

Towards Legally Binding Online Elections in Germany

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Abstract: Our paper contributes to the interdisciplinary foundations for legally binding online elections in Germany. We focus on long-term retention of election documents as this is an issue of vital importance in terms of verifying the legitimacy of an election. With regard to conventional paper-based elections, specific documents have to be retained (for example the ballots or the voters' register) for later review in the case that an election contest is filed. Such retention obligations apply to online elections as well. However, this important issue has so far received only little attention in the research field of e-voting. We therefore address the following questions: Which legal obligations regarding long-term retention of election data have to be complied with? What must therefore be taken care of while carrying out an election and afterwards? In this respect, what can we learn from the case of paper-based elections regarding the implementation of online elections?

We approach the issue as follows: Based on an analysis of the existing legal framework for parliamentary as well as non-parliamentary elections in Germany, we derive the objectives of long-term retention for elections. Then we investigate how these objectives can be adapted to the e-voting scenario and derive concrete security requirements for online elections. We argue that meeting these requirements verifiably, even in the long term, will be a prerequisite for legally binding online elections. Hence, our work may help to establish e-voting as a true alternative to conventional paper-based elections.

Keywords: e-voting, long-term retention, security requirements, legally binding online elections

1. Introduction

With regard to e-government, secure long-term retention of relevant documents is an important issue. The goal is to preserve long-term verifiability of the correct implementation of administrative processes. Strict regulations are imposed here, and this applies in particular to elections as they embody democratic decision-making.

Election documents have to be retained to ensure long-term verifiability of the lawfulness of the election. In its Recommendation on legal, operational and technical standards for e-voting, the Council of Europe (2005, p. 17) states that "any data retained after the election or referendum period shall be stored securely". Specific measures are to be established on the national level. In Germany, legal stipulations on retention of electronic election data have not been issued so far. However, there have been pilot applications of online voting: The German Informatics Society (Gesellschaft für Informatik, GI) has been electing its executive committee over the Internet since 2004, while still retaining the option for postal voting. The according electoral regulations (GI 2004, p. 7) state that the evaluation records of the remote electronic election as well as the postal ballots have to be retained for two years.

With respect to e-voting, there is a general need to harmonize legal regulations and technical requirements. As Meißner, Hartmann and Richter (2004, p. 8) have already addressed, there are still many interdisciplinary legal and technical problems left unsolved concerning online voting systems: Neither does a legal background exist to provide a starting point to solve the technical difficulties, nor has sufficient technical experience been gained to allow for passing a legal framework on online voting. We try to overcome this deadlock by deriving technical security requirements for online elections from current electoral law on conventional paper-based elections, focusing on the obligations regarding long-term retention of election documents. Thus, we hope to contribute to establishing the basis for legally binding e-voting.

Our work is structured as follows: In Section 2 we analyze current German law on conventional paper-based elections with respect to the retention obligations specified and investigate what these obligations aim at. Section 3 structures the objectives we have identified and relates them to basic principles of voting. According security requirements for online elections are derived and analyzed in Section 4. Section 5 summarizes the results and concludes the paper.

2. German electoral law

In this section we analyze current German electoral law, focusing on obligations regarding the retention of election documents. We consider one example for parliamentary and one for non-parliamentary elections. For each we at first ascertain which documents have to be retained for which period of time. In the next step we investigate the scope and purpose of these legal retention obligations.

2.1 Federal elections

Federal elections of the German Bundestag are held every four years. They are subject to the German Federal Electoral Law (Bundeswahlgesetz, BWG) and specified by the according Federal Electoral Regulations (Bundeswahlordnung, BWO). We will henceforth refer to these using the official abbreviations BWG and BWO, respectively.

According to §1 BWG, the 598 members of the German Parliament are elected in *universal, direct, free, equal and secret elections* by the Germans who have the right to vote. According to Mitrou et al. (2003, p. 2), it is commonly accepted that parliamentary elections have to be free, equal and secret, while the principles of universal and direct elections belong to the European electoral heritage. These five *basic principles of voting* are of prime importance since an offense often even violates German Basic Law and usually renders the election void. In the following we explain briefly what these basic principles of voting mean. Similar interpretations have been provided by Grimm et al. (2007, pp. 1–2).

An election is *universal* if it is guaranteed that any eligible voter can participate and cast her vote. According to Schreiber (1990, p. 68), the right to vote may not be denied because of political, economic or social reasons.

The principle of *direct* elections postulates that the voters alone determine the composition of the parliament (Schreiber 1990, p. 71). After polling is terminated, nobody may influence the results of the election anymore (Schreiber 1990, p. 72). Furthermore, a voter cannot transfer her right to vote to someone else who then votes on her behalf (§14 (4) BWG). However, auxiliary persons may be used to help disabled voters (§33 (2) BWG).

