

Cross-border Exchange and Comparison of Forensic DNA Data in the Context of the Prüm Decision

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DIRECTORATE GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT FOR CITIZENS' RIGHTS AND
CONSTITUTIONAL AFFAIRS

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STUDY

Abstract

This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the LIBE Committee, provides an overview of the Prüm regime. It first considers the background of the Prüm Convention and Prüm Decision. The subsequent two chapters summarize the Prüm regime in relation mainly to DNA data looking at value and shortcomings; and ethical, legal and social implications of forensic DNA typing and databasing in relation to the Prüm regime. Finally, based on the analysis, it provides the policy recommendations.

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LIST OF ABBREVIATIONS

AIMs	Ancestry Informative Markers
CODIS	US Combined DNA Index System
DAPIX	Working Party on Information Exchange and Data Protection
DNA	Deoxyribonucleic Acid
ECtHR	European Court of Human Rights
EDPS	European Data Protection Supervisor
EFSA2020	European Forensic Science Area by 2020
ENFSI	European Network of Forensic Science Institutes
EU	European Union
FDP	Forensic DNA Phenotyping
HVC	High Volume Crimes
MAP	Mutual Assistance Procedures
MLA	Mutual Legal Assistance
MPS	Massive Parallel Sequencing
NCP	National Contact Point
NDNAD	National DNA Database of England and Wales
NICC	National Institute for Criminalistics and Criminology
PCR	Polymerase Chain Reaction
PIES	Prüm Implementation, Evaluation, and Strengthening of Forensic DNA Data Exchange
PoFA	Protection of Freedoms Act 2012
SNPs	Single Nucleotide Polymorphisms
STRs	Short Tandem Repeats
SV	Severe and Violent Crimes
VRD	Vehicle registration data

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EXECUTIVE SUMMARY

This study considers the 2005 Prüm Convention, the 2008 Prüm Decision, and the resulting Prüm regime. The study's main focus regards the cross-border exchange and comparison of forensic DNA data. The Prüm regime refers to that exchange and comparison as well as the resulting cross-border exchange of personal information and intelligence between authorities involved in crime fighting. Main elements of the Prüm regime as well as some of the study's main findings are reported here:

- The Prüm Convention of May 2005 is an agreement between Belgium, Germany, Spain, France, Luxembourg, the Netherlands, and Austria. Aimed at stepping-up cross border cooperation to fight terrorism, cross-border crime and illegal migration, the Prüm Convention set provisions for exchanging data regarding DNA, fingerprints and vehicle registration plates (VRD).
- On 23 June 2008, the EU Council transposed parts of the Prüm Convention into EU *acquis*. As a result of the Prüm Decision, data on DNA, fingerprints and VRD became available and searchable for each EU Member State, for the purpose of the stepping up of cross-border cooperation, particularly in combating terrorism and cross-border crime. In 2009 Iceland and Norway decided to make DNA, fingerprints and VRD data available but are not operational yet. In May 2018, negotiations between the EU and Switzerland and Liechtenstein were concluded on the agreement to implement the Prüm Decision and the Council is expected to adopt a draft agreement in the near future.
- By August 2011, all EU Member States were supposed to have complied with the Prüm Decision, however, most countries were unable to do so due to inter alia pending legislation, technical issues, staffing problems or financial limitations.
- In May 2018, and despite significant progress and evaluation visits, some Member States were still in the process of implementing the Prüm Decision regarding exchanging and comparing DNA data. The draft Council Implementing Decision for Croatia has been submitted to the European Parliament. Ireland and the UK have been evaluated and the evaluation reports are under discussion within the relevant Council Working Party. Italy has submitted the relevant questionnaires.
- It is anticipated that the Prüm Decision will be implemented by all Member States by spring 2019.
- Very little information regarding the cross-border exchange of fingerprints and vehicle registration data is publicly available. Because much more information is accessible on the exchange and comparison of DNA data, this study focuses on the cross-border exchange and comparison of DNA profiles.
- This study considers the Prüm Decision as a regime. Consequently, it not only examines and reviews cross-border exchange and comparison of DNA data (Step 1) as part of the Prüm Decision, but also addresses the cross-border exchange of personal information and intelligence between national authorities involved in criminal investigations (Step 2). While technically Step 2 is not part of the Prüm Decision it is neatly connected to Step 1.

- The Prüm Decision produces intelligence for authorities involved in criminal investigation and prosecution through cross-border exchange and comparison of data on DNA, fingerprints and VRD. Based on a hit/no hit cross-border data comparison, Prüm might lead to cross-border exchange of information pertaining to suspects and unsolved crimes, potentially leading to prosecutions and convictions; and domestic authorities are interacting more with their international partner-organizations.
- Commentators have expressed some criticism of the Prüm Convention and Prüm Decision for lacking democratic and judicial control, as well as for deficits in transparency and equality. They have also questioned the legality and legitimacy of the Prüm Convention and Prüm Decision.
- Others have argued that the Prüm Treaty and the Prüm Decision were consistent with the rules available at the time and thus they should be considered as being enacted while respecting the principles of procedural legitimacy.
- The Prüm regime is a network of national forensic databases aimed at generating intelligence for investigative authorities across borders. Practitioners and professionals involved in daily cross-border exchange of DNA data—or Step 1—seem to agree that the Prüm regime works technically.
- Many hits produced in the Prüm regime are not followed-up by national crime investigative authorities, and it seems even less hits are used as evidence in courts of law. While not part of the Prüm Decision, Step 2 poses operational challenges for the Prüm regime's utility.
- Several reasons add to the loss of hits throughout cross-border interaction. Among them are: organizational and jurisdictional differences between international partners, the selection and evaluation of hits by custodians at national level, the prioritization by national criminal investigators and prosecutors, and hits with victims, criminal investigators or passers-by.
- Accurate, quantitative and up-to-date information regarding Step 1 (e.g. the number of forensic data hits produced between Member States and the number matches forwarded to criminal investigative authorities) and Step 2 (e.g. how many of those reported matches lead to the exchange of personal information or intelligence and how often such intelligence is used as evidence in a court of law) is key to understanding the efficacy and utility of cross-border exchange and comparison of DNA profiles.
- However, exactly that information—for Step 1—is only publicly available by sending a request to the so-called Access to Documents department. The request is subject to an assessment, and a possible outcome of that assessment is that the document is not released. Any data regarding follow-up in Step 2, with one exception, is publicly unavailable.
- A Dutch study systematically collected information and reviewed how effective cross-border DNA profile exchange and comparison is. They found that less than 10% of hits were used in criminal proceedings. It has not been possible to find similar studies for other Prüm Member States.

- Low utility of cross-border DNA exchange and comparison seems contradictory to the often-reported usefulness and effectiveness of DNA exchanges in the fight against cross-border crimes.
- Forensic DNA typing, databasing and cross-border exchange and comparison of such data pose risks for privacy and data protection. It is argued that they should therefore be legislated and governed according to the highest possible standards.
- Systematically collected, available and accessible information is required to objectively and reproducibly evaluate utility of cross-border DNA data exchange and comparison (and by default the Prüm regime). Subsequently, whether the Prüm regime can be considered a proportional crime control mechanism remains a question yet to be answered.
- DNA hits are reported if a profile with at least six loci matches another profile. Considering that millions of DNA profiles are exchanged and compared in the Prüm regime, the six (and seven) loci matching rule is considered by many to be too low because of the high frequency of false-positive matches reported.
- Some jurisdictions report, request and/or submit personal information based on those six and seven loci matches, without comprehensive follow-up forensic and tactical work. Based on such matches, cases have been found where citizens have been arrested and undergone police suspicion and scrutiny until proven innocent.
- Members of the European Parliament should anticipate that, once the Prüm Decision has been fully implemented by all Prüm countries, the Commission might decide to submit a legislative proposal to amend the Prüm Decision.
- Issues that are of great concern include modernization of the technology and infrastructure and whether new forensic data modalities (e.g. data on weapons, facial recognition, DNA profiles of missing persons and unidentified corpses) should also be exchanged and compared in a Prüm-like manner.
- An important issue deserving further consideration is the evaluation of follow-up procedures (e.g. requesting another Member State to share personal information after a reported hit or responding to such international legal assistance or MLA request) in Step 2. While not part of the Prüm Decision, a further harmonization and simplification of Step 2 would contribute to increasing the utility of the Prüm regime.

1. A DESCRIPTION OF THE BACKGROUND AND RATIONALE OF THE PRÜM DECISION

On 27 May 2005, government officials of Belgium, Germany, Spain, France, Luxembourg, the Netherlands, and Austria agreed to commence the exchange of data relating to DNA, fingerprints and vehicle registration plates (VRD). Data exchange between these seven countries aimed to step up cross-border cooperation to fight terrorism, cross-border crime and illegal migration. As the meeting took place in Prüm, a small town in Germany, the agreement was coined the Prüm Convention.¹ Between 2007 and 2008, Bulgaria, Portugal, Sweden, Greece, Finland, Hungary, Italy, Romania, Slovakia, and Slovenia ratified or acceded to the Convention also.²

The Prüm Convention came about, against the general backdrop of free movement of persons between EU Member States and the elimination of internal border controls, which was to be balanced by efficient cross-border cooperation between national law enforcement authorities of the Member States.³ The Convention was designed in a way that facilitated adaption of its provisions to the EU legal framework. In 2007, the EU Council of Ministers of Justice and Home Affairs decided to transpose parts of the Convention's agreements on the exchange of data regarding DNA profiles, fingerprint and VRD into EU law; and on 23 June 2008, Council Decision 2008/615/JHA and Council Decision 2008/616/JHA were adopted (Council 2008a, 2008b).⁴ The Decision contained:

"provisions which are based on the main provisions of the Prüm Treaty and are designed to improve the exchange of information, whereby Member States grant one another access rights to their automated DNA analysis files, automated dactyloscopic identification systems and vehicle registration data (Council 2008a: 2).

The Prüm Decision ruled that each Member State implements national contact points (NCP) for the exchange of each data modality, and that they are to be governed in accordance with national laws. NCPs became the designated national units responsible for searching the databases of their international partners.

Although the Prüm Decision legislates cross-border exchange of three data types, the mutual automated access to DNA databases across borders might be considered as the most significant aspect. This is partially reflected, for example, in the number of news items on DNA hits, issued reports and scholarly studies available on the exchange of DNA data vis-à-vis a lack of items, reports and studies for fingerprints and VRD.⁵ This study will mainly focus on the practices, arrangements and execution of the cross-border exchange of forensic DNA data in the context of the Prüm Decision.

¹ For matters of consistency, this text refers to the Prüm Convention. It is however important to realize that scholars and analysts have been using the terms Prüm Convention and Prüm Treaty interchangeably.

² See Balzacq et al. (2006) and Luif (2007) for a more extensive and detailed analysis of the Prüm Convention.

³ In this context, the Schengen Agreement which abolished checks at common borders of EU Member States as well as the Hague Program which fostered law enforcement cooperation in criminal matters between Member States are important.

⁴ Note that for example, the aim of fighting illegal migration was not adopted in the Decision. They were published in the *Official Journal of the European Union* on 6 August 2008 and took effect on 26 August 2008. In the remainder of this study, these two decisions (in plural) are referred to as the Prüm Decision (in singular). See Guild (2007a), Bellanova (2008) and Santos (2016) for a more extensive and detailed analysis of the Prüm Decision.

⁵ This study has used data from publicly available information. Due to language constraints as well as information made available by national database custodians, the focus of this study mainly regards north-west European countries.

Because the Prüm Decision is part of EU *acquis*, it became mandatory for EU Member States to make data held in these databases searchable to other Member States on a hit/no hit basis. Thus, when the Prüm Decision came into force, establishing a national DNA database—including drafting, ratifying and enacting national legislation—became compulsory through EU law. In August 2011, all Member States were supposed to have complied with the Prüm Decision. However, apart from the ten Member States already operational, not more than two additional Member States complied with the legal and technical provisions for DNA data exchange under the Prüm Decision.⁶ By the end of October 2012, 18 Member States had implemented the Prüm Decision.⁷ Writing in May 2018, some Member States are still in the process of implementing the Prüm Decision (see Table 4).

It is important to note that the practices of the Prüm regime can be divided in two different steps. Step 1 involves the provisions as stipulated in the Prüm Decision pertaining to the automatic exchange of information relating to DNA, fingerprints and VRD, and is followed-up by mutual assistance procedures (MAP) or Mutual Legal Assistance (MLA) requests. Informing domestic criminal investigators and prosecutors, MAPs or MLA requests, and subsequent follow-up by international partners is commonly referred to as Step 2:

“In the case of data from national DNA analysis files and automated dactyloscopic identification systems, a hit/no hit system should enable the searching Member State, in a second step, to request specific related personal data from the Member State administering the file and, where necessary, to request further information through mutual assistance procedures (Council 2008a: 2).⁸

Requesting personal data through MLA or MAP requests, are technically not part of the Prüm Decision; they are consequently governed according to national laws and legal assistance rules of the Member State providing the requested data.⁹

The Prüm regime has now been operational for over a decade. In January 2007, Germany and Austria started comparing DNA data held in their national databases under the Prüm Convention for the first time:

“Already at this early stage, the automatic information exchange has brought about noticeable operational success: for instance, the German authorities matched DNA profiles of open cases against data held by the Austrian authorities and found hits in 1510 cases. In this context 710 open traces from Germany could be attributed to persons known to the Austrian criminal prosecution authorities. Broken down by types of crime, 41 hits in homicide or murder cases, 885 hits in theft cases, 85 hits in robbery or extortion cases were found” (House of Lords 2007: 16; see also Machado and Granja 2018).

By connecting DNA databases, DNA traces from unsolved crimes held in the German national database have resulted in matches to 710 individuals whose DNA profiles are held in the Austrian database. In the subsequent years, as more and more EU Member States have become Prüm compliant, more national DNA databases have become connected. For example, while the EU consists of 28 Member States, the national DNA database of the

⁶ <http://data.consilium.europa.eu/doc/document/ST-17761-2011-INIT/en/pdf> (accessed 22 May 2018).

⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0732&from=EN> (accessed 28 May 2018, with minor amendments).

⁸ Mutual assistance procedures include those adopted in accordance with Framework Decision 2006/960/JHA.

