The use of 'supporting software' in elections, The peculiar case of the Netherlands 2017

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Abstract. In this contribution, we outline the organisation of the Dutch election process and the role of supporting software in this process. During the Dutch elections of 2017, the role of supporting software in the election process threatened to be reduced to a minimum. This placed pressure on the process and on the determination of the outcome of the election.

Keywords: Elections, software, politics.

1 Introduction

In the elections in the Netherlands it is often stated that 'paper is leading'. Yet during the last ten years the use of 'supporting software for the election process' became customary. At first glance, there seems to be a certain tension between aspiring on the one hand to use software as much as possible for the election process (the nomination procedure, determining the results and calculating the allocation of seats) and, on the other hand, this principle that 'paper needs to be leading'. In this contribution, we outline the organisation of the Dutch election process and the role of supporting software in this process. We will then focus specifically on the events of the 2017 elections to the Dutch Lower House. During these elections to the Dutch Lower House, the role of supporting software in the election process threatened to be reduced to a minimum. This placed pressure on the process and on the determination of the outcome of the election.

2 The organisation of the Dutch election process

In the Netherlands, the Lower House constitutes the most important political organ of the parliament. During general national elections, the members of the Dutch Lower House are elected based on proportional representation. The organisation and implementation of these elections in the Netherlands takes place via an interplay between municipalities, electoral districts, the Electoral Council and the Ministry of the Interior and Kingdom Relations.

On the day of the elections to the Dutch Lower House, which for historical reasons always takes place on a Wednesday in the Netherlands, the municipalities open the polling stations in their municipal district so the residents can subsequently cast their votes. Once the polling stations are closed, the votes are counted at these same polling stations. The official report of the results, completed by hand and signed, is delivered to the town hall on the same night. The mayor receives the report in the town hall. Each of the 388 mayors determines the results for their municipality. For three public-sector bodies[1], this is carried out by the lieutenant governor. The results are then handed over to the so-called principal electoral committees in 20 electoral districts. In general, the organisation of these electoral districts corresponds with the provinces in the Netherlands. A number of provinces have so many residents that they have two, three or (in South Holland) even four electoral districts. The European part of the Netherlands has a total of 19 electoral districts. The overseas territories[1] form a separate electoral district.

On the Friday morning, the principal electoral committees determine the results of the electoral districts. These results are then handed over to the Electoral Council. The Electoral Council is an independent body, which acts as the Central Electoral Committee for these elections. After receiving all the results from the principal electoral committees, the Electoral Council determines the results in their entirety and both

[1] This 20th electoral district consists of the islands of Bonaire, St. Eustatius and Saba.

calculates the allocation of seats and determines this. After the weekend, the Electoral Council presents the final results.

3 'Paper is Leading'

The applicable laws and regulations prescribe that all official documents, such as the official report of the results, must be compiled on paper and signed. The results must also be handed over in person by the chair of the various polling stations to the body whose turn it is to subsequently determine the (partial) results. Due to these guiding principles, it takes several days to determine the final results. This does not change the fact that a relatively accurate prediction of the results is already available on the Wednesday evening after the elections, based on exit polls taken around 40 polling stations. Over the course of the evening, the Netherlands National News Agency collects the preliminary results from all of the municipalities — on the basis of a quick count — and adds these up at a party level before publishing preliminary results in the early hours of Thursday morning. The trickle of results coming in from the municipalities and its impact on the outcome are important ingredients for an 'exciting' evening of television viewing.

4 The paper process is leading, but it is supported digitally

Electronic tools are used, as long as they are available, to organise the election process and to aid in the determination of the results. In the 1970s, initially calculators were available, followed by the first spreadsheets and the advent of personal computers. These electronic devices have, from the outset, been considered and used as tools to support and check the leading 'paper process'. For several years, until 2006, many municipalities used electronic voting devices. Yet, after 2006 it was established that using these devices resulted in an insufficient level of transparency regarding the outcome of the elections. They were therefore abolished.

In 2008, the Electoral Council took the initiative to design special software to support the entire process, from nominating politicians to determining the results and calculating the allocation of seats. This software was developed by the software company IVU, which had produced similar software for Germany approximately five years earlier (2003). In the Netherlands, this software was used for the first time during the 2009 European elections. From the outset, this software was assigned a supporting role. In practice, however, all parties involved in the process started relying heavily on it.