Free elections exclude the possibility that voters are influenced unlawfully by others or even coerced to vote in a particular way. This applies also to the period after the votes have been cast: Any control of the content of the particular vote must be excluded (Schreiber 1990, p. 73). Furthermore, voters must not be influenced by intermediate results of the election (Schreiber 1990, p. 75).

The principle of *equality* states that all votes cast by eligible voters have equal influence on the election results (Schreiber 1990, p. 84). This principle applies also to the eligible candidates in the sense that equal opportunities for all candidates should be ensured (Schreiber 1990, pp. 87–88).

Finally, the principle of *secret* elections postulates that the voter's decision must be kept secret. It must not be possible to associate a vote with the voter who cast it. According to Schreiber (1990, p. 112), unrestricted freedom of vote may only be given provided that secrecy of the vote is ensured.

2.1.1 Retention obligations

The federal territory is subdivided into 299 constituencies, each of which comprises several polling districts. In each polling district an Electoral Board including an Electoral Officer is appointed (§6 BWO). Furthermore, each constituency appoints a Constituency Returning Officer (§3 BWO).

The voters' register must be closed the day before the election at the latest. Closure of the register is certified by completing annex 8 of the BWO. Polling cards may be issued to voters registered in the voter's register upon application if they declare to be outside of their polling district on election day or unable to go to the polling station due to physical or other reasons. A notice is placed in the voters' register next to the name of each voter who applied for a polling card. The polling card issued may thereafter be used for postal voting or for voting in a different polling district of the same constituency. If the polling card is used for postal voting, the voter must sign an affidavit on the polling card certifying that she has voted personally.

After the poll has been closed, the Electoral Board shall establish the election result in the polling district (§67 BWO). Hereafter the ballots are collected and the pile of ballots as well as the pile of received polling cards are sealed by the Electoral Officer and later on handed over to the local authority of the commune. Each authority in charge must protect these documents against unauthorized access (§73 (1), (2) BWO).

According to §89 (1) BWO, the following documents must be retained and protected against unauthorized access:

- Voters' register
- Polling card register
- Register of polling cards which have been declared invalid according to §28 (8) BWO (affecting voters whose names have been cancelled from the voters' register)
- Register of voters that shall vote before a moving Electoral Board according to §29 (1) BWO
- Forms with supporting signatures for nominated candidates
- Voter's notices which have been collected

According to §72 BWO, the clerk in each polling district shall compile an election record on the polling procedure and the determination of the election results. Furthermore, the election record contains decisions on

- Admission or exclusion of voters whose voting right was questionable (§56 (7) BWO)
- Questionable ballots (§69 (6) BWO)
- Questionable polling cards, in terms of validity or legal ownership (§59 BWO)

The ballots and the polling cards which correspond to the latter two items are enclosed in the election record. The completed election record must be approved and signed by each member of the Electoral Board. It is handed over to the local authority of the commune immediately, whence it is forwarded to the Constituency Returning Officer (§72 (3), (4) BWO). All authorities in charge have to ensure that the election records including the annexes are protected against access by unauthorized persons (§72 (4) BWO).

While the voter's notices have to be discarded immediately to ensure data protection and voter privacy (§90 (1) BWO), all other documents have to be retained for at least six months after the election (§90 (2) BWO). If electoral scrutiny proceedings are pending, further retention may be ordered by the Federal Returning Officer (§90 (2) BWO). All other election documents may be discarded 60 days before a new German Bundestag is elected (§90 (3) BWO). These documents comprise the ballots, the postal vote documents (polling cards and ballots) as well as the election records.

2.1.2 Scope and purpose of the retention obligations

We will in the following refer to the documents which have to be retained and consider what their retention aims at. We start with the election documents which according to §90 (2) BWO have to be retained for almost the whole election period and therefore are of special importance.