⁹ Step 2 is linked closely to Step 1 and therefore important for the full consideration of the Prüm regime.

Netherlands is currently connected to national DNA databases from 22 other EU Member States. Exchanging DNA data has, as per 1 March 2018, led to 12 323 matches between the Dutch database and the 22 other databases. Matches include those between traces and persons, traces and traces, and persons and persons. While such impressive numbers provide clear evidence of the technical effectiveness of cross-border DNA data comparison, to date, only one study has attempted to record how many of these hits led to convictions (see Taverne and Broeders 2015 who found only a small number of matches resulted in a conviction; 3.3.3.2). Thus, reporting DNA matches does not provide a good measure for determining the utility of such a mechanism. The Prüm Convention and Decision as well as the practices of the Prüm regime, have been critically received by academics, committees and NGOs for over a decade. Among the main problems of the cross-border comparison of DNA data are:

- Very limited information regarding utility and efficacy is publicly available. Data deficiencies render it difficult to assess whether the Prüm regime is a proportional mechanism. This becomes all the more problematic as inter alia genetic, individual and familial privacy are at stake in forensic DNA typing and databasing.
- While many hits are generated during Step 1—the cross-border comparison of DNA data—they are subject to selection, evaluation and prioritization resulting in drop-out of reported hits. Matches reported to criminal investigative authorities are also subject to further selection, evaluation and prioritization, resulting in further drop-out. Consequently, many of the initially reported hits are not followed-up in Step 2. As a result, a small but unknown percentage of the total generated hits in Step 1 are being used as evidence in a court of law.
- The rules for reporting currently allow for hits based on six and seven matching loci to be utilized. While millions of DNA profiles are being compared across the EU, hits based on six and seven loci are often false-positive matches. While some experts and professionals call for increasing the matching standards, other Prüm Member States oppose changing these because that could potentially lead to missing many matches. In addition, it is of the utmost importance that all hits are rigorously followed-up, to avoid potential wrongful incrimination.

It is anticipated that the Prüm Decision will be implemented by all Member States within the next year, 2019. In relation to the exchange of DNA information, Italy has recently submitted the data protection questionnaire and thus is preparing a pilot-run with another Prüm country (or countries), and evaluation reports for Ireland and the UK have been submitted (see Table 4; 3.3.1). Once the Prüm Decision is implemented by all Member States, it might be amended on the Commission's initiative.¹⁰

This study provides a comprehensive analysis of the available literature addressing ethical, legal and social implications considered in social scientific articles, reports and other written sources. This study, however, reflects an imbalance between the available literature on two different counts. Firstly, a lot has been published on cross-border exchange of DNA data comparison, but very little has been published on cross-border exchange of fingerprints and

¹⁰ In January 2007 the proposal by the German Presidency to transpose (parts of) the Prüm Convention into EU *acquis* not only received broad support during a Ministers meeting, but it was also decided that "solutions already existing in relation to the implementation of the Prüm Treaty must remain unchanged," see: https://www.parlementairemonitor.nl/9353000/1/j4nvgs5kjq27kof_j9vvij5epmj1ey0/vi3aqkaxuix2/f=/blq11264.p df (accessed 24 May 2018).

VRD. Secondly, the published accounts on cross-border DNA data exchange and comparison as well as the Prüm Decision are, in general but not exclusively, critical of the regime. This is one of the main reasons that this study focuses on the cross-border exchange and comparison of DNA data, emphasizing the critique. A small number of interviews with professionals involved in the Prüm regime were also conducted and their views are represented in subsequent sections.¹¹ Furthermore, input from a number of experts and scholars has been considered in the production of this study.

¹¹ Interviews involved a DNA database expert, three professionals working for the Netherlands Public Prosecution Service, and an official overseeing the implementation of the Prüm Decision.

2. THE ADDED VALUE AND SHORTCOMINGS OF THE PRÜM DECISION IN RELATION TO THE EXCHANGE AND COMPARISON OF DNA DATA

KEY FINDINGS

- Before the Prüm regime became operational, cross-border exchange of forensic data required a lot of work; data protection was not properly assured and results were highly uncertain. In short, common standards in managing and exchanging forensic data were required. The Prüm regime was a significant step towards solving these problems.
- The Prüm regime has been operational since 2007. Cross-border exchange and comparison of DNA data resulted in thousands of reported hits. These hits have led to arrests and subsequent prosecutions of an unknown number of suspects. Cross-border exchange and comparison (Step 1) has led to increased international cooperation between domestic organizations involved in criminal investigation and prosecution (Step 2).
- Each EU Member State organizes criminal investigation and prosecution, including forensic data custody, in different ways. Inherent differences and the complexity of national systems hamper cross-border exchange and cooperation and have been found to be persistent problems.
- After Step 1, reported hits are subject to high drop-out rates. Drop-out occurs when the assessment criteria of a hit (e.g. tactical, reliability, legal, priority and sustainability) by database custodians or the selection criteria of hits reported to investigative authorities (e.g. priority of a case, date when a crime happened) are not met. Consequently, only a limited number of hits are followed-up. Even less hits result in the exchange of cross-border exchange of intelligence and personal data and, potentially, prosecution.
- The number of hits demonstrate that the Prüm regime works on a technical basis and the drop-out rate shows that there is scope for improving procedures.
- By 2016, 6 120 000 DNA profiles of known individuals and 1 139 000 profiles of traces from unsolved crimes were available for cross-border comparison.
- If the UK, Norway, Switzerland and Liechtenstein were to become operational in the Prüm regime, approximately 5 300 000 reference profiles and 600 000 DNA profiles from unsolved crimes would additionally become available for cross-border comparison.
- DNA matches with only six or seven loci are reported as hits. However, in light of comparing vast amounts of DNA data, many reported hits are false-positives. Member States, experts and professionals have different opinions regarding increasing the number of loci to define a hit. Against increasing them is that potential valuable hits may be missed.
- While it is pivotal to do follow-up work on reported hits, those based on six or seven loci matches require extra attention. However, it was reported that not every country performs these quality assurance mechanisms. Omitting such quality checks potentially harms subjects living in the Prüm area.
- The highest possible standards for legislation and governance in forensic DNA data exchange and comparison must apply for two reasons. First, DNA profiles from known individuals allow, although indirectly, the identification of an individual. And

second, forensic DNA typing, databasing and exchange can potentially interfere with an individual's body, genomic material and genetic, individual and familial privacy.

- Much anecdotal evidence regarding the Prüm regime's success is available, but very little epistemologically-sound and reproducible evidence has been published; hardly any data is available or accessible to analyze the efficacy of cross-border exchange and comparison of forensic data like DNA profiles, fingerprints and VRD.
- Due to cross-border exchange and comparison of forensic data becoming more routinized and standardized, the main elements of the Prüm regime—including the science, the scientists, the laboratories, the evidence, the criminal investigators and prosecutors, and the applicable legal and broader regulatory frameworks—require further research on their implications.

In January 2007, England and the Netherlands began the process of trying to compare DNA data held on national databases. Because this pilot project was not part of the Prüm Convention, there was no mechanism or dedicated network for forensic DNA databases to communicate directly to one another. The authorities of the Netherlands posted a disk containing 2 159 DNA profiles of unsolved crimes to the UK Crown Prosecution Service. Nevertheless, it took a year before that disk reached the desk of the custodian of the National DNA Database of England and Wales (NDNAD). In January 2008, these 2 159 DNA profiles were finally compared with the almost four million DNA profiles held in the NDNAD, and lead to 45 potential matches. These matches underwent further testing and consequently only five were considered to be a real match—the remaining matches were identified as false-positive matches (see NFI 2008: 42). From this pre-Prüm DNA exchange exercise, significant lessons could be deduced. Firstly, it demonstrated the need for common standards in managing and exchanging data. Secondly, national differences in the investigation and management of crimes caused significant problems, demonstrated partly by the fact that the disc from the Netherlands was more or less in limbo for a year as it found its way to the appropriate UK authority. Thirdly, comparing vast amounts of DNA data potentially leads to many false-positive outcomes, and thus, a lot of follow-up work is required to ensure that these are weeded out rigorously and that any match is a true match (see Neyroud and Vassilas 2010: 81).

In creating a highly automated and standardized system capable of connecting national forensic databases and enabling the cross-border exchange and routine comparison of forensic data, it can be argued that only one of the three exemplary problems was remedied when the Prüm Convention and later the Prüm Decision came into force. The remaining two issues—national and organizational differences between Member States, and the high frequency of false-positive matches—remain significant problems. It is not easy to harmonize the vast differences in modes of intelligence and evidence production, let alone be competently able to do so between jurisdictions. Furthermore, national legislative and regulatory regimes of criminal investigation are extremely complex and sometimes, if not always, incompatible with regimes and practices in other countries. The practices of cross-border exchange of data are subjected to the process of becoming routinized, and standardized. These developments require a "closer examination of the science, the scientists, the laboratories, the evidence, and the applicable legal and broader regulatory frameworks" (McCartney and Graham 2018 in press). Cross-border judicial cooperation is and remains challenging, thus further research on the various implications of the exchange and comparison of cross-border forensic data is urgently needed. As matching DNA profiles

are really a matter of statistical reasoning, it is not expected that the problem of false-positive matches can ever be solved completely (see PIES 2016).

Against the backdrop of these two significant and persistent problems, an important question is, how successful is the exchange of forensic data in accordance with the Prüm regime? Simple as it seems, it is quite hard to answer. One measure of success has been the many success stories of the Prüm regime, for example:

"In several cases, cross-border cooperation through Prüm proved to be very successful for law enforcement.

For example, an elderly married couple was found killed in Vienna (Austria) in 2015. The Austrian police found DNA of the perpetrator on the crime scene, but no match in their DNA-database. By means of a Prüm data comparison, they found a match in the Netherlands DNA-database. Austria subsequently had a name matching the DNA trace and started searching for the perpetrator. It turned out that the suspect was active on social media and a couple of months later he was arrested in Germany. The extradition to Austria of the suspect needed the assistance of his state of origin, which meant another (fourth) Member State was to be involved. In Austria, the suspect admitted another murder in Sweden and an attempted one in Salzburg a few weeks earlier.

Another example was a rape in Munich (Germany). The police was able to seize palm print latent at the crime scene and a search in the national and international Prüm AFIS with the seized latent was launched. The latent had a hit in Austria. The police was able to identify the criminal and he could be arrested.

A last example from a case which was solved through Prüm, was an armed robbery in Köln (Germany). Two masked man, armed with handguns, robbed a gambling hall and stole money from the cash box. Through Prüm DNA comparison, Germany could identify one of the offenders. The man was registered in the Austrian DNA database after he committed store theft in Austria. The police was able to identify and arrest this person in Slovakia."¹²

The above are just three of many other examples of serious offenders being identified after a Prüm hit, and such stories are regularly reported in the media. While we must not underestimate the value of arresting criminals who may go on to commit new crimes, such examples likely exaggerate the efficacy of cross-border DNA data exchange. In an important report on the future of forensic bioinformation, McCartney and colleagues (2010) highlighted a significant shortcoming of cross-border exchange and comparison:

"There is a consistent, but almost anecdotal view held by experienced investigators about the value of routinely exchanging bioinformation for dealing with transnational crime. In the absence of statistical analysis and independent case evaluation however, it is difficult to reach an informed view about the optimal scale and arrangements for such cooperation" (McCartney et al. 2010: 119).

Another possible measure for evaluating the Prüm regime is analyzing the number of hits that are produced through the exchange and comparison of cross-border DNA data. This, however, is a very complex exercise. Despite Chapter 4 in the Council Decision 2008/616/JHA and a 2011 agreement between Prüm Member States on a model to make statistics available

¹² <http://data.consilium.europa.eu/doc/document/ST-9823-2016-INIT/en/pdf> (accessed 25 May 2018); see also Taverne and Broeders 2015: 1-2.

regarding DNA data exchange,¹³ data required to complete an evaluation of the utility of the Prüm regime are hardly publicly available (see Council 2008b: 71; Santos and Machado 2017¹⁴). An extensive search yielded only one document with the most basic statistics in 2011:

“Total verified matches for fingerprints in 2011: 2 553
Total DNA matches in 2011 according to current model: 20 719
Total VRD requests in 2011 for which information was found: 260 253.”¹⁵

In addition to this data, some DNA database custodians do report the number of Prüm hits. The 2016 annual report of the Dutch DNA database, for example, reported 10 286 hits between the first exchanges in 2008 and 31 December 2016 (see Table 1).

Table 1: Number of reported DNA Prüm hits with the Dutch DNA database

NL trace, foreign person	NL trace, foreign trace	NL person, foreign trace	NL person, foreign person	All hits together
3 876	2 893	1 599	1 918	10 286

Source: NFI 2017: 13

But 10 286 hits do not equate to the solving of 10 286 criminal cases. For Dutch criminal authorities, the most interesting category is “NL Trace, Foreign Person” because this indicates the number of DNA profiles from unsolved crimes held in the Dutch national database which matched the DNA profile of a known individual held in the database of another country. Thus, between 2008 and the end of 2016, 3 876 hits relevant for Dutch authorities were found; considered to be Step 1 of the exchange in Prüm terminology. But between Step 1 and Step 2—the phase where domestic investigative authorities commence exchanging relevant criminal intelligence—additional work is required leading to a high drop-out rate of reported hits in Step 1, to the number of hits forwarded to criminal investigators and prosecutors. For example, a database custodian assesses a hit in accordance with several criteria such as tactical, reliability, legal, priority and sustainability (see Taverne and Broeders 2015). When a custodian reports a hit to the relevant investigative authorities, that hit is again subjected to further selection criteria (e.g. priority of a case, date when a crime happened). Taverne and Broeders (2015)—one of the only available studies analyzing how many Prüm hits have been used to prosecute criminals (see also PIES 2016; Santos and Machado 2017)—found that, for the Netherlands in 2010, only 6% of the matches between DNA traces of unsolved cases and reference profiles held in foreign DNA databases made it to court, and that only 2% of the total number of matches identified were used in court. Relatedly, in 2012 the European Commission reported on the drop-out in Step 2 that the “automated search function is an enormous advance. But without a proper follow-up, ‘hits’ have hardly any

¹³ <http://data.consilium.europa.eu/doc/document/ST-14103-2011-REV-1/en/pdf> (accessed 31 May 2018).

