive advice helped me to get past all of the difficulties I encountered.

I would like to thank my truly amazing parents, without whom I would literally be nothing. Thank you for supporting me so much throughout my life. Without your generous support I would never have ending up coming to Estonia in the first place. I will never be able express with words how much of an impact you have had on my life. Thank you for everything you have done for me including taking the time to proofread this thesis.

Thank you Tatjana Dedova for inspiring me when I was lacking the inspiration and motivation to continue. You are an excellent coach and I hope you know how much I admire you and your wonderful family and how important your friendship means to me.

To my son, Walter, thank you for your patience with me. I love you more than you will ever know, and I look forward to being able to give you much more of my well-deserved attention.

Last, but certainly not least, I would like to thank Katrin Shuyler, the love of my life, to whom I am so honored to be married and to whom this thesis is dedicated. Thank you for all the additional effort you have contributed to help me get through this challenge. And thank you for your insightful suggestions. I would not be where I am if it were not for you!