The *election record* is a public deed setting out that the election has been duly performed. First of all, the record documents that the members of the Electoral Board have been informed about their duties and responsibilities, in particular discretion and impartiality. Any special incidents such as turning away voters in accordance with §56 (6) BWO (for example because they are not registered in the voters' register and do not possess a polling card) must be thoroughly documented. The election record also accounts for the fact that proper surroundings for vote casting have been established, for example tables equipped with shields to protect voter privacy or a duly installed ballot box which has been checked to be empty before the election started and sealed hereafter. It must not be opened again until the poll has been closed (§53 (3) BWO). If any changes to the voters' register are required (for example due to belatedly issued polling cards which require an according mark to be set beside the name of the affected voters), these must be documented, and the voters' register has to be closed before the election starts. The election record also accounts for proper polling: The Electoral Board must take care and also confirm in writing that the voters have been unobserved while voting and hereafter folded the ballot paper. Moreover, the poll must be closed at 6 p.m., and after that time only present voters may cast their ballots. Furthermore, the correct evaluation of the election documents and determination of the election results can be verified on the basis of the election record: Polling and tallying must be conducted in public (see also §54 BWO). The ballots have to be counted by two members of the Electoral Board independently. In case there are doubts about the values written down in the election record, the *ballots* allow for re-tallying and hence verifying the correctness of the announced election results. The collected *polling cards* will be considered below.

The *voters' register* allows for verifying the voting rights. It is retained to make this verification possible even after the election, for example in case the election is contested because of alleged participation of persons who were not eligible to vote. The voters' register contains also further information: When a voter casts her ballot, this is acknowledged by placing a mark beside her name in the voters' register (§56 (4) BWO). Hence, the total of voters who have cast a ballot can be determined by these marks after the election has ended. Thus, the voters' register can be used to check that this value matches the one written down in the election record and, if required for verification, also the number of ballots cast.

The *polling card register* contains the names of voters who have been issued a polling card for voting in a different electoral district or for postal vote. This register should match the voters' register in the sense that each voter who is in the polling card register should have a corresponding mark beside her name in the voters' register. This way it can be checked that a voter who has obtained a polling card could not have voted twice. Since polling cards are first and foremost used for postal voting, this review may contribute to excluding the possibility that someone has cast a ballot in person and by postal vote as well. Furthermore, by comparing the *polling cards* received during the election with the *register of polling cards which have been declared invalid* it can be verified that only valid polling cards have been used for voting.

The *forms with supporting signatures for nominated candidates* testify to sufficient support for the candidates by the general public. These may be used as a justification for nomination of the candidates if challenged.

2.2 Works council elections

Works councils in Germany are elected every four years in secret and direct elections. The elections are subject to §7 to §20 of the Works Constitution Act (Betriebsverfassungsgesetz, BetrVG) and the according election regulations determined by the First Ordinance on the implementation of the Works Constitution Act (Erste Verordnung zur Durchführung des Betriebsverfassungsgesetzes – Wahlordnung, WO). As for federal electoral law, we will henceforth make use of the official abbreviations BetrVG and WO, respectively.

2.2.1 Retention obligations

The Electoral Board is supposed to write an election record (§16 WO) containing the following details:

- Total number of votes cast
- Number of valid and invalid votes cast
- Calculated maxima according to §5 BetrVG and §5 WO (explained below)
- Distribution of the calculated maxima to the lists
- Names of the elected candidates
- Any special incidents which occurred during the election

The maxima which have to be calculated according to §5 BetrVG and §5 WO are supposed to ensure that the staff gender ratio is duly represented by the works council.

§19 WO states that the election documents must be retained by the works council at least until the end of its term in office. These election documents comprise the election record described above as well as the ballots and the postal vote envelopes which have been received too late and hence cannot be counted. These envelopes remain sealed and are to be discarded one month after the announcement of the election results, as long as the election has not been contested (§26 (2) WO).

2.2.2 Scope and purpose of the retention obligations

The *ballots* allow for re-tallying and hence for verification of the election results which have been announced. The values set down in the election record which correspond to the *total number of votes cast, valid votes and invalid votes*, may be verified as well.

The *calculated maxima and their distribution to the lists* may be used to prove that the gender which represents the minority of staff is not discriminated with regard to the seats on the works council.

The *postal vote envelopes* which have been received too late may become relevant if an election contest is filed. The same applies to the *special incidents* if given.

3. Retention objectives

Hitherto we have analyzed the scope and purpose of retention obligations laid down in the laws and regulations on federal elections and works council elections in Germany. In the following we will reconsider what these obligations aim at and structure them according to the election phase in which they come up: The preparation, implementation and evaluation of the election.

As the retention obligations with respect to parliamentary elections are most comprehensive, we will henceforth restrict to retention objectives of federal elections. Since federal elections comprise all of the retention obligations which apply for works council elections (except for protection of minorities with respect to gender), these may easily be derived. Similarly, obligations for other types of non-parliamentary elections may be deduced.

Considering the retention purposes we have identified in Section 2, it becomes apparent that any retention of election documents basically aims at *verifiability*: Election documents are retained in order to keep the lawfulness of the election verifiable. According to §1 (1) BWG, an election of the German Bundestag is lawful if it complies with the basic principles of voting described in Section 2.1. Following the three election phases we will thus relate the purposes of retention which we have identified in Section 2.1.2 to the principles of universal, direct, free, equal and secret elections.