¹⁴ Santos and Machado (2017) were able to analyze statistical data regarding the number of Prüm hits for the years 2011 to 2015. While they acknowledge that their data and scope of their analysis is limited, their research shows that such information potentially can be made available. Nevertheless, reference to the actual data, where and how they got it, or where it is accessible, is not reported in their article.

¹⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0732&from=EN> (accessed 28 May 2018, with minor amendments).

meaning for investigators.”¹⁶ Considering the abovementioned 3 876 hits, this would potentially—if the 6% remained stable—mean that, based on a Prüm hit, approximately 230 suspects were prosecuted in a court of law between 2008 and 2016. While 230 suspects prosecuted in court proceedings of course adds to more justice and possibly more safety, it is clear that such a number sends a very different message when compared to 10 286 or 3 876 hits reported initially.

While numbers like 10 286 or 3 876 hits, and even 230 prosecutions, demonstrate that the Prüm regime works, these numbers—apart from drop-out—demonstrate a significant shortcoming. There is no objective, reliable and easily-accessible information available that would render it possible to assess and evaluate a reproducible model of the efficacy of cross-border exchange of forensic data like DNA profiles. Until such information becomes available, it is difficult to see how any quantifiable, epistemologically-sound and authoritative claims can be made about the Prüm regime’s true utility and impact. Data deficiencies regarding the utility, efficacy and success of the Prüm regime is problematic because, on the one hand, much is invested in fully implementing the Prüm Decision and, on the other, forensic data are also inherently personal and thus sensitive information. Consequently, potentially sensitive and private information are exchanged routinely between Prüm Member States but the benefits to society and the criminal justice systems remain unclear.

To produce a DNA profile, an individual’s bodily integrity must be infringed in order to obtain a biological sample, for example by swabbing, drawing blood or scraping someone’s finger nails. Once a sample has been obtained, judicial or police authorities have acquired the most personal information of an individual, their genetic information which contains not only information relevant for forensic DNA typing and databasing, but also information which holds clues about kinship; visible features like ancestry, sex, hair and eye color; and possible susceptibility to certain diseases and other inheritable traits (M’charek 2008; Toom et al 2016). Thus, at stake in forensic DNA analysis are an individual’s body, genomic material and genetic, individual and familial privacy (Toom 2011). Infringements of body and personal life, and genetic analysis of biological material in the context of crime control, should therefore only be allowed if there is very strong evidence of the efficacy and utility of the system. As demonstrated above and throughout this study, there is a knowledge deficiency regarding efficacy and utility of DNA databases and cross-border DNA data exchange. Such deficiency renders it very difficult to objectively assess whether the Prüm regime as a whole is a proportional crime control measure.

Prüm Member States retained approximately 6 120 000 DNA profiles of known individuals and 1 139 000 traces from unsolved crimes for cross-border comparison in 2016.¹⁷ With such large amounts of data being compared, six and seven loci hits become problematic, and interlocutors expressed concerns about reporting them. The exchange of large volumes of DNA profiles across borders has the potential to lead to billions of comparisons. In that context, the current standard of reporting six and seven loci matches becomes problematic as many false-positive matches will be identified (Van der Beek 2011; Prainsack and Toom 2013; PIES 2016). While every reported hit must be validated and assessed for evidential value, six and seven loci matches require additional forensic analysis to identify their value.

¹⁶ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0732&from=EN> (accessed 28 May 2018).

¹⁷ These numbers do not include the 5 300 000 reference profiles and 600 000 DNA traces included in databases in potential Prüm Member States—UK, Norway and Switzerland, see: <http://enfsi.eu/wp-content/uploads/2017/02/2001/ENFSI-Survey-on-DNA-Databases-in-Europe-June-2016.pdf> (accessed 22 May 2018). The UK’s House of Lords (2016) reported a strong support to participate in the Prüm regime after Brexit.

However, during an interview, it was suggested that not every country conducts the required follow-up research, i.e. the validation and assessment of the evidential value of the reported match.¹⁸ One interlocutor referred to instances where citizens were arrested as a consequence of such disregard for due process by some Member States. They were considered suspects until it transpired that those arrested were not actually involved in a crime because the hit was found to be a false-positive or other evidence was found to indicate they were unable to have committed that particular crime (e.g. suspect was abroad or imprisoned). This is one of the reasons why there are calls for higher standards (or loci numbers) as well as introducing additional legal safeguards to protect citizens before a hit is followed-up by police and prosecuting authorities (see GeneWatch 2015; PIES 2016).

¹⁸ This claim is also consistent with findings by Machado and Granja when they interviewed DNA database custodians about the Prüm regime: "We have good procedures in place to make sure that we first find out if it is a good match before it is reported to the authorities. So, I think, in [my country] there is no risk of a false positive match being used for legal actions. But I am not sure whether this is also the case in other countries" (2018: 252).

3. AN ASSESSMENT OF THE ETHICAL, LEGAL AND SOCIAL IMPLICATION OF FORENSIC GENETICS IN GENERAL, AND IN THE CONTEXT OF CROSS-BORDER COMPARISON OF THAT DATA IN PARTICULAR

KEY FINDINGS

- Forensic DNA typing and databasing are dependent on the law and legal system, science, civil rights, policing, and citizens' bodies and biological material therein. These practices, objects and logics are at the heart of democracy and a state of law. Forensic DNA typing and databasing therefore are highly political issues.
- Legislation and governance of forensic DNA typing and databasing requires a holistic approach where discussions about new legislation and regulation are not only a matter for legislators, forensic experts and legal professionals, but should also include the wider audience, including scholars and other citizens.
- DNA typing and databasing should be legislated, regulated and governed in accordance with democratic principles. The legislative process and resulting practices should be transparent, proportional and responsible; and high standards (e.g. data protection, proportionality of mechanism, due process) must apply.
- While the Prüm Convention and the Prüm Decision came about in accordance with democratic procedures and rules, scholars criticized them for their lack of legitimacy, transparency, and democratic and judicial checks and balances.
- A DNA database compares DNA profiles from known individuals to DNA profiles obtained from crime scenes. Sometimes a match is generated that supports a suspect's incrimination. At other times, however, a DNA match between a subject and an unsolved crime identifies a person of interest. Connecting a potential suspect to a crime requires a different policing strategy to secure a conviction, i.e. through which facts and circumstances is the potential suspect connected to the crime? Such policing strategy has been associated with the risk of tunnel vision and thus prosecuting and even convicting the wrong person.
- While there is little evidence of the critique about arresting, prosecuting and convicting wrong persons, there is also little evidence about the utility of DNA databases. Available evidence favors the deployment of DNA databases, yet effects are smaller than anticipated and results are often contradictory. Lack of required data and methodological challenges render it extremely hard to make substantive claims about the efficacy and utility of national DNA databases.
- Problems of collecting and examining data from cross-border DNA comparison poses even bigger challenges; while such data are available to the Council and to the Commission, accessibility for the public at large is restricted. At this moment, it is unclear whether statistics on the result of automatic data exchange will be made available on the Access to Documents websites. Would such data become available, they would be hard to compare because each country applies different categories and definitions.
- A Dutch study found only 7% of detected Prüm matches were followed-up by MLA requests, and 2% of matches were used in a court of law.
- Such limited efficacy contrasts with reports about the thousands of Prüm hits. While reporting such numbers exaggerates the efficacy and utility of cross-border DNA exchange and comparison, it also provides evidence that national authorities

perform extensive checks before they start interacting with foreign criminal investigative agencies.

- Drop-out of Prüm hits is the result of various mechanisms. They include: selection, evaluation and prioritization of DNA hits and follow-up procedures by custodians and criminal investigators; organizations which have to cooperate internationally with partners that have different competences sometimes rendering the exchange of information and intelligence difficult; and sub-optimal record keeping sometimes leads to DNA hits which are held unlawfully, and consequently, valuable intelligence cannot be exchanged. In addition, an unknown number of matches will be linked to individuals other than the perpetrator (e.g. crime scene investigator, passers-by).
- Another problem is the sheer volume of DNA data held on Prüm databases. In 2016, approximately 6 120 000 reference DNA profiles and 1 139 000 DNA profiles from unsolved crimes were available for cross-border exchange leading to billions of comparisons. The current matching rule of at least six full designated matching loci leads to many matches, many of which turn out to be false-positive matches.
- While the Prüm Decision set provisions to validate and check the evidential value of the matching profile, the omitting of such checks risks that wrong persons are arrested, incriminated or even convicted.
- It is expected that each Prüm Member State will have implemented the Prüm Decision by spring 2019. However, it seems unlikely that each Prüm Member State will also have commenced exchanging data with all other Member States operational for each data modality.

3.1 Main developments in science

The first publications about the most significant crime-fighting tool since the introduction of fingerprints, DNA fingerprinting, appeared in the mid-1980s (Jeffreys et al. 1985; Cole 2001). This technology has been used to clear individuals under suspicion, to incriminate suspects, and to prove the innocence of convicted individuals.¹⁹ Its successor-technology—short tandem repeats (STRs)—was first deployed in a forensic context in the mid-1990s and has become the workhorse of forensic modern-day DNA profiling. Compared to DNA fingerprinting, DNA profiles based on STR technology are *inter alia* easier to interpret, cheaper, quicker to determine, and matching profiles are accompanied by a statistical number which provides information about the relative strength of a match between two similar STR profiles (see Butler 2014). Another mid-1980s invention—polymerase chain reaction (PCR)—which multiplies DNA *in vitro*, has also been very important for the adoption of DNA typing by the criminal justice system. PCR rendered small biological traces with low quantities of DNA, suitable for genetic analysis (Butler 2014).

Before PCR became a standard technology in forensic laboratories, biological samples the size of a EUR 0,20 coin containing blood or semen were required for reliable DNA analysis. Given the necessity of such amounts of a sample, forensic DNA analysis was mainly restricted to severe violent crimes (e.g. sexual assault, homicide and aggravated assault). When PCR

¹⁹ Two American lawyers started the Innocence Project (www.innocenceproject.org) in 1992. In the 25 years thereafter, they have successfully proven the innocence of over 350 convicted individuals—many of whom were imprisoned for many years, some awaiting execution. Oftentimes, DNA evidence was essential in proving a miscarriage of justice. The Innocence Project has been adopted by lawyers and academics in many countries, including in the UK, Netherlands, Germany and Italy. The Innocence Projects clearly demonstrate that criminal justice systems are fallible.

became available, stains with a much smaller volume such as saliva on cigarette butts or very small blood stains became viable for forensic DNA testing and as such, forensic DNA analysis has now become the standard technology for most crimes, including burglary, motor vehicle thefts, mistreatment, etc. (Toom 2010).

3.1.1 Forensic DNA databases

With the introduction of STRs as the standard forensic DNA typing technology and the subsequent statistically capable comparisons, forensic DNA databases were also introduced. The first criminal DNA database, established in 1995, was the national DNA database of England and Wales (NDNAD; see Williams and Johnson 2008). Since then, forensic DNA databases have become a significant crime control mechanism, and have received a general support by inter alia legislators, policy makers, criminal investigators and the public at large (see Amankwaa 2018).

Forensic DNA databases typically retain two types of profiles: DNA profiles obtained from individuals (e.g. convicted offenders, suspects and/or volunteers), and DNA profiles produced from crime scene samples.²⁰ These two registers are automatically, instantly and continuously compared in efforts to genetically match known individuals to crime scene samples. Databases produce several kinds of matches:

1. A suspect's DNA profile is included in a national database and matches the crime scene sample they were arrested for;
2. A suspect's or convicted offender's DNA profile matches one or more DNA profiles of crime scene samples which were already on the database;
3. A DNA profile of a trace is uploaded to the database and it matches a DNA profile of a known individual already included in the database;
4. A newly uploaded DNA profile of a trace matches one or more DNA profiles obtained from crime scenes;
5. A DNA profile from a known individual matches the profile of a known individual.

Whereas in scenario 1, the match provides further evidence that the arrested person is involved in the crime or genetically links the suspected person to unsolved crime(s), scenario 2 and 3 give rise to the opening of a criminal investigation against the person whose DNA profile matches the crime scene(s). Scenario 4 genetically links various crimes and crime scenes to each other, for example burglaries in different cities—or in the context of the Prüm regime: matches found in different countries. And scenario 5 may indicate two different occurrences – a) the person is an identical sibling; or b) the person has previously been profiled.²¹ These five scenarios are associated with specific normative issues and questions (see 3.2).

Forensic DNA databases from different countries often have very different inclusion and data retention criteria (Hindmarsh and Prainsack 2010). They may have been in operation for more than 20 years, or only a few (Santos et al. 2013), and they may be governed according to very different standards and regimes (Toom 2014; Wallace et al. 2014). Such differences

²⁰ Recent years have seen also the inclusion of DNA profiles from missing persons and their family members in separate, non-criminal, registers. DNA profiles of missing persons and their families are significant for identifying, for example, bodies interred anonymously or recovered unidentified bodies.

²¹ While these examples refer to matches or hits in national databases, the scenarios for hits after cross-border exchange—like in the Prüm regime—are very similar. One significant difference however is that a cross-border hit requires MLA or MAP requests.

are often reflected in forensic DNA database sizes (see Table 2).²² Regarding governance standards and regimes, China's DNA database does not only retain profiles from criminals and suspects, but reports suggest that at least some regional databases include profiles from inter alia migrant workers, dissidents and minorities. As this example demonstrates, forensic DNA databases may not only be used for crime control, but also for the surveillance of citizens, and potentially to discriminate against a group of individuals. As such, databases such as those thought to be in existence in China provide a powerful reminder of the requirement to legislate and govern forensic DNA databasing in a manner that is democratic, responsible, and transparent, and in accordance with human rights standards (see Forensic Genetic Policy Initiative 2017).

Table 2: DNA database sizes of England and Wales, the USA and China

	England and Wales	USA	China
Number of individuals included in the national database	5 340 000	16 200 000	40 000 000
Size of the population ²³	58 381 000	325 719 000	1 403 500 000
Proportion of the population included in the database	9.14%	4.97%	2.85%

Sources: <https://www.gov.uk/government/statistics/national-dna-database-statistics>; <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/ndis-statistics>; <https://www.hrw.org/news/2017/05/15/china-police-dna-database-threatens-privacy> (accessed April 5, 2018).