The software is first used to support the nomination process. Because people (not parties) are elected formally in accordance with the Dutch system, the registration of all participating candidates forms a solid foundation for all the other steps and official reports that are included in the process. A total of 1,116 candidates took part in the 2017 elections, distributed across 28 participating political parties. Political parties

that want to participate in the elections are also offered the possibility to use the software to register their candidates. The software is set up so that, on the basis of the inputted political parties and candidates, various models for the official reports can be created throughout the various stages of the process.

Over a short period of time, the application of supporting software has become a perfectly accepted practice in Dutch elections. After this software was developed, the Electoral Council became responsible for its management. Amongst other things, this means that the Electoral Council commissions the supplier to adapt the software to comply with amended laws and regulations, if necessary. The software is also adapted to new versions of operating systems and to new browsers. The Electoral Council also ensures that the software undergoes periodic quality and security checks by independent authorities.

Prior to the elections, the software is made available to political parties and municipalities.[2] These municipalities can use the software to complete the official report for the municipalities and to print it. In the same way, the principal electoral committees are also provided with the appropriate software.

It is important to point out that no supporting software is being used at the level of the polling stations. There, the votes cast on paper are counted manually. The results are determined with the aid of calculators or a tablet at most, after which a pre-printed paper is filled in manually and signed. As previously mentioned, these signed results are delivered in person to the town hall by the chair of the polling station. It is only once the results are in the town halls that software plays a role. The results from each polling station are manually entered twice into the software, after which the software determines the results for the municipalities and prints them on paper. This process is repeated at the principal electoral committees and eventually at the Electoral Council.

At various moments during the process, results which have also been established by computer counts are manually re-entered into the system. Over the years, a practice has developed whereby a result, in addition to the official report on paper, is also recorded on a USB stick and this USB stick provides the input for the following step. This procedure is accompanied by some safeguards. Amongst other things, an integrity check takes place, which employs hash codes. Details of this procedure can be found in Annex A.

Until 2017, this was by and large the electoral practice in the Netherlands. However, in the run-up to the 2017 elections to the Dutch Lower House, this entire process suddenly came under fire.

5 The 2017 elections

In November 2016, as is well known, the American presidential elections took place. In the context of these elections, there was much talk about the possible hacking of election results, websites of political parties and/or email accounts of presidential candidates and the manipulation of these elections by foreign powers. Furthermore,

[2] Municipalities are not obliged to use this software.

the 2017 elections to the Dutch Lower House took place in a somewhat turbulent political climate. The right-wing populist Party for Freedom[3] was at the top of the polls for a considerable length of time, but it started to lose this lead in the run-up to the elections for the Dutch Lower House. It also came as a surprise that many parties, besides those already represented in parliament, wanted to try their hand at acquiring one or more seats and so came forward in the run-up to the elections. All in all, these elections in the Netherlands attracted a great deal of attention.

It goes without saying that these developments resulted in a greater focus on the security for the results determination process. With this in mind, measures were also taken to better protect the software, particularly regarding its distribution. Furthermore, the Electoral Council instructed the well-known software security company Fox-IT to investigate the reliability and security of the software.

On 30 January, all parties wanting to take part in the elections had to submit their list of candidates to the Electoral Council. This list of candidates had to be submitted in person by an authorised agent on behalf of the relevant party. This process involves a great deal of paper. And it was not just the candidates who were required to provide details. In each of the 20 electoral districts, parties wanting to take part in the elections but who were not currently represented in the Lower House, had to collect at least 30 declarations of support in order to gain a place on the ballot paper in an electoral district.[4] On the day itself and the next day, all these submitted papers were checked for completeness and accuracy. As a relatively large number of new parties wanted to take part in the elections this year, the office of the Electoral Council was a hive of activity. Furthermore, during the day it emerged that a relatively large number of parties had submitted incomplete or unstructured documents, which meant that the control activities were much more intensive than usual.

Over the course of the day, the news filtered through that one of the major news shows on Dutch television was going to be doing a piece about the alleged unreliability of the supporting election software. During the day, this news show submitted several questions to the Electoral Council. In view of the major strain on staffing capacity that the Electoral Council was already experiencing, this was a very unwelcome complication. In the evening, a piece was broadcast that discussed possible weaknesses in the software itself and the application thereof. It was not the most important piece in the news show and the content was presented in a relatively restrained manner. However, in the subsequent days, the limited security of the supporting software caused more and more of a stir in the media. Various real and self-proclaimed 'experts' expressed their concerns. After a week, discussions had become so intense that a debate was scheduled in the Dutch Lower House. Just before this debate was to take place, the minister appeared on the same news show that had sparked off the discussions. He declared that not a shadow of doubt about the reliability of the results should hang over the elections to the Lower House in the Netherlands. For that rea-

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3 PVV, which stands for 'Partij van de Vrijheid'.