3.1 Preparation phase

First of all, the trustworthiness of the election staff must be ascertained. If the Electoral Board could unduly influence the election results this would violate the principle of *direct* elections. Moreover, impartiality and discretion support *freedom and secrecy* of the vote.

Next, it must be verifiable that the polling station has been equipped properly: It must be checked that the ballot box is empty before the election starts, and the ballot box must be sealed or locked hereafter. This shall prevent untimely opening of the ballot box. It relates to the objective of *free* elections as voters must not be influenced by intermediate results of the election. The tables which are used for vote casting are supposed to be equipped with shields to protect voter privacy and hence support the *secrecy* of the vote.

While authorized corrections to the voters' register during preparation phase are still possible, the voters' register must be closed before the election starts. This prevents illegal changes to the voters' register and hence may be viewed as supporting *universal* elections in the sense that only persons who have the legal right to vote are permitted to participate in the election.

Nomination of candidates is justified by the forms with supporting signatures, which at the same time may guarantee equal opportunities for all candidates and hence support the principle of *equal* elections.

Verifiability of the correct preparation of the election thus comprises the following issues:

- Trustworthy election staff
- Proper installation and surroundings
- Voting rights and restrictions
- Justified nomination of candidates

3.2 Implementation phase

Documentation of any special incidents during polling, especially recording voters which have been turned away, aims at verifying that no eligible voter has been excluded from the election and thus supports the principle of *universal* elections.

It must be verifiable that the ballots were cast properly, which means that voters cast their vote unobserved and folded their ballot papers before they were put into the ballot box. These measures clearly aim at *secret* and *free* elections.

In case of postal voting, the affidavit which has to be signed by the voter to certify that the vote was cast personally aims at ensuring *direct* elections. Mutual exclusion of voting in person and postal voting as well as checking the acknowledgements of voting provides for *equality* in terms of permitting each voter to cast at most one vote. Verifying validity and legal ownership of polling cards contributes

to *universal* elections in terms of ensuring that only persons who have the legal right to vote are permitted to participate in the election.

Closing the poll in due time while allowing the present voters to cast their ballots is necessary since with respect to *universal* elections it must be ensured that votes that were cast in time are not excluded from the poll.

Hence, verifiability of the proper implementation of the election comprises the following issues:

- Documenting special incidents
- Proper vote casting
- Mutual exclusion of postal vote and voting in person
- Validity and legal ownership of polling cards
- Closing the poll duly

3.3 Evaluation phase

Verifying the tallying process by re-counting the ballots supports *universality and equality* since repeated counting ensures that all ballots have been counted properly. The same accounts for the fact that the ballots have to be counted by two members of the Electoral Board independently.

The requirement to conduct the poll as well as the tallying in public does not directly relate to any of the basic principles of voting, but rather is important with respect to the *transparency* of the election. According to Meißner, Hartmann and Richter (2004, p. 4), transparency is one of the aspects which verifiability is related to (besides from confidence in the election and preparation of a possible election contest).

Verifiability of duly evaluation of the election results thus comprises the following:

- Tallying
- Independent vote counting
- Public conduct of the tally

4. Deriving requirements for online elections

From the retention objectives which we have identified and structured in Section 3 we will now derive security requirements for online elections following the three election phases. As a matter of course, online elections have to reach the same level of security as paper-based elections. Therefore, to establish legally binding online elections, the following requirements will have to be met in a verifiable way.

As our goal was to provide a comprehensive set of requirements derived from legal obligations on retention, we focused on the scenario of federal elections. For other, especially non-parliamentary types of elections, some of the requirements might apply only in a weaker form or not at all. We will refer to this where necessary, otherwise the particular requirement should be regarded as mandatory.

4.1 Preparation phase

When we turn to online elections, ascertaining the integrity and trustworthiness of the election staff concerns not only the Electoral Board. Several people are involved in setting up and maintaining the voting system. Depending on the level of the election (parliamentary versus non-parliamentary), appropriate measures such as background and reference checking should be applied here and compliance with due diligence procedures should be verified.

In the scenario of online elections, the ballot box is electronic. It is usually implemented using a database table. As for the physical ballot box, this table must be empty before the election starts. Sealing or locking the ballot box corresponds to ensuring that votes in the electronic ballot box cannot be read as long as the voting procedure has not been terminated. As to the use of shielded tables, online voting of course works differently here. The Electoral Board has no influence on the surroundings in which voters cast their vote, thus this objective cannot be transferred to online elections. We will take up this matter in Section 4.2.