3.1.2 Innovations in forensic genetics

Recent years have seen significant developments regarding forensic DNA analysis. One is related to the organization of so-called mass screenings where sometimes thousands of individuals are requested to volunteer a biological sample to exclude them as possible perpetrators of a severe crime. An example is the Marianne Vaatstra case in the Netherlands, where 8 000 citizens who matched a particular description (e.g. age) or were living in a specific location were profiled (see Jong and M'charek 2017). A secondary search strategy for which DNA databases can be used relate to the searching for partial matches. A partial match between a DNA profile obtained from a crime scene sample and a subject profile (from an individual already included in the database) may indicate a degree of relatedness (e.g. parent, sibling, child) due to the increased similarities between profiles of related individuals. Such search strategies have been described as familial searching (see Maguire et al. 2014) or finding a criminal through the DNA of their relatives (Bieber et al. 2006). A more recent development relates to the possible prediction of physical characteristics of an unknown individual from a biological sample recovered from a crime scene. Phenotypes like sex, age, hair and eye color can now be determined statistically by such techniques, using single nucleotide polymorphisms (SNPs). A recent review has shown that eye color can be predicted correctly in 84% of cases, and an accuracy rate of 93% is achieved when only brown and

²² While China's database currently holds the largest number of individuals, the NDNAD holds the largest proportion of its population. The NDNAD retains DNA profiles of over 5 340 000 individuals arrested or convicted for a recordable offence as per 31 December 2017. The US Combined DNA Index System (CODIS), holds over 13 200 000 offender profiles and over 3 000 000 arrestee profiles as per February 2018. Currently the largest forensic DNA database is thought to be maintained by China with, reportedly, over 40 million individual DNA profiles.

²³ Information regarding the size of the population was obtained from Wikipedia

blue eyes are considered (see Kayser 2015). In addition, ancestry informative markers (AIMs) have been selected that, upon examination of criminal samples, may provide clues about a person's ancestry and may provide some clues of how a person may look like (Phillips 2015). Mass-screenings, familial searching and forensic phenotyping are sometimes combined in policing practices, such as in the ongoing investigation of the murder of 11-year old Nicky Verstappen in the Netherlands.²⁴

3.1.3 Biolegal advances

STRs, PCR, DNA databases, SNPs, forensic phenotyping, AIMs, mass-screenings and familial searching are all forensic genetic innovations which offer new mechanisms for finding criminals or to generate suspects. However, these mechanisms require legislation and regulation before they can be deployed by criminal justice professionals. As such, these technologies and the laws to legislate and govern them, are engaged in dynamic and symbiotic interactions. Coined "biolegality," the ongoing interactions between biotechnological innovation and the law redefine rights, identities, credibility and status of suspect bodies and criminal evidence (Lynch and McNally 2009; Machado and Costa 2013). In a recent contribution, Wienroth and colleagues (2014) suggested that biolegal progress and its interplay of scientific, technological, legal and social issues can be understood as more or less chronologically ordered "waves," of which they identified four. In their ordering, the first wave was concerned with the credibility of DNA evidence in a courtroom; the second wave was focused on establishing, expanding and the use of forensic DNA databases; the third wave was characterized by extracting information from DNA profiles, like familial searching, forensic phenotyping and AIMs; and the fourth wave was distinguished as the contemporary developments in forensic genetics like massive parallel sequencing (MPS) and high-speed DNA profiling (or rapid DNA). As Table 3 clearly indicates, each of these waves are accompanied by other ethical, legal and social implications.

Having highlighted some of the main forensic DNA technologies and innovations, and outlined some of the main ethical, social and legal implications, the next section provides an overview of normative issues in relation to forensic DNA databasing in order to provide a more comprehensive insight into many of the normative issues of the Prüm regime.

²⁴ See <https://nltimes.nl/2018/02/26/mass-participation-dna-investigation-dutch-boys-murder> (accessed 14 May 2018).

Table 3: Four waves of the biolegal progress

	First wave	Second wave	Third wave	Fourth wave
Time frame	From 1985 onwards (especially 1990s)	From 1995 onwards	From early 2000s onwards	From 2010s onwards
Key scientific elements	DNA fingerprinting Standardization Calculation and evaluation of random match probabilities (RMPs)	Short tandem repeats Standardization and evaluation National DNA databasing Database searching and matching algorithms Bayesian reasoning	Phenotyping (eye color, hair color, etc.) Ancestry informative markers Familial searching	Next generation (high throughput) sequencing Rapid DNA
Ethical, social and legal aspects	Introduction into police work Statistical basis and weight of evidence Use in court	Privacy and equality issues raised by collection, retention, and use of databased profiles Cross-border data exchange and internationalization of DNA databasing and profile exchange (e.g. Prüm Treaty)	'Race' and 'ethnicity' conceptualizations and consequences Focus on categories of persons rather than identification of individuals International collaboration on DNA research	Diffusion of boundary between medical and forensic genetics On-going consideration of 'proportionality' in determining legal uses of innovations in DNA profiling and databasing

Source: Wienroth et al. 2014: 102 (adapted).

3.2 Normative issues of forensic DNA typing and databasing

The body of social science knowledge on the use and deployment of forensic genetics in crime control practices has steadily grown since the late-1990s. With backgrounds in inter alia law, sociology, anthropology, science and technology studies, surveillance studies, criminology and philosophy, contributors to this body of knowledge have engaged with forensic practitioners, police officials, policy makers and convicted offenders. Their qualitative, empirical analyses were based on documentary research, interviews and ethnographic studies, and offer a counterbalance to the discourses of forensic genetics as a "truth machine" (Lynch et al. 2008) producing "absolute truth" (Kruse 2010). While critical contributions speak to the four waves of forensic genetics as proposed by Wienroth et al. (2014), the discussion below regards the second wave simply because cross-border exchange and comparison of forensic DNA profiles is best understood as a second wave development.

3.2.1 Early 'second wave' publications addressing normative issues

Contributions of scholars working in the UK focusing on the NDNAD became influential from the mid-2000s (see McCartney 2004; Williams and Johnson 2008). Developments of the NDNAD were often a central focus because the model of the English and Welsh practices was considered to be world-leading. One of the first critical studies of the NDNAD was published in 2003 by Williams and colleagues. Their study was concerned with the interaction between the use of DNA in policing, and the creation and expansion of the NDNAD. They concluded that those interactions were not only facilitated by scientific and technical developments, but,

equally important, also by a redefinition of what was deemed an intimate sample. Thereby extending the criteria for inclusion of subjects in the NDNAD, and changes in the law aimed at the indefinite retention of profiles and samples (Johnson et al. 2003: 34). Their work clearly indicated that forensic DNA profiling and databasing is highly dependent on subjects' bodies and access to the biological samples therein. In this respect, forensic DNA databases and a citizen's biological body became intertwined through newly introduced legislation. That legislation limited an individual's right to an inviolable body, redefined what was considered to be an intimate sample, and redistributed the power for collecting those bodily samples from medical physicians to police officers.

Reviewing some of the available literature from the early 2000s, another leading scholar (McCartney 2004, 2006) problematized the often-rehearsed rhetoric that DNA databases produce swift and cost-effective criminal enquiries and convictions (Schneider and Martin 2001). She also argued that it is virtually impossible to prove that DNA databases enable speedier arrests, prevent criminal careers or save money. One reason for such problems was that no consensus existed on relevant definitions (i.e. what constitutes a hit and a match in the database). Therefore, she argued, a database's success cannot be assessed objectively (McCartney 2004: 162). In such and other contexts, McCartney warned against too much enthusiasm towards forensic DNA databases as they may foster abuse, mistakes, wrongful prosecutions, wrongful convictions and a suspect-society (McCartney 2004, 2006). This becomes even more problematic if one considers the logic of a DNA database, summarized by Williams and Johnson, as shaping an:

“enquiry by identifying potential suspects from the start rather than merely supporting their incrimination or exoneration after they have been nominated for attention by other more traditional—and often very protracted—forms of investigative practice” (Williams and Johnson 2006: 234).

Where there is no basis for suspicion other than a database hit—at any stage of the investigation—has been called a “cold hit suspect” (Cole and Lynch 2006: 47). The idea of the cold hit suspect is further captured in the concept of “reconstructive surveillance in which detection of an individual through the use of an archive is rendered ‘automatic’. Automatic here denotes the ‘engine’ of the archive [i.e. a DNA database]” (Williams and Johnson 2004: 7). DNA databases were thus depicted as automatic engines rendering cold hit suspects instantly and constantly. Intervening in policing logic resonates with a development often referred to as “intelligence-led policing” (McCartney 2004, 2006; see also Innes and Clarke 2009). As such, a reversal of policing logic was witnessed where facts and circumstances no longer lead the police to a particular individual but, instead, a criminal investigation is opened against a suspect after a DNA match is found between a profile and a crime scene sample. In this scenario, the new task for investigative authorities is to add the facts and circumstances to produce a compelling narrative of the crime (Williams and Johnson 2008). Such policing logic has been associated with the risk that investigators become susceptible to tunnel vision and thus, potentially, lead to wrongful convictions (McCartney 2006).

The development of the NDNAD and its inclusion and retention policies clearly demonstrated that there are limits to its size and expansion. Since 2001, NDNAD inclusion regimes have targeted anyone, including children (see Levitt and Tomasini 2006), who had been arrested

for any *recordable offence*²⁵, including inter alia being arrested for being drunk in a public space, or being arrested while participating in a demonstration that did not receive the approval of authorities. Considered like this, DNA database inclusion regimes are a highly political and politicized governance issue because they interfere and intervene in a state of law's power and citizens' legal position.

While the NDNAD expanded by including new categories of persons (i.e. from being charged with a serious arrestable offence to arrested for any recordable offence) as well as through retaining profiles and samples indefinitely, two cases became of great significance to halting the regime of an ever-expanding NDNAD. British citizens *S.* (a minor) and *Marper* were both arrested for a recordable offence, but not convicted. Because they were legally innocent, both *S.* and *Marper* requested to have their fingerprints, their DNA profiles and the underlying biological samples destroyed. However, at the time the law permitted the indefinite retention of such material, and the police refused to remove and destroy them. Following a long trajectory of domestic appeals, in 2008 the case was concluded by the European Court of Human Rights (ECtHR). Article 8 of the European Convention on Human Rights was invoked, which protects the Right to respect for private and family life:

“1. Everyone has the right to respect for his private and family life, his home and his correspondence.

2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.”

Based on its reading of Article 8, the ECtHR decided in *S. and Marper v. the United Kingdom* that the indefinite retention of fingerprints, DNA profiles and biological samples of persons suspected but not convicted of offences “constitutes a disproportionate interference with the applicants’ right to respect for private life and cannot be regarded as necessary in a democratic society” (ECtHR 2008: 35). ECtHR’s decision is a clear reminder that there are limits to forensic DNA profiling and sample inclusion and retention regimes—as they were formulated pre-*S. and Marper v. the United Kingdom*.²⁶ Since the *Marper* decision, the rules governing the retention of DNA data on the NDNAD have changed with the implementation of the Protection of Freedoms Act 2012 (PoFA). The new Act stipulates different treatment of data from convicted adults and juveniles, unconvicted individuals arrested or charged for a serious offence, and those arrested for a minor offence. In a recent review regarding the implementation of PoFA, evidence of an improvement in the NDNAD’s performance was found (Amankwaa and McCartney 2018). However, there are concerns that the new rules that require the temporal retention and subsequent deletion of DNA data from unconvicted individuals may lead to public security risks.

²⁵ In British law, such offences currently include drunkenness in a public place, causing harassment, alarm or distress, taking part in a prohibited assembly, and taking or riding a pedal cycle without owner’s consent, see <http://www.legislation.gov.uk/ukxi/1997/566/regulation/2/made> (accessed April 6, 2018).

²⁶ For further information, including the response to *Marper* by the UK government, see McCartney 2012, Toom 2012a, and <http://www.genewatch.org/sub-570225> (accessed 12 May 2018).

3.2.2 Recent 'second wave' publications addressing normative issues

The work of Williams, McCartney and others has guided subsequent European and American critical scholarship on forensic DNA databases. This body of literature is interesting in particular because it articulates the many differences between national DNA databases. For example, the NDNAD of England and Wales was established in 1995, Austria and the Netherlands followed in 1997, Germany in 1998, Finland and Norway in 1999, and Denmark, Sweden and Switzerland in 2000 (INTERPOL 2008). Other countries were less expeditious in setting up DNA databases. By 2011, countries like Italy, Greece, Malta, Cyprus, Portugal and Ireland were still in the process of establishing forensic DNA databases. These differences in implementing national databases between EU Member States also reflects differences in political, legal and governance structures among Member States. This was most significantly brought forward in an edited volume comparing governance of DNA profiling and databasing in, among others, England and Wales, Austria, the Netherlands, Norway and Portugal (Hindmarsh and Prainsack 2010; see also Williams and Johnson 2005; Heinemann et al. 2012; Machado and Prainsack 2012; Toom 2012a; Santos et al. 2013).

The contributors to the edited volume recorded substantial differences between inter alia inclusion, retention, and removal regimes; custodianship; competencies of authorities; and juridical-political systems. For example, while the NDNAD and the Austrian DNA database are police databases, the Dutch DNA database was established under the responsibility of the Ministry of Justice and hence is connected to the Office of the Public Prosecutor.²⁷ Another example relates to the trust that the citizenry places in its institutions. While Portuguese citizens were reported to have low confidence in public institutions, including the criminal justice system (Machado and Silva 2010; Machado and Prainsack 2012), citizens of Austria and Norway for example, highly value their institutions (see Prainsack 2010; Dahl 2010). Such levels of trust translate to very different inclusion regimes and DNA database sizes—both absolute and relative to the population—of national forensic DNA databases. Where the relative size of the NDNAD currently holds approximately 9.14% of its population, approximately 1.6% and 0.02% of the population are included in the Dutch and Portuguese database, respectively (see Santos et al. 2013; Santos 2016). These differences are powerful reminders that national, legal, organizational and historical contexts feed into the processes and practices of establishing and maintaining DNA databases. Or as contended by Prainsack and Hindmarsh (2010) regarding *good* governance of DNA databases:

“What is ‘good’ in this context depends on the particular configurations of collective values, norms and narratives in each country—even if we agreed that ‘good’ would need to meet the requirement of striking a fair balance between the public interest in efficient criminal investigation on the one hand, and individual civil rights and liberties on the other” (p.339).