4 The last electoral district, which comprises the islands of Bonaire, St. Eustatius and Saba, only involves ten signatures.

son, he had decided, with immediate effect, to prohibit the use of all supporting software for the upcoming elections that were set to take place within a month.

6 Elections without software?

This was an unexpected development, for both the Electoral Council as well as for the municipalities. In the meantime, the claim that the software was 'as leaky as a sieve' was subject to ongoing discussion. To start off with, none of the critics had based their claims on the actual use and tests of the most recent version of the software. The expert that had featured in the news piece seemed to have based his judgement on an outdated instruction clip about the software that was still available on YouTube. He also seemed to assume that personal computers that used this software were directly connected to the internet. Many other critics were experts in the field of software and software security, but at the same time they seemed to be almost entirely unfamiliar with the organisation of the election process and its established procedures. In reference to prohibiting the supporting software, none of the involved parties seemed to be aware that this software has various modules that fulfil a range of roles in the process. Some of these elements are hardly vulnerable at all to hacking or other ways of manipulation. Experts familiar with the election process reported that implementation without supporting software could possibly involve greater risks. It was also striking that the decision was made before the results of the security investigation that the Electoral Council had ordered Fox-IT to carry out had been released.

In the days following this decision, there was growing uncertainty about the consequences. Municipalities in particular, who are responsible for implementing the most intensive logistical tasks, wanted the minister to let them know what support they were allowed to use. Could they still use computers, but not the software? Could spreadsheets be used? And if spreadsheets were to be used, how could anyone be sure that they were working correctly? The ministry appeared to be unable to provide any clarification, which was met with increasing levels of irritation from the municipalities. The Electoral Council also regularly asked for clarification because legal deadlines are involved in the process of determining the results. Ever more uncertainty arose if these deadlines would be met.

Especially due to the pressure placed on the municipalities, who had less and less incentive to develop their own solutions, the pressure on the ministry to reconsider the prohibition increased. There was also more scope to reconsider the decision after an initial draft report from Fox-IT revealed that although weaknesses and risks in the software and the application thereof may be present, these were not urgent or especially worrying if used in a specific context. Most of these weaknesses could be dealt with by means of improved procedures and arrangements, provided the software would be used exclusively for support. Based on this information, the minister decided to permit limited use of the supporting software. At the same time, it was explicitly stated that the 'paper process' was and would remain leading and that the software should only be used at most as a control. One of the main deviations from the former

standard procedures was that a digital transfer of results (by using USB-sticks) was strictly forbidden.

Another new guideline was that municipalities, principal electoral committees and the Central Electoral Committee first had to calculate all results manually. They were only allowed to use the software for support and checks. The Electoral Council had no insight into the extent to which the municipalities complied with this regulation. The Electoral Council itself performed all its calculations both manually as well as with the supporting software.[5] Ultimately, the final results were published the Tuesday after the elections.

7 In the aftermath

Over the years, the Electoral Council has built up a database of election results. The data stored in the database are derived from the digital exchange of results using supporting software. This database is consulted often, including by students, researchers and political parties. Due to the ban of the digital exchange of results, it had been known even before the elections that the continuity of the results in the database would be disrupted. Politieke Academie, a private political organisation using and processing the information in the database to provide advice about targeted campaign activities ("micro targeting") to political parties, has been active in the Netherlands for some years now. The lack of data on the last elections formed a direct threat to Politieke Academie's business model. The organisation therefore engaged dozens of persons to visit all municipalities to copy the results in the days directly following the elections. In view of the sizeable effort this entailed, Politieke Academie considered this data to be their private business capital.

Existing Dutch legislation does not allow for directly requesting the election results. Politieke Academie was able to circumvent this limitation by having their reporters manually copy the results available for inspection for a couple of days following the elections. Because the Electoral Council did not receive the results of the municipalities and the polling stations in a digital form, the Council directed the Ministry's attention to the fact that the quality of the database of election results would be compromised. A couple of weeks after the elections, the Minister nonetheless allowed the Electoral Council to request the election results published on the websites of all municipalities - much to the chagrin of Politieke Academie. Upon having processed the results so obtained, both the Electoral Council and Politieke Academie independently found that adding the separate municipal results did not correspond with the results established by the principal electoral committee of some electoral districts. While some very slight errors between the counts are always possible, in this case it concerned some thousands of votes. Further analysis showed that the differences were concentrated in one particular electoral district. When Politieke Academie informed

[5] In practice, this meant that one of the authors of this article spent an entire Saturday calculating the results with the help of a newly purchased calculator, to repeatedly establish that the results did not deviate from those that had been calculated by the supporting software for verification.

the media of their findings in June, this led to new consternation among the media and the public at large. For it turned out that the votes cast for certain parties were completely absent in the results provided by one municipality.