Closing the voters' register in an online election can be realized by providing write protection. This way data from the voters' register can be read, but not deleted, altered or overwritten. The write

protection should still allow for setting flag bits (or any other suitable acknowledgement of voting) to indicate that a voter has already cast her vote.

The collection of supporting signatures for candidate nominations does not imply any specific requirements for online elections. It may still be accomplished using pen and paper. An electronic variant may be applicable in the case that digital signatures are available to the public, for example if electronic Citizen Cards have been issued to support e-government. However, this may be appropriate for parliamentary elections only.

4.2 Implementation phase

To document any special incidents that occurred during polling, system monitoring should be carried out and log files for the voting system should be created and retained.

For paper-based elections the Electoral Board has to take care that polling takes place unobserved. Folding the paper ballot can be mapped to encrypting the electronic ballot in order to keep its content secret. But the scenario of online voting does not allow unobserved polling to be controlled by any supervising authority as voters cast their vote from their home computers or workstation computers. Since this situation is similar to postal voting, the voter may be required to digitally sign an affidavit certifying that the vote was cast personally. As to the scenario of works council elections, the employer may also be obliged to ensure that each workplace offers sufficient privacy to the voter, e.g. by providing adjustable computer screens to avoid shoulder surfing. Alternatively, a special computer for polling may be set up in an environment which offers a sufficient level of privacy.

If the option of online voting is offered then mutual exclusion of voting in presence and postal voting is extended by online voting. The voting system must provide secure procedures to ensure this. If multiple vote casting is permitted (for example the voter has voted online and hereafter wants to vote in person), it must still be ensured that only one vote is accounted. Thus policies are required to determine which vote is to be counted. This "valid" vote may be determined by a predefined priority mode of voting (e.g. voting in person) or by the time it was cast (i.e. the latest vote counts).

Verifying the validity and legal ownership of polling cards does not apply to online voting and hence does not imply any specific requirements.

Closing the poll in due time while keeping the ballot box open for votes which are still pending is a specific challenge for online elections. It is referred to as the *last call problem* and has been discussed for example in (Meißner, Hartmann and Richter 2004). Secure procedures for intermediate storage must be provided to solve this problem.

4.3 Evaluation phase

If the ballots are electronic, re-tallying the online voting result is especially easy and fast. For online elections it is often postulated that re-counting the results should be open to all voters and moreover to the general public. This property which is commonly referred to as *universal verifiability* is believed to be one of the main features of e-voting systems (Burmester and Magkos 2003, p. 3).

Requiring two members of the Electoral Board to count the ballots independently does not apply to online voting if re-tallying by the public or by official scrutiny authorities is provided. Nevertheless, the approach of using two or more separate individuals or entities operating together which is commonly referred to as *dual control* is an important method to enhance the security of an online voting system. It should be adhered to where appropriate, for example when starting or closing the poll is initiated.

The objective of public polling and tallying can be broken down into requirements for online voting as follows: First, the programs and procedures which the voting system is based on should be open to public scrutiny. Second, the tallying process should be made transparent by providing to the public an according routine for re-counting the votes as described above. However, small-scale elections as for example in societies require only small-scale verifiability. The higher the level of the election, the more important public scrutiny is.

5. Results and Conclusion

Based on an analysis of retention obligations comprised in current German electoral law, we have identified the retention objectives in this field, relating to the basic principles of voting. We have thereupon derived requirements for online elections. Due to our approach, these requirements are based upon legal obligations on conventional paper-based elections. For online elections to become legally binding, they will have to meet the same demands regarding security and verifiability as conventional elections. Hence, we are convinced that in order to establish legally binding online elections, the requirements we have derived will have to be met in a verifiable way. Moreover, compliance with these requirements must be verifiable in the long term.

We have seen that for paper-based elections the established election record contains, briefly stated, the essence of the election. Even for online elections there may be an according document in writing setting out that the election has been duly carried out. However, the log files for the voting system will certainly be part of the data to be retained as these may provide evidence that the voting program has run successfully or recorded any errors that may have occurred. It has been out of the scope of this paper to investigate which further data should be retained for online elections to prove that the requirements we derived have been met. However, we will address this issue in future work.

We believe that our work may help legislative organs in terms of providing one piece of the background which is necessary to issue a legal framework on e-voting in Germany. As electoral law in other countries is similar, this profit might not be restricted to German legislation. Furthermore, our work may also be valuable to practitioners who develop online voting systems and might consider these requirements already when designing and implementing an online voting system. In summary, we hope that our work will help to establish e-voting as a true alternative to paper-based elections and hence contribute to advancing online elections, not only in Germany.

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