Legislating and governing DNA databases is an art where many variables require careful weighting by political leaders, policy makers, practitioners and the public at large, including scholars, advocates and other citizens concerned with the protection of civil rights. Moreover, public discussions aimed at fostering public and general support for establishing and expanding DNA databases are essential (see McCartney 2004, 2006; Wallace et al. 2014; Amankwaa 2018). This latter argument becomes even more important in light of the severe

²⁷ In 2010, the duties of the Dutch Ministry of Justice were combined with the Ministry of the Interior (and Kingdom Relations) and together they became the Ministry of Justice and Security.

impact forensic DNA typing and databasing have on, among other things, objects, practices and logics like law and legal systems, science, civil rights, criminal conduct, and policing.

Many of these objects, practices and logics and their impact have been described since the start of the 2010s. Take for example the notion of “function creep,” the slow and gradual widening of the deployment and use of a particular technology or system beyond the purpose for which it was originally intended (see Dahl and Saetman 2009; Prainsack 2010). This notion is exemplified by the searching of DNA databases not only for full-matches, but also for partial-matches—familial searching is currently allowed in England and Wales, the Netherlands, France and Germany.²⁸ As a result, it is not only those individuals that are included on a DNA database who are subjected to reconstructive surveillance, but also their biological kin. As such, suspicion can be extended to complete families, or the “suspect family” (Toom and M’charek 2011). Another example of function creep, are the biological repositories containing DNA samples included in forensic DNA databases. While those biological repositories’ function was to enable the establishment of digital databases, those same criminal justice samples are now also used, in some jurisdictions, for scientific research (see Levitt 2007; Toom 2012b). Both changes in deployment—familial searching and scientific research on criminal justice samples—come with very different normative, ethical and governance issues for forensic DNA databasing (see Toom 2012b; Wienroth et al. 2014).

Others have expressed their concerns about the balancing of liberty, social equity and security in the context of ever expanding DNA databases. Writing mainly from an American perspective, Krinsky and Simoncelli (2011) scrutinized, among other things, genetic surveillance, racial disparities, errors and the efficacy of DNA databases. They problematized for example, that while medical data is protected according to the highest standards, forensic data is utilized for crime control, resulting in a double privacy standard (2011: 227), and scientific research on criminal justice samples are an example of this. They argue further that DNA databases don’t just ‘capture’ the criminal population but, rather, they mirror the systemic racial bias of the criminal justice system. Consequently, people of color living in the USA are more prone to be included in state databases and the national database CODIS (Krinsky and Simoncelli 2011: 273; Ossorio and Duster 2005; Washington 2010). In another chapter, Krinsky and Simoncelli turn to the commonly held belief that DNA evidence is infallible, and subsequently expose a number of myths regarding DNA typing and matches. Among the many issues they discuss in this context, they argue that errors in the chain of custody, contamination, interpretation of results and database search strategies may all cause mistakes, coincidental matches or adventitious matches (Krinsky and Simoncelli 2011: Chapter 16; McCartney 2004, 2006; Murphy 2017). And lastly, they critically examine claims about a database’s efficacy. While acknowledging that DNA databases are efficacious and cost-effective when they are deployed in connection with violent crimes, Krinsky and Simoncelli also conclude that “when the technology is extended to petty crimes or innocent and suspicionless individuals, the evidence leads to the conclusion that there will be a rapid decline in efficacy” (2011: 320; see also Murphy 2017).²⁹ While these four topics of concern all merit separate discussion, for matters of space and context to the Prüm regime, only literature in relation to efficacy of DNA databases is reviewed here.

²⁸ Personal communication, Dr. Rafaela Granja, 17 April 2018.

²⁹ In addition to such studies, Lapointe and colleagues (2015) demonstrated that not every crime scene sample originated from a criminal. In their study to populate an elimination DNA database, they “obtained 327 voluntary submissions from crime scene workers to date, of which 46 individual profiles (14%) have been matched to 58 criminal cases” (Lapointe et al. 2015: 50; Forensic Science Regulator 2016).

3.2.3 Efficacy and utility of criminal DNA databases

Closely related to efficacy is the concept of utility (Wilson et al. 2010). Forensic DNA database utility refers to “the extent to which a database produces measurable improvements in the police’s performance in correctly identifying and distinguishing offenders in relation to particular reported crimes” (Human Genetics Commission 2009: 64). Yet measuring forensic utility is notoriously hard for methodological reasons as well as due to a lack of required data (Wilson et al. 2010). Nevertheless, some empirical work has been published. In an American study, Roman and colleagues (2008) concluded that DNA is more effective in solving high-volume crimes than traditional investigations. In their study, they found that more suspects were identified by DNA than traditional investigation measures and DNA rendered five times more identifications than fingerprint comparisons (Roman et al. 2008: 147). Another American study suggested that uploading DNA profiles from convicted offenders and crime scene samples led to more effective means to increase hits, when compared to DNA profiles uploaded from those simply arrested (Goulka et al. 2010: 20).

Testifying to the difficulty of assessing forensic genetic utility are two recent studies addressing the notion of deterrence. The hypothesis is that if offenders know that their DNA profile is included on a database, they will be deterred from committing new crimes. As expected, Bhati and Roman (2014) found small deterrent effects (2-3%) for robbery and burglary, but, unexpectedly, they found a recidivism increase of 20-30% for other crimes, including violent crimes. Another study by Doleac, however, presented a partly opposite conclusion:

“DNA databases have a net deterrent effect on convicted offenders – particularly for violent offenders, but also for some property offenders – and that this individual-level effect results in a decrease in crime. The effects on crime are large, statistically significant, and economically meaningful for both violent and property offenses. This provides support for the hypothesis that it is more cost-effective to increase the probability of conviction rather than the punishment” (Doleac 2017: 26).³⁰

Only a limited number of studies regarding forensic DNA database efficacy are available in the EU area. One such study attempted to measure (cost) effectiveness of DNA matches in the Netherlands (Taverne et al. 2013). The study concluded that sampling convicted offenders contributed to the detection of suspects yet the effectiveness for the criminal justice system was difficult to assess because the available quantitative data was unsuitable for calculating effectiveness (amongst other reasons) (Taverne et al. 2013: 120). Another Dutch study found that—based on examining 116 forensic reports in relation to severe and violent crimes (SC) and 2,791 high volume crimes (HVC) from one police region for the year 2011—the contribution of DNA to the criminal investigation is smaller than anticipated on theoretical grounds:

“The data show that in 3% of the SC-cases and in 1% of the HVC-cases, the DNA from the crime scene yielded a “cold hit” in the DNA database leading law enforcement to a suspect in a case, which had no previous suspects” (Mapes et al. 2015: 855).

³⁰ Doleac found a statistically significant reduction (4.5 percentage point, 17%) in recidivism for serious violent offenders over five years, and a marginal recidivism reduction for serious property offenders (2.4 percentage point, 6%; see Doleac 2017: 15).

The above-mentioned studies testify to the challenges in measuring effects, utility and efficacy of DNA databases. One problem, for example, is related to the research questions. While some studies compared DNA with other techniques for generating intelligence or proof (e.g. fingerprints), others focused on inclusion regimes and DNA database efficacy, and others yet measured the effects of database inclusion on levels of recidivism, DNA databases' contribution to generating suspects or cost-effectiveness. It goes without saying that such diversity in research questions not only generate different outcomes, but also pose challenges for comparing results. Although empirical studies tend to favor DNA, results sometimes contradict each other and net effects are smaller than typically anticipated. This is all in contrast with common-held assumption that more DNA leads to more crimes being solved and thus a safer society—in popular discourse, more DNA means more safety (see Etzioni 2004).

3.3 Normative issues of forensic DNA typing and databasing in the context of the Prüm regime

The many accounts on ethical, legal and social implications of forensic DNA databases provide an important background to the cross-border exchange and comparison of DNA data in the Prüm regime. While in the first chapter backgrounds and histories of the Prüm Convention and Prüm Decision were described, the current section first describes daily exchange practices in the Prüm regime and then continues to address the normative issues of connecting national DNA databases and exchanging DNA data.

3.3.1 Description of the daily exchange practices of DNA data

Before a Member State is connected to the Prüm data exchange, the national technical and legal provisions undergo a comprehensive peer evaluation. Access to the Prüm regime is only allowed after inter alia answering a data protection questionnaire, carrying out a pilot run, undergoing an evaluation visit and a report is submitted to the Council (Council 2008b). The Working Party on Information Exchange and Data Protection (DAPIX), established in 2008, assesses whether the Member State evaluated complies with mandatory and agreed upon standards; DAPIX also monitors implementation of the Prüm Decision.³¹ The Prüm Decision stipulated that all Member States had to be Prüm ready with regard to automated data exchange within three years. This was an ambitious assignment, not only because several Member States did not yet have forensic DNA legislation or a functioning DNA database (e.g. Greece, Ireland and Italy), but also because of unavailable fiscal budgets due to the global financial crisis and subsequent economic crisis in the EU area. Against the backdrop of the financial and economic crisis at the time, as well as the many measures that Member States had to implement to be Prüm ready in August 2011, DAPIX reported problems in implementing the Prüm Decision.³² Among these problems were issues related to IT, legal problems, funding and human resources. However, the problems were not only technical and organizational: "legal aspects and governmental decisions are a constant nuisance [regarding available funding and human resources]. Instead of technical support of some sort, a strong

³¹ "The Working Party on Information Exchange and Data Protection (DAPIX) handles work relating to the implementation of legislation and policies on the information exchange and protection of personal data in the field of law enforcement. It also closely cooperates with Europol, especially regarding the Information Management Strategy (IMS) on streamlining cross-border information exchange," source: <https://www.eumonitor.eu/9353000/1/j9vvik7m1c3qyxp/vh7ej5swx002> (accessed 27 April 2018).

³² Only twelve Member States met the operational requirements for DNA exchange on 26 August 2011: Bulgaria, Germany, Spain, France, Luxembourg, the Netherlands, Austria, Romania, Slovenia, Slovakia, and Finland (see Prainsack and Toom 2013; Santos 2016). Portugal, however, had not yet commenced connecting its database to the Prüm network.

political response seems more appropriate when it comes to resolving this type of issue.”³³ To date, a number of Prüm countries are still not operational regarding the exchange of DNA, fingerprints and VRD (see Table 4).

Table 4: Overview of countries not yet ready for Prüm as per April 2018

DNA	Croatia, Ireland, Italy and the UK ³⁴
Fingerprints	Croatia, Ireland, Italy and the UK
VRD	Greece, Ireland, Italy and the UK

Source: <http://data.consilium.europa.eu/doc/document/ST-5077-2018-REV-1/en/pdf> (accessed 31 May 2018).

After fulfilling the stipulated requirements satisfactorily, current practice is that the abovementioned evaluation report is “submitted to the Council so that the Council, after having consulted the European Parliament, can adopt the Implementing Decision that the Member State concerned can start the operational data exchange.”³⁵ Once a country has implemented the Decision and thus commences exchanging DNA data, the procedure runs as follows: Upon the cross-border exchange of DNA profiles, a country makes a copy of the DNA profile(s) it wants to exchange to the Prüm database—these are typically DNA profiles obtained from crime scene samples. Only the numerical profiles, including a unique identification number, are uploaded to the Prüm database. This assures that no personal information is exchanged during Step 1. Those profiles retained in the Prüm database are sent to the request and response database via a secured network called TESTA. The two database copies are compared and the results are sent back to the requesting party. Results are reported based on a hit/no-hit principle, meaning that for every submitted profile a result should be available (see Annex 1). For matching profiles, rules and qualities are stipulated:

“The comparison of two DNA-profiles will be performed on the basis of the loci for which a pair of allele values is available in both DNA-profiles. At least six full designated loci (exclusive of amelogenin) must match between both DNA-profiles before a hit response is provided.

A full match (Quality 1) is defined as a match, when all allele values of the compared loci commonly contained in the requesting and requested DNA-profiles are the same. A near match is defined as a match, when the value of only one of all the compared alleles is different in the two DNA profiles (Quality 2, 3 and 4). A near match is only accepted if there are at least six full designated matched loci in the two compared DNA profiles” (Council 2008b: 21).

³³ <http://data.consilium.europa.eu/doc/document/ST-14918-2010-INIT/en/pdf> (accessed 23 May 2018).

³⁴ Greece fully implemented the Prüm Decision but is not yet operational.

³⁵ <http://data.consilium.europa.eu/doc/document/ST-5077-2018-REV-1/en/pdf> (accessed 31 May 2018). After judgement of the Court of Justice of the European Union on 22 September 2016, the European Parliament is now consulted regarding connecting a national database to the Prüm regime, for details see: <http://curia.europa.eu/juris/document/document.jsf?text=&docid=183702&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=550028> (accessed 4 May 2018).

DNA databases connected to the Prüm regime contained approximately 6 120 000 DNA profiles of known individuals and DNA profiles of 1 139 000 unsolved crimes in 2016.³⁶ Comparing millions of DNA profiles renders a significant problem as it is statistically expected that many six and seven loci profiles will match with other profiles adventitiously (i.e. a false-positive match, see Van der Beek 2011; Prainsack and Toom 2013). Because the required validating and checking of the evidential value is time consuming and burdens budgets, some regard the matching rule of at least six full designated loci “a waste of time and effort” (PIES 2016: 21). Several experts have referred to this problem during interviews and called for increasing the number of matching loci before a hit is reported (see also GeneWatch 2015; PIES 2016). However, increasing the matching rule risks missing real hits and thus opportunities for cross-border exchange of intelligence relating to severe and violent crimes.

Forensic data-exchange and subsequent forensic re-analysis is commonly referred to as Step 1 of the Prüm Decision. Each match between an unsolved crime in country A and a known individual in country B is a potential lead for the police. But many of those matches are not followed-up through MLA or MAP requests, or Step 2. Several problems and challenges are related to this deficiency. Tensions potentially arise when a Member State issues a MLA or MAP request, because for example professionals with different backgrounds and competencies are involved and because different authorities have custody over forensic databases.³⁷ An example of countries where information is followed-up differently was presented in the final report of a research program called PIES:³⁸

“[I]n Requested Country, DNA-based information might be judicial evidence and must achieve higher standard of validity (hence the stricter reporting rule), whereas in Requesting Country, DNA-based information might be law-enforcement investigative evidence and is exploited differently than in Requested Country” (PIES 2016: 28).