This discovery resulted in an official investigation, which produced the following conclusions. The results of the municipalities were, at the level of the electoral district, to be manually entered into a standalone network comprised of a limited number of computers. Under the official instructions, all results had to be entered twice. The person responsible for entering the data on his own authority decided not to enter all data twice, as he feared that doing so would take up so much time that the deadline for determining the election results laid down by law could not have been met. At one point, while the results were being entered, a software error occurred, necessitating a reboot. This caused some of the persons involved with entering the data to lose sight of where they were: following the reboot, they continued on to the next municipality, believing they had already completed entering all results from the previous one. And because no double entry of results took place, the data entered was not checked.

So, in essence, these votes "getting lost" was due to a human error. At the same time, this human error could occur because the standard use and application of supporting software had to be deviated from. Test calculations proved that the failure to count these votes had no impact on the final results. Nonetheless, there was significant unrest among the public at large, which in the end caused the Lower House to carry a motion to finally start taking measures to embed greater security in the process.

8 Focus areas

The developments related to determining the results were unexpected and often tense. In our opinion, the following focus areas can be distinguished within these developments.

8.1 Technology and the human factor

The current software to help determine the election results is only around for less than ten years. In that time, all sorts of conditions and security procedures were considered and established. The problem is that too little attention was devoted to the question as to whether users would abide by all of these regulations. The Electoral Council has no insight into all the employees at the municipalities and principal electoral committees who are responsible for correctly implementing the procedures, as was painfully shown when some thousands of votes went missing. The human factor remains a big question mark.

Furthermore, it was inconceivable for many people, especially at municipalities, to continue working without its support. In order to do that safely, the use of software for support involves many guidelines and safeguards. The most important of these is that the software can only be used on a stand-alone system, which is not connected to the internet. In general, working with a stand-alone system is something that has been

dying out rapidly over the past years. Information is increasingly being stored in the cloud. Software applications, and software updates, are only available via the internet. As such, lots of organisations, such as municipalities, do not actually have access to any personal computers that are not, or have not been, connected to the internet in one way or another.

The course of affairs at municipalities was not taken into account in the investigation by Fox-IT. This was noted (page 30): 'Furthermore, no measures were taken to ensure and/or check that all municipalities actually follow the recommendations to use a stand-alone system and/or networks that are not connected to the internet. In addition, there is the possibility that official reports can be printed from a workplace in the normal office environment of the municipalities, as no specific instructions about this are provided. Fox-IT did not carry out any investigations into the actual security of the IT infrastructure with respect to the ESS servers and/or clients at the various municipalities'

Aside from these possible oversights related to the use of hardware and software, there are other stages in the process during which it is tempting to rely solely on the software and to leave out all sorts of controls. That is the case with the installation of the software, for instance: does the user know for certain that he/she is installing an official version that hasn't been tampered with? Is the installation process supervised, so that whoever is installing the software is not able to make any modifications?

8.2 Unclear powers

The Dutch administrative system is characterised by an intricate interplay between the central and local government. This also applies to elections. Furthermore, a role and responsibilities are set aside for an independent Electoral Council, as the Central Electoral Committee. The Ministry of the Interior and Kingdom Relations is responsible for the regulations and the conditions. Municipalities are responsible for the implementation of the elections themselves. Subsequently, the Electoral Council then takes back responsibility when it comes to determining the results. In this interplay, it is not clear in advance who is now actually responsible for the use and implementation of the supporting software. Initially, this software was developed by the Electoral Council. The Electoral Council took charge of the independent management of the software, but it does receive financial funds from the ministry for this purpose. Municipalities can decide for themselves whether they want to use the software in their local election process. Considering this, it is very questionable as to whether it was up to the minister to prohibit the use of this software, but in view of the public stir it caused, none of the parties involved deemed it relevant to open up a public debate on this issue.