Apart from such tensions, hits are subjected to selection and evaluation criteria by custodians as well as professionals involved in investigations and prosecutions. Matches between a known individual abroad and DNA profiles from domestic unsolved crimes will be prioritized over a national reference profile matching a DNA profile of an unsolved crime in another country. Similarly, matches potentially linking a suspect to a severe crime like rape and murder will be considered more important than petty or high-volume crimes. Sometimes a hit is linked to an old case or an already closed case. Furthermore, a hit between two profiles must be considered as legal. It sometimes happens, that the removal of a DNA profile is omitted (e.g. due to an administrative or human error) after someone is cleared from suspicion; that DNA profile is then retained illegally on a database. If that DNA profile subsequently matches an unsolved crime, then that hit is considered to be unlawful. Even if that unlawful hit is associated with a severe and violent crime, (some) authorities will not report it due to the legality issue. Lastly, matching profiles may also lack any intelligence value due to contamination or adventitious transfer of biological material (see Kloosterman et al. 2014; Lapointe 2015; Forensic Science Regulator 2016).

While thousands of hits from cross-border exchange of forensic data are regularly reported by custodians and other officials, empirical research on the follow-up of hits in Step 2 shows

³⁶ If the UK, Norway and Switzerland were also to become connected to the Prüm regime, an additional 5 300 000 reference DNA profiles and 600 000 crime scene samples would become available, see: <http://enfsi.eu/wp-content/uploads/2017/01/ENFSI-Survey-on-DNA-Databases-in-Europe-June-2016.pdf> (accessed 22 May 2018).

³⁷ I thank Dr. Rafaela Granja for bringing these tensions to my attention.

³⁸ PIES was a research program regarding Prüm Implementation, Evaluation, and Strengthening of Forensic DNA Data Exchange.

that most are not used for criminal investigation and prosecution (Taverne and Broeders 2015; see 3.3.3.2). If this conclusion is true for other Prüm Member States as well, the utility as defined by the Human Genetics Commission (2009) is low (see 3.2.3).

3.3.2 Critical discussions of the Prüm Convention and Prüm Decision

The Prüm Convention and Prüm Decision triggered critique on various levels. In their influential contribution, Balzacq and colleagues (2006) problematized that seven EU Member States (initially) signed the Convention which, in their analysis, disrupted the notion of coherence of the EU, thus leading to “less Europe and a reduced capacity in the field of freedom, security and justice” (Balzacq et al. 2006: 18). While this shortcoming was solved when the Convention was transposed into EU *acquis* (see Guild 2007a), another significant shortcoming often rehearsed by commentators was that the Convention was negotiated and signed without Parliamentary and judicial intervention. Therefore, the Convention lacked legitimacy and infringed trust between EU Member States (Balzacq et al. 2006: 18; House of Lords 2007; Luif 2007; Bellanova 2008; Kierkegaard 2008; McCartney et al. 2011). The European Data Protection Supervisor (EDPS) remarked that the process of bypassing any Parliamentary oversight meant that there was:

“no democratic control by the European Parliament and no judicial control by the Court of Justice and as a result there are less guarantees that all the (public) interests are equally balanced. This includes the perspective of data protection. In other words, the institutions of the European Union do not have the opportunity to assess—before the system is established—the impact of the policy choices on the protection of personal data” (EDPS 2006: 13).

Despite the articulated lack of legitimacy and trust regarding the Convention, parts of the Prüm Convention were incorporated into EU *acquis*. The incorporation into EU *acquis* was, according to several commentators, also flawed.³⁹ Commentators argued that the Prüm Decision did not “benefit from rule of law and accountability mechanisms and structures characterising the EU legal system” (Bigo et al. 2009: 5). And in a memorandum addressing the UK’s House of Lords European Union Committee, Guild concluded:

“Not only is the process seriously flawed but the flaws which we highlighted in 2005 are now at risk of being replicated in the transposition of the Prüm Convention to the EU *acquis*. The content of the Prüm Convention also raises concerns in particular regarding the respect for individual’s privacy and the protection of people’s data. Finally, the legal basis on which this process has been launched does not seem to us sufficiently robust to support the action” (Guild 2007b: 16).

Consequently, these commentators argued that the Prüm Decision’s deficit for democratic and judicial control is unconducive to respect for the principle of transparency and equality, has questionable legality, and does not fulfil requirements of legitimacy. During interviews conducted when this study was in preparation, interlocutors indicated that these harsh conclusions required nuancing. For example, because treaties require legislative and democratic procedures before they are ratified, they are discussed in Parliament. And indeed, before the Prüm Convention was ratified by the Dutch government, it was discussed in the

³⁹ See also <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+CRE+20080421+ITEM-016+DOC+XML+V0//EN&language=EN> (accessed 24 May 2018).

Dutch Parliament (both Chambers) in 2006 and 2007.⁴⁰ Nevertheless, these discussions were about the Treaty's text after it was signed by the seven countries, and not before.

The Prüm Convention contained provisions to incorporate, on the basis of an assessment of experience of its implementation, the Prüm Convention into EU *acquis* within three years at the most. The German Presidency subsequently initiated a debate during a Minister's meeting in January 2007, and the proposal to transpose (parts of) the Prüm Convention into EU *acquis* received broad support; it was also decided that the "solutions already existing in relation to the implementation of the Prüm Treaty must remain unchanged."⁴¹ Members of the European Parliament regretted "the obligation imposed on Parliament by the Council to express its opinion as a matter of urgency, without adequate and appropriate time for Parliamentary review and the absence both of a comprehensive impact assessment and an evaluation of the application of the Prüm Treaty to date."⁴² Following the European Parliament's legislative resolution of 7 June 2007,⁴³ Council Decision 2008/615/JHA and Council Decision 2008/616/JHA were adopted on 23 June 2008, were published in the *Official Journal of the European Union* on 6 August 2008, and took effect 20 days following the Decisions publication (Council Decision 2008a, 2008b).

In addition to abovementioned critiques of the Prüm Decision, the Prüm regime has been critically regarded for a number of reasons, many of which reflect and resonate with arguments summarized in the sections above. They included the fear of increased surveillance and the rise of the EU as a policing state (Bunyan 2010), a redistribution of power from criminal investigators to forensic technocracy (Prainsack and Toom 2010), worries about viability, legitimacy and acceptability of the Prüm regime (McCartney et al. 2011), issues of data protection (Topfer 2011), concerns that initiatives like the Prüm regime are driven by crime control incentives and less by due process mechanisms (McCartney 2013), incompatibility of STR systems (Topfer 2011; McCartney 2014), and all kinds of operational and technical problems regarding implementing, connecting and exchanging DNA data as well as fingerprints (Topfer 2011; Prainsack and Toom 2013).

3.3.3 Empirical analyses of the Prüm Decision

Apart from commentators' critique of the Prüm regime, three collectives of practitioners and scholars have been engaging with the Prüm regime. They are the abovementioned Working Party on Information Exchange and Data Protection (DAPIX, since 2008), the research program Prüm Implementation, Evaluation, and Strengthening of Forensic DNA Data Exchange (PIES, 2012-2015), and the EXCHANGE project (Forensic Geneticists and the Transnational Exchange of DNA Data in the EU: Engaging Science with Social Control,

⁴⁰ See <https://zoek.officielebekendmakingen.nl/dossier/30881> (accessed 3 May 2018). Compared to the other signatory countries, the Netherlands were late ratifying the Treaty; Austria and Germany ratified already in 2006, Belgium, France and Luxembourg in 2007.

⁴¹ <http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%206003%202007%20INIT> (accessed 24 May 2018).

⁴² <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-20070228+0+DOC+XML+V0//EN> (accessed 4 June 2018).

⁴³ The complete title is: European Parliament legislative resolution of 7 June 2007 on the initiative by the Kingdom of Belgium, the Republic of Bulgaria, the Federal Republic of Germany, the Kingdom of Spain, the French Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the Republic of Austria, the Republic of Slovenia, the Slovak Republic, the Italian Republic, the Republic of Finland, the Portuguese Republic, Romania and the Kingdom of Sweden on the stepping up of cross-border cooperation, particularly in combating terrorism and cross-border crime (6566/2007 – C6-0079/2007 – 2007/0804(CNS)), see <http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P6-TA-2007-228> (accessed 25 May 2018).

Citizenship and Democracy, 2015-2020).⁴⁴ These three efforts to monitor, evaluate, value and critically approach the Prüm regime are discussed here.

3.3.3.1 Future Challenges

The Prüm Decision requires a Working Group to monitor the implementation of the legal and technical requirements and to prepare the relevant legal acts of the Council necessary to start automated data exchange. This group, within Council structures, is the Working Party on Information Exchange and Data Protection (DAPIX). DAPIX's tasks include that the monitoring of information exchange and comparison in the field of law enforcement is accomplished in accordance with current principles and rules on data protection. It functions as a forum for Member States to discuss ongoing issues, concerns and to remedy problems. DAPIX regularly produces overviews, regarding the implementation of the Prüm Decision. Furthermore, it offers guidance to Member States acceding Prüm data exchange. In 2011, the year that all member states had to be Prüm ready, it recorded several problems in a questionnaire:

"According to Member States, their meeting the deadline of 26 August 2011 was hampered by domestic issues such as pending legislation or implementation problems such as technical issues (23), concerns with regard to human resources (18) or financial issues (13). Since technical difficulties are identified as the main concern, a solution to that impediment is expected to be the support of the [mobile competence team] operational since July 2011."⁴⁵

Writing in May 2018, five countries still in the process of implementing (parts of) the Prüm Decision are nearing completion (see Table 4; 3.3.1). A DAPIX official anticipated that it will take another year before implementation of the Prüm Decision is completed by each Member State. However, becoming operational does not mean that each Member State is exchanging and comparing data with each other Member State (see Annex 2). The differences regarding the number of connections between the Member States—some exchange data with over 20 Member States, others with four or five Member States—demonstrates that the Prüm regime has not yet reached its full potential regarding the possible number of connected databases. Apart from monitoring and guiding the implementation of the Prüm Decision, DAPIX also formulates policy challenges possibly requiring future action, as was suggested in a recent report:

"[E]xpeditious law enforcement across borders will only be yielded when implementing the Prüm Decisions is understood not only in a narrow sense, that is tackling information technology issues, but also in a wider sense, that is by establishing smooth follow-up procedures in the Member States. Workflows along the lines of the national legislation that facilitate cross-border information exchange after an initial data match will be a permanent topic on future DAPIX agendas."⁴⁶

Thus, DAPIX identifies Step 2 follow-up procedures by Prüm Member States as problematic. A DAPIX official referred to the follow-up procedures as the big problem of Prüm. Optimizing Prüm follow-up procedures could be achieved through new standardizing forms, procedures

⁴⁴ In addition to the three programs mentioned, a fourth project referred to as the Finish program was started. However, an extensive online search did not generate information or a reference.

⁴⁵ <http://data.consilium.europa.eu/doc/document/ST-17761-2011-INIT/en/pdf> (accessed 1 May 2018).

⁴⁶ <http://data.consilium.europa.eu/doc/document/ST-9014-2017-INIT/en/pdf> (accessed 23 May 2018).

and language or to include Step 2 follow-up procedures in an amended Prüm Decision. Furthermore, the technical infrastructures of the Prüm regime require modernization.

3.3.3.2 PIES

The Prüm Implementation, Evaluation, and Strengthening of Forensic DNA Data Exchange, (PIES), was an EU funded project with seven international partners in Belgium, the Netherlands, France and the UK which ran between 2012 and 2015. The Belgian National Institute for Criminalistics and Criminology (NICC) coordinated the program. PIES' objective was to promote an efficient use of DNA data exchange under Prüm by:

- "1) supporting the implementation of the Treaty in its technical, legal and organizational aspects,
- 2) developing methods of evaluation of the exchange, and
- 3) offering recommendations to strengthen Prüm cooperation."⁴⁷

Two studies in the PIES project looking at data exchange between the Netherlands and Belgium, and the Netherlands and Germany recorded a proximity effect, that is, they often found "a pattern of regional concentration, with crime scenes clustering in close proximity to each other, frequently but not always at some—relatively small—distance from the offender's place of residence" (Taverne and Broeders 2016: 28; Taverne and Broeders 2015; Bernasco et al. 2016). Albeit not surprising in a borderless Europe, it had thus far been hard to generate insight into cross-border criminal mobility (Bernasco et al. 2016). Exchanging DNA in the Prüm regime provides significant insight into such criminological question, and it is therefore no surprise that criminologists have been calling for the deployment of data held in forensic DNA databases for further research (see Jeaniaux et al. 2015; De Moor et al. 2017).

Less clear are the results, or utility and efficacy, of cross-border exchange of forensic DNA data. Research from Taverne and Broeders (2015) on the effectiveness of cross-border DNA exchange and comparison produced results which are consistent with DNA database utility as discussed above (see 3.2.3). Their research question for the year 2010 asked: "What is the effectiveness of DNA profile exchange and comparison between the Netherlands and other participating Prüm States?" (Taverne and Broeders 2015: 18). They measured effectiveness through a selection funnel that considered (1) the total number of DNA hits between the Netherlands and a foreign country, (2) the number of reported hits by a custodian to judicial authorities, (3) the number of matches resulting in a MLA request, (4) the number of matches forwarded to police for subsequent investigation, and finally (5) the number of matches being used as evidence in a court of law (p. 36).⁴⁸ The total number of DNA hits in Step 1—automatic exchange and comparison—rendered 2,020 matches and included reference/reference profiles, crime scene/crime scene samples, and reference profiles/crime scene samples. The 568 (or 28% of 2,020 matches) matches between nationally held crime scene samples and reference profiles held in other national databases were considered most valuable. Those 568 DNA matches resulted in 138 (or 6.8%) MLA requests. After receiving information from foreign authorities, 86 (4.2%) matches were forwarded to the police by judicial authorities. Eventually, 37 (1.8%) matches contributed to

⁴⁷ <https://nicc.fgov.be/pies> (accessed 30 April 2018)

⁴⁸ This model is related to the attrition model describing the loss of cases through the criminal justice system, see Burrows et al. 2005.

a prosecution (see Annex 3). Whether this ~2% has increased in subsequent years is unknown.

The Office of the Public Prosecutor is responsible for Step 2 in the Dutch (as well as Belgian) legal system. In most other EU Member States, the police are responsible for Step 2. Consequently, the Dutch apply stricter criteria for submitting MLA requests and responding to MAP requests than other EU Member States (see also Machado and Granja 2018: 251). It is therefore possible that other Member States' effectiveness as deployed by Taverne and Broeders is higher than 2% of the total number of hits in Step 1.⁴⁹ Nevertheless, the study by Taverne and Broeders contains two important lessons. First, there is a significant drop-out when the number of reported hits in Step 1 are compared with the number of hits being used in a court of law. While this may say something about the effectiveness of Step 2, it also indicates that many checks and balances are deployed when hits and intelligence are evaluated. Taverne and Broeders identified five criteria deployed by the Dutch database custodian and prosecutors when they are assessing a hit:

- "1. Tactical Criteria: assessment by the custodian of the DNA database whether a match may be considered *relevant* and qualifies for follow-up in the form of a match report to the prosecutor.
2. Reliability Criteria: assessment by the custodian of the DNA database of the *reliability* of a match in terms of its evidential value including the possibility of it being a false positive match.
3. Legal Criteria: assessment by the prosecutor of the *legal basis* of the DNA profile involved in a match in terms of retention and exchange.
4. Priority Criteria: assessment by the prosecutor of the need for a follow-up procedure subject to the *opportunity* principle.
5. Suitability Criteria: assessment whether the foreign follow-up information received might have *prosecution value* for the case in hand" (Taverne and Broeders 2015: 20).

Secondly, simply reporting the number of hits produced during Step 1 is insufficient to assess the utility of the Prüm regime as such numbers exaggerate the efficacy and utility of cross-border DNA exchange and comparison.⁵⁰ Until mechanisms are introduced to collect, analyze and compare Prüm results, efficacy in accordance with standards of scientific evidence of Prüm exchange remains anecdotal in the sense that those results represent hits, and provide only little information about the investigative and prosecutorial value.

3.3.3.3 Exchange

A project run and executed by social scientists in Portugal, funded by the European Research Council, considers among other things cross-border exchange and comparison of forensic DNA data.⁵¹ Running since 2015, and to be completed by 2020, this group of scholars provide critical, scholarly analyses on the Prüm regime. Several publications are now available. One is concerned with the development and implementation of the Prüm Treaty and Prüm Decision as well as visualizing the implementation of the Prüm regime (see Santos 2016). Another draws on data regarding patterns of DNA exchange between 2011 and 2015, which found

⁴⁹ Similar studies in other countries that replicated the study by Taverne and Broeders have not been found.

⁵⁰ See for example the reported result of Belgian DNA database after connecting it to the Prüm regime: "Among these 5760 individuals, 1159 (25%) correspond to unidentified Belgian traces, 3607 (59%) correspond to Belgian traces that match with the identity of a person known in Belgium and 994 (16%) correspond to Belgian traces that only match with the identity of a person either known in the Netherlands and/or in France. In other words, without the Prüm DNA data exchange, Belgium may have been unable to retrieve the identity of about 1000 persons" (PIES 2016: 20).

⁵¹ See <http://exchange.ics.uminho.pt/about/#overview> (accessed 4 May 2018).

that most DNA matches were found in west and central EU Member States, and that eastern EU Member States contribute many matches with reference profiles. They nevertheless conclude, in view of required transparency and accountability of the Prüm system that “more extensive and informative statistics would be an important contribution to the assessment of its functioning and societal benefits” (Santos and Machado 2017: 307). In yet another study on Prüm standards and protocols, Santos (2017) described how stability and reliability of exchange was secured in an area defined by difference. This presents one of the largest challenges of the Prüm Decision: how to subsume 28+ jurisdictions with their different national judicial systems, laws, governance models and authority competences under one system to make possible the production and exchange of criminal intelligence? But as Santos argued, “the diversity of legal regulations and rules of custody and access to forensic DNA databases tend to generate frictions when it comes to the exchange of personal data associated with DNA profiles” (2017: 5).

The final EXCHANGE contribution discussed here regards an article that explored what the concept of ethics means for professional and forensic practitioners involved in the Prüm regime. Based on a number of interviews, Machado and Granja (2018) demonstrated that professional and forensic practitioners presented a wide-variety of ethically significant issues, including good science, laboratory practices, procedures to deal with false-positive matches, data protection, and adhering to principles like accountability and transparency. More specifically, the authors found that participants created “ethical boundaries” between, for example, science/ethics, science/criminal justice systems, and good and bad science. Such distinction was, or so argued by Machado and Granja, consequential for the management and mechanisms of dealing and solving controversies. An example regards when a match is not good enough, e.g. the reported hit is based on six markers. Interviewing a database custodian, Machado and Granja recorded the following quote:

“Sometimes, we have discussions because we are not always in agreement, because, in countries where the DNA database is a police DNA database, they would like to have all the information like this [immediately] (...) we will not report a match if we don’t have many markers (...) we are very strict on that. If we have a match on six markers, we know [there is a chance of] more than 60% that it is a false positive. (...) For me, it’s a problem to do [this] kind of reporting: the magistrate will not understand when it’s a good match and when it’s not a good match. So we prefer not to report these cases” (Machado and Granja 2018: 251).

Apart from such scientific issues, Machado and Granja recorded several other modes of dealing with ethical issues in relation to databasing and cross-border exchange and comparison of DNA data. Risks of privacy infringements, for example, were no longer considered to be problematic because privacy-sensitive data was black-boxed and personal information was only circulated on protected and secure IT systems. And because (some) custodians make information about Prüm exchange available, controversies about accountability and transparency had been resolved. These examples demonstrate that some database custodians are not only reporting matches or conduct follow-up forensic research, but that they also monitor what is happening in a society or how the techniques and regimes they are governing and are responsible for are represented in media or other forums.

3.3.4 Future challenges

With the full implementation of the Prüm Decision expected to occur within a year, and technology as well as politics changing the forensic landscapes, at least three developments

are to be considered: adding more data to the Prüm network, third countries implementing Prüm-like mechanisms, and the European Forensic Science Area. These three issues are briefly introduced.

3.3.4.1 Exchanging more data-modalities through the Prüm network

Partly included in EFSA2020's (see 3.3.4.3) ambitions include adding more information relevant to police and other crime fighting organizations. One objective thus regards expanding the exchange of data on weapons, ammunition, explosives and drugs in a Prüm-like manner. In addition, facial recognition algorithms are becoming more mature, leading to the possibility of establishing forensic facial databases which could, similarly to DNA and fingerprints in the Prüm regime, potentially be compared across national borders.⁵² DAPIX therefore calls for establishing a forum where such future exchange could be discussed. Less ambitious would be to also start exchanging DNA data held on missing persons and recovered but thus-far unidentified bodies. Several Prüm countries have been collecting such data and exchanging them, which potentially leads to missing persons being found and identified thereby providing answers to surviving family members about the status of their vanished kin.

3.3.4.2 Third countries implementing Prüm-like mechanisms

Albania, Austria, Bosnia and Herzegovina, Bulgaria, Hungary, Macedonia, Moldavia, Montenegro, Romania, Serbia and Slovenia are developing a Prüm-like network of databases enabling cross-border exchange and comparison of forensic data. While the developing network is comparable with the Prüm regime, the underlying technology has higher technical standards because they deploy modernized technologies. Other developments are that the US has been seeking bilateral Agreements on Preventing and Combating of Serious Crimes, including cross-continental exchange of forensic data, including fingerprint data and DNA data with many countries all over the globe. In 2014, it was recorded that the US established agreements with (at least) Belgium, Austria, Switzerland, the Czech Republic, Germany, the Netherlands, Finland, Spain, Estonia, Greece, Denmark, and also South Korea (Toom 2014). While some countries have already started exchanging fingerprints with the USA, the "DNA part has not yet come into force because the federal DNA law of the USA has to be adjusted to give other countries access to the DNA database of the USA" (ENFSI 2017: 53).

3.3.4.3 European Forensic Science Area

In 2011, the EU Council endorsed the action plan to create a European Forensic Science Area by 2020 (hereafter EFSA2020) fostering a high quality forensic science infrastructure through working towards an:

"area in which routine forensic processes for the collection, processing, use and delivery of forensic data are based on equivalent minimum forensic science standards, and in which forensic service providers will work on the basis of a common approach to implementation of these standards that fosters closer cooperation between them and the criminal justice systems" (EU Council 2011: 3).

Such would be accomplished through inter alia training, introduction and harmonization of standards, shared best practices and optimizing the sharing forensic data (EU Council 2011). Among others, the European Network of Forensic Science Institutes (ENFSI) as well as Europol were asked to participate in furthering the initiative to establish EFSA2020; DAPIX is

⁵² <http://data.consilium.europa.eu/doc/document/ST-8770-2016-INIT/en/pdf> (accessed 15 May 2018).

responsible for activity 6 of EFSA2020: "Stimulating exchange of forensic data via Prüm and improving its quality." The activity is defined by 7 actions:

- "1. Monitoring of the implementation of the Prüm Decisions (DAPIX);
2. Monitoring Prüm implementation and daily application – obstacles (DAPIX);
3. Analysis of possibilities to reduce the number of false positive matches with DNA-profiles (DAPIX);
4. Exchange of experience in the implementation and ongoing operation of communication between the systems of EU MS, in particular mutual assistance in solving the problems that arise not only during implementation, but also in the current work (Member States in cooperation with DAPIX);
5. Development of mechanisms for the mutual prompt notification in the event of unavailability of the application (e.g. sudden technical problems, routine modifications to systems) (Member States in cooperation with DAPIX);
6. Search for new solutions / ideas to improve and streamline the exchange of DNA or fingerprint data between EU MS (DAPIX);
7. Analyse how to optimise Prüm follow-up procedures (DAPIX)."⁵³

While 2020 is approaching, various stakeholders, including DAPIX, ENFSI and Europol currently implement some of EFSA2020's key elements.

⁵³ <http://data.consilium.europa.eu/doc/document/ST-8770-2016-INIT/en/pdf> (accessed 26 May 2018).

4. POLICY RECOMMENDATIONS

KEY FINDINGS

- Transparency and accountability of the Prüm regime is still problematic.
- Quantitative and qualitative data which allow determining for the utility of the Prüm regime for Step 1 and Step 2 must become available.
- Using those quantitative and qualitative data, independent scholars should be able to produce knowledge required to assess the proportionality of the Prüm regime.
- Many DNA hits are recorded during cross-border comparison but only a limited number of those hits are reported to criminal investigators and prosecutors.
- High drop-out rates not only signal that there is room for further improvement of the Prüm regime, but also that reported hits are subject to rigorous evaluation and prioritization.
- Harmonization of Step 2 is essential for furthering the value, and therewith utility, of the Prüm regime for criminal investigators and prosecutors.
- Current matching rules generate many potential false-positive matches, thus upon validation, a significant number of six and seven loci matches turn out to be no match.
- Omitting such checks risks that wrong persons are arrested, incriminated or even convicted.
- There's a difference of opinion between some Member States and experts whether the matching rule should be increased and be more robust. Increasing it would result in less forensic follow-up work, but also leads to less matches being found.
- It is likely that the Prüm Decision shall be implemented by every Prüm Member State by the spring of 2019.
- Once implementation has been completed, the Commission may initiate amendments to the Prüm Decision.
- Possible amendments regard modernization of the technology underlying the Prüm regime as well as making more (forensic) data modalities available for cross-border exchange and comparison.
- After completion of implementation, every Member State must make an effort to start comparing data with every other Member State.

Based on the analysis presented in this study, and a limited number of interviews conducted with experts and professionals, this chapter sets out to formulate key-issues for consideration aimed at improving Step 1 of the Prüm regime as well as harmonizing and improving follow-up procedures in Step 2. Recommendations are grouped together in four main themes: data deficiency, drop-out, false-positives, and the new Prüm regime.

4.1 Data deficiency

A serious problem encountered while drafting this study was the limited primary information available regarding cross-border exchange and comparison of forensic data—the information that is available is hard to find, and it's uncertain whether documents will be disclosed for research in the future. In this context, it can be considered that the Prüm regime lacks transparency and accountability, and this finding is consistent with other studies researching the Prüm regime.

Primary and reliable data need to be made easily available. At least data for every modality being exchanged and compared should include: the number of reported hits, the number of re-examined hits, how many hits were reported to criminal investigative authorities, how many of those hits led to issuing a legal assistance request, how many of those requests were answered, how many hits were used in criminal proceedings and the outcome of those legal cases (see Santos and Machado 2017: 309). Other relevant data about mistakes made (e.g. the number of falsely arrested citizens, or hits with a DNA profile retained without a legal basis, see 3.3.1, 4.2 and 4.3), the financial costs of implementing and the day-to-day operation of the Prüm regime would also be beneficial.

In addition to such primary quantitative information, updates based on qualitative information from each Member State (e.g. queries and/or interviews with custodians, criminal investigators of police and office of the prosecutor) should be submitted or conducted regularly to monitor operational issues of the Prüm regime, including Step 2.

Primary information that is collected, as well insight into the outcomes of queries and interviews should become publicly available through a dedicated, easy to find and access, website. Such would certainly add to the transparency and accountability of the Prüm regime. Considering its central role in implementing and monitoring the Prüm Decision, DAPIX would be an ideal Council Working Group to take the lead in, and be responsible for, such endeavor.

Such primary information regarding cross-border exchange and comparison would render it possible to assess Prüm regime's utility regarding Step 1 and Step 2, and related, make it possible to evaluate whether the Prüm regime is a proportionate crime control mechanism.

In light of the above, independent academic quantitative and qualitative research on Step 1 of cross-border forensic data comparison as well as on Step 2 regarding the exchange of personal data relevant for criminal investigators and prosecutors, should be conducted according to the standards of peer-review.

4.2 Drop-out

After extensive efforts, some scholars were able to collect and process relevant information and data regarding cross-border DNA exchange and comparison. They demonstrated that the number of reported hits in Step 1 are subject to significant drop-out in Step 1 and Step 2. Consequently, only a limited number of hits are being used in criminal investigation and prosecution. This also hampers the utility of the Prüm regime.