8.3 Is it possible without the use of software?

Elections require many intensive logistical operations. It goes without saying that the use of computers and software can simplify these processes and make them less onerous. It is well known, for instance, that people will make counting errors if they can

only make use of 'figures on paper'. Also, many other errors may then occur. In the weeks during which a general prohibition of the use of software was on the cards, several larger municipalities stated that it would take them days to determine the results manually. This would have put the rest of the process, in which a number of deadlines are set out in law, under a great deal of pressure.

The ultimate written report of the elections to the Dutch Lower House and the results (official report) comprises no less than 300 pages. The basic texts of this report are pre-programmed in the software. Had all the software been prohibited, it would have been almost inconceivable to type out all of these texts and figures again in such a short amount of time.

9 What next?

In 2018, elections to the Municipal Council are set to take place in the Netherlands. Municipalities will then also want to use software. In a maximum of four years, another election will be held for the Dutch Lower House. Structural measures will need to be taken to prevent a new discussion about the reliability of determining the results.

It goes without saying that the weaknesses in the software and the application thereof indicated by Fox-IT should be repaired as much as possible in the limited time before the 2018 elections for the Municipal Council. The Electoral Council is currently discussing the possibility of a more fundamental redesign of the underlying architecture for the use of the supporting software, so that the whole process involves greater security in the integrity of the software and safeguards against both manipulation and human errors.

In our view, an effective redesign and application of supporting software in elections should be aimed at promoting maximum transparency for both the election process and the determination of the election results. When maximum transparency is created, any manipulation of the published data cannot, and will not, go unnoticed. Furthermore, using supporting software will help to reduce the common mistakes that are an inherent part of the paper process. This relates to (preventing) counting and transfer errors.

The election process might benefit from allocating supporting software with a bigger role. Sure, at a first glance this seems to be in contrast with the initial response of the minister when he prohibited the use of the software, to avoid any doubt on the results. In our opinion, however, a bigger role of the supporting software will contribute to a more transparent and reliable election process.

10 Annex A.

In the standard election process that was used up until 2017, interim results of counts were transferred to a USB stick and subsequently re-loaded from the USB at the principal electoral committee. In order to ensure that the data on the USB stick was not manipulated between the moment of transfer and uploading, a number of safeguards were incorporated into the process. This process and the safeguards are described as follows in the Fox-IT report from 2017 (see pages 21 and 23):

'The digital count file (PSB-EML) contains all entered N10 vote totals alongside the aggregate vote totals (as on the paper N11 PV [official report]).' In order to safeguard the integrity of the PSB-EML file during transport, ESS calculates a cryptographic hash over the contents of the file. This hash value is also included on every page of the paper N11 official report. The N11 official report signed by hand as well as the digital PSB-EML file (on a USB stick) are subsequently taken to the principal electoral committee in person.

The principal electoral committee imports all PSB-EML files that it has received from the municipalities (PSBs) into the ESS (programme P4_HSB). To perform an integrity check of the PSB-EML file, the user is asked to enter the first four characters of the hash value. This hash value can be found on the paper N11 official report provided. The remaining characters of the hash value are displayed to the user in ESS. If the characters entered correspond with the hash value of the PSB-EML file that the ESS itself has calculated, the vote totals of the municipality in question (PSB) are transferred from the PSB-EML file.

After all vote totals from the municipalities of the respective electoral district have been entered and the necessary functional checks have been carried out by ESS, the process is allowed to continue. ESS generates two types of file when creating the final results for the principal electoral committee:

*1. **O3 PV**: an official report to be printed O3*

The O3 official report contains the vote totals aggregated by the ESS of the N11 official reports of the municipalities, thereby forming the vote totals of the respective electoral district (per list and per candidate). The printed O3 official report is determined during a public session and signed by the chair and members of the principal electoral committee.

*2. **HSB-EML file**: a digital count file in XML format generated by a principal electoral committee. The digital count file (PSB-EML) contains all entered N11 vote totals alongside the aggregate vote totals (as on the paper O3 official report). The individual N10 vote totals are no longer present in this file, contrary to the PSB-EML. In order to safeguard the integrity of the HSB-EML file during transport, ESS calculates a cryptographic hash over the contents of the file. This hash value is also included on every page of the paper O3 official report.*

The O3 official report signed by hand in addition to the digital HSB-EML file (on a USB stick) are subsequently taken in person to the Central Electoral Committee. Besides the HSB-EML file generated by the HSB, the PSB-EML files are also sent from the PSBs to the Central Electoral Committee.