Drop-out in Step 1 and Step 2 is the effect of many moments of selection, evaluation and prioritization of hits by custodians, criminal investigators and prosecutors. These results warrant the conclusion that there is scope for improving the Prüm regime's utility.

The drop-out provides evidence of another aspect—DNA hits are subject to many moments of careful checks and balances. During interviews, it transpired that not every other Prüm Member State potentially applies similarly high standards.

Nevertheless, drop-out may be the result of differences between the various partners in cross-border cooperation and exchange; in jurisdiction A, a prosecutor decides on exchanging data in a particular case which was requested by a police officer in jurisdiction B. Given their different roles in the criminal justice system, these stakeholders apply different rules and standards (e.g. prosecutors usually apply stricter reporting rules than police officers).

Another problem reported during interviews was that sometimes DNA reference profiles are retained unlawfully. For example, an originator of a DNA profile was cleared of all suspicion but, for reasons unknown to the custodian of the database no order to remove that profile from the database was received. Later, that unlawfully retained DNA profile matches a DNA profile obtained from a crime scene sample in another country. That hit is therefore in some (but not all) countries considered to be unlawful and thus will either not be reported, or a MLA or MAP request will be refuted. Errors and poor record keeping thus potentially leads to preventable drop-out.

While the Prüm regime technically does what it is meant to do in Step 1, the significant drop-out of hits demonstrate that Step 2 is of concern. Would Step 2 be harmonized and standardized, it potentially becomes possible to improve the Prüm regime's efficacy.

4.3 False-positives

Millions of DNA profiles are retained in databases connected to the Prüm regime leading to billions of cross-border comparisons. The matching rules are that DNA profiles with at least six corresponding loci are reported. Six and seven loci matches are often false-positive (or coincidental) matches.

In Council Decision 2008/616/JHA, provisions stipulated the validation and assessment of the evidential value of the reported match (Council Decision 2008b: 22). Validation and assessment of a match are the Prüm regime's main mechanisms to prevent a false-positive match being reported to police, prosecutor or international partners.

Chapter 2 of this report provided anecdotal evidence that not every Member State may conduct the required validation and assessment of evidential value. There is a real risk of arresting, incriminating or even convicting wrong persons. Such would negatively affect trust and confidence in the Prüm regime.

Hits based on six and seven loci are often false positive matches, and validation effectively weeds these false positive matches out. However, if the volume of reported six and seven loci hits is large, follow-up forensic research can be costly and timely, and has been considered by some to be a waste of time and effort (see PIES 2016). While some support increasing the matching rule to eight, nine or ten loci (see GeneWatch 2015), other Prüm Member States oppose such increases based on the argument that real hits, including matches with severe and violent crimes, may be missed or remain undetected.

A compromise might be to follow-up on six and seven loci hits in cases where persons are matched to the most severe crimes like sexual assault and homicide.

Arresting, incriminating and convicting the wrong person is also a risk if a real match is the only basis for a MLA or MAP request. The introduction of legal safeguards preventing the extradition of persons connected to a crime only through a DNA match would prevent this.

4.4 The new Prüm regime

It is very possible that the implementation of the Prüm Decision will be completed in the spring of 2019. Once every Member State is operational, the Prüm Decision can be amended.

Several amendments might be proposed, and they include modernizing the technology underlying the Prüm regime and making available new forensic data modalities to other

Member States (e.g. data on weapons and explosives, facial recognition, DNA profiles of missing persons and unidentified corpses).

Initiatives may be rolled out to increase the utility of the Prüm regime, including suggestions regarding Step 2 which is not part of the Prüm Decision. Among possible proposals are to limit the number of reported false-positive matches, and to minimize the risk that information is exchanged based on false-positive DNA matches.

Furthermore, after every Prüm Member State has implemented the Prüm Decision, it is expected that they become fully operational by making accessible their databases to every other Member State and an effort is made to start comparing data with every other Member State.

If there is an initiative to amend the Prüm Decision, it is strongly recommended that this is executed using a holistic approach where legislators not only consult forensic experts, legal professionals, criminal investigators and other policy makers, but also scholars and other citizens, including experts from civil rights organizations like GeneWatch UK, Privacy International and the Deutsches Institut für Menschenrechte.

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ANNEX 1

Overview of the automated flow of information when DNA profiles are exchanged, <https://nld.promega.com/resources/profiles-in-dna/2011/foren%20si%20cdna-profiles-crossing-bor%20ders-in-europe/> (accessed 21 May 2018).

Prüm Software

The Prüm software was developed jointly by DNA and IT experts from the Bundeskriminalamt (BKA) in Germany, the Ministry of the Interior of Austria and the Netherlands Forensic Institute in the Netherlands. From the Prüm database of a country, DNA profiles can be sent to other countries for comparison to their Prüm databases. A country can decide to send a DNA profile to one or more selected countries or to all operational countries to which it is connected. Figure 1 shows the automated flow of information.

1. DNA profiles that meet the Prüm inclusion rules (see below) are copied from the National DNA database (N-DNA-DB) to the Prüm database of a country at a predetermined frequency. The Prüm database of a country can either be a physical copy or a view of the National DNA database.
2. From the Prüm database, DNA profiles can be sent to other countries.
3. This is done using the Communication Tool, which converts the DNA profile into an encrypted e-mail attachment.
4. The e-mail is sent to one or more other countries via the secure European TESTA network.
5. The e-mail arrives at the e-mail server of the requested country.
6. The Communication Tool of the requested country picks up the e-mail attachment and decrypts it.
7. The Communication Tool of the requested country puts the DNA profile in the Request and Response Database of that country.
8. The Matching Tool of the requested country picks up the DNA profile from the Request and Response Database.
- 9/10. The Matching Tool of the requested country compares the DNA profile with the Prüm database of that country.
11. The Matching Tool puts the result of the comparison back in the Request and Response Database of the requested country, where it can be viewed via the Graphical Use Interface.
12. The Communication Tool of the requested country picks up the result of the comparison.
13. The Communication Tool of the requested country converts the result of the comparison into an encrypted e-mail attachment.
14. The e-mail is sent to the requesting country via the secure European TESTA network.
15. The e-mail arrives at the e-mail server of the requesting country.
16. The Communication Tool of the requesting country picks up the e-mail attachment and decrypts it.
17. The Communication Tool of the requesting country puts the result of the comparison in the Request and Response Database of that country, where the results can be viewed via the Graphical User Interface.

Note that the results of a comparison can be viewed by both the requesting and requested country.

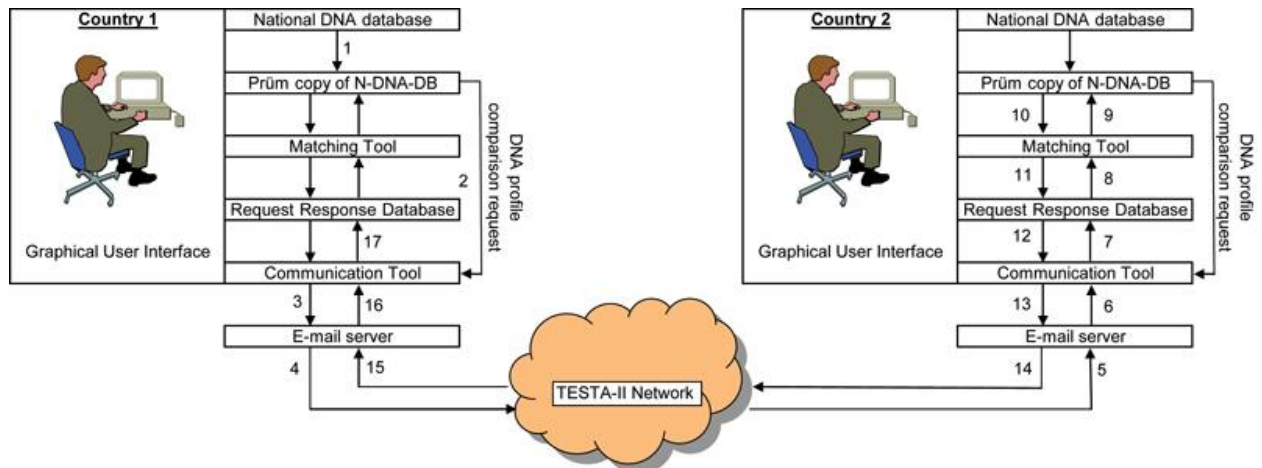


Figure 1. The automated flow of information.

In 2009 the FBI decided to build all functions necessary to join the Prüm operation in CODIS. Figure 2 shows the flow of information when this version of CODIS is used. In the second half of 2011 all CODIS-using European countries will get the new version of CODIS to enable them to join the Prüm operation. At the time of writing this article the Netherlands was already using this new version of CODIS for the international exchange of DNA profiles and at the time of publication probably many more countries will be using it.

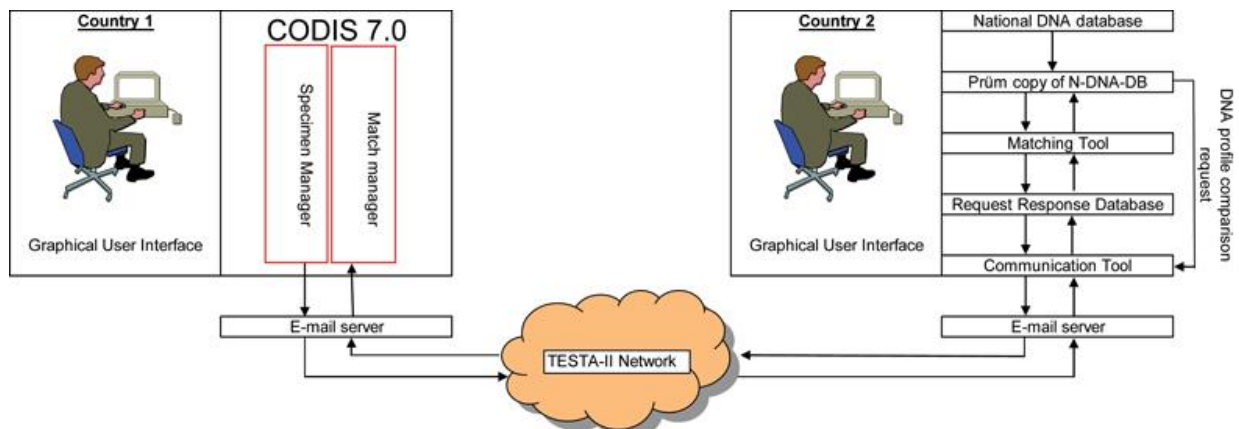


Figure 2. International exchange of DNA profiles with CODIS.

ANNEX 2

DAPIX 2018 State of Play,

<http://data.consilium.europa.eu/doc/document/ST-5077-2018-REV-1/en/pdf> (accessed 31 May 2018).

DNA operational data exchange																														
	BE	BG	CZ	DK	DE	EE	EL	ES	FR	HR	IE	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK	NO	
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ANNEX 3

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EN

		FP operational data exchange																											
	BE	BG	CZ	DK	DE	EE	EL	ES	FR	HR	IE	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK	NO
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BG		x																											
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VRD operational data exchange		BE	BG	CZ	DK	DE	EE	EL	ES	FR	HR	IE	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK	NO
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ANNEX 3

Selection funnel by Taverne and Broeders (2015: 52)

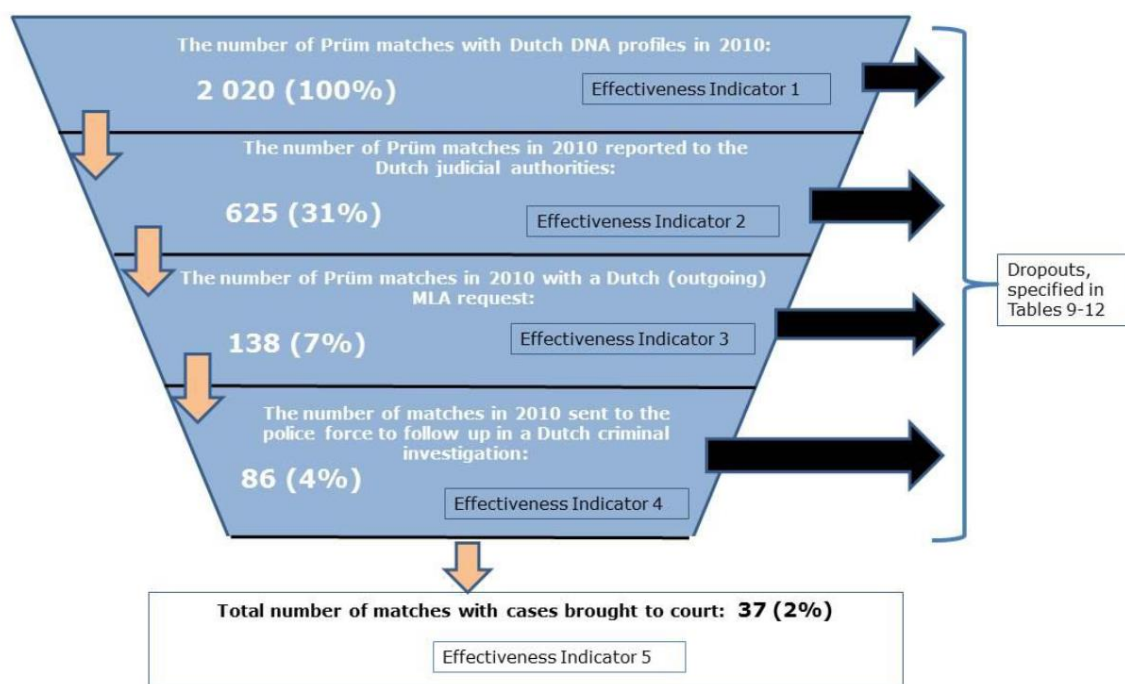


Figure 15: 'Selection Funnel' with the number of matches in 2010 at various stages in the course of the journey of the DNA matches through the selection process in the Netherlands

This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the LIBE Committee, provides an overview of the Prüm regime. It first considers the background of the Prüm Convention and Prüm Decision. The subsequent two chapters summarize the Prüm regime in relation mainly to DNA data looking at value and shortcomings; and ethical, legal and social implications of forensic DNA typing and databasing in relation to the Prüm regime. Finally, based on the analysis, it provides the policy recommendations.

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