AUTOMATED ENFORCEMENT, GET IT RIGHT, MAKE IT SAFE

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ABSTRACT
It is common knowledge that an effective road safety strategy needs a balanced approach on engineering, education and enforcement. When motorised mobility starts to increase with economic growth road safety suffers dramatically. Expansion of manual police enforcement is no longer feasible which forces countries to also incorporate automated traffic enforcement into their road safety strategy. Moreover, the traffic police, as an essential, costly and limited resource should be used for (enforcement) tasks which cannot be automated.

This presentation does not present research results and related conclusions. The focus lies on recommendations for policy makers in connection with the “enforcement chain” concept. In particular with automated enforcement (e.g. speed and red light cameras) this chain concept is crucial: if one link is not effective or efficient, enforcement is compromised and road safety is negatively affected. The automated enforcement chain consists of a dozen links from detection and measurement to fine collection and/or court proceedings. It also includes basic issues such as vehicle registration and readability of license plates. Many counties struggle to get the wide range of multi-disciplinary aspects of the enforcement chain right and are thus not able to optimise their enforcement and improve road safety.

Key bottlenecks in the automated enforcement chain can be found e.g. when

1) the legal and operational framework and its capacity are not in place for dealing with automated traffic enforcement and the resulting huge volumes of traffic violations,
2) the license plate/vehicle owner and/or driving license administration are not in order,
3) inadequate requirements for the legal integrity of evidence and equipment homologation,
4) ticket processing, issuance and fine collection are ineffective and inefficient,
5) authorities argue over ticket revenue and funding of road safety investments e.g. enforcement equipment,
6) political and administrative support for automated traffic enforcement are wavering,
7) public support suffers because the background, results and road safety benefits of enforcement are not properly communicated through various media.

In case of bottlenecks in the enforcement chain and its legal and operational preconditions the investment in the enforcement infrastructure is, in the best case scenario, not used optimally. In the worst case it could be virtually wasted. Properly recognising the various
actions required to create the proper preconditions and optimise the enforcement chain can prevent this and make automated traffic enforcement what it can be: an effective tool to improve and maintain road safety.

1 INTRODUCTION

When motorised mobility starts to increase with economic growth road safety suffers dramatically. The increase of the motorisation outpaces the expansion of infrastructure. Moreover, investment for the lagging infrastructure expansion mostly focuses on extension and widening of the road network, not on incorporating road safety features. Quantity triumphs over quality.

A similar capacity related issue can be seen in the area of enforcement. Expanding manual traffic enforcement by increasing the number of police officers to cope with the higher traffic volumes is no longer feasible and often not desirable. Especially for speed and red light violations automated solutions by means of enforcement cameras have shown to be very effective from a road safety, operational and cost perspective. This has been confirmed by academic research in various studies. In some emerging countries adding automatic speed cameras, to compliment enforcement by occasionally subjective local police officers, results in a more efficient, fairer and higher fine collection. The traffic police, as an essential, costly and limited resource should be used for enforcement tasks which cannot be automated i.e. checking for alcohol, helmet, seat belt and mobile phone (ab)use. The above developments encourage countries to incorporate automated traffic enforcement into their road safety strategy.

Traffic enforcement with cameras can only be effective if certain preconditions are met and if the automated enforcement chain is effective and efficient. The enforcement chain is a sequence of events and actions from the initial observation of a violation to the final verdict in a court of justice on that violation. In case of an observation by a police officer the enforcement chain is relatively simple. In a court of justice, based on the police oath, the judgement of a police officer on a traffic violation prevails over that of the violator. However, when that judgement over traffic violations is transferred from an officer to a technical device such as a camera a range of complex issues are introduced. When not properly resolved these could have a detrimental effect on the efficacy and efficiency of the enforcement chain and thus on road safety.

The focus of this article lies on automated traffic enforcement and the required preconditions and changes to various links of the enforcement chain to make such enforcement an effective road safety tool. Several countries struggle to make a smooth start with automated enforcement since it involves many multi-disciplinary changes which involve various ministries, agencies and other (semi-) government organisations, often at different administrative levels. The consequences of not getting the automated enforcement chain and its preconditions right, leads, at best, to a sub-optimal investment of public finances and a failure to maximise the road safety benefit of enforcement. At worst, it leads to a long term, hopefully temporary, termination of automated enforcement with a painful legal, administrative and operational repair process, financial losses and a postponed reduction in traffic casualties, injuries and crashes.

This article subsequently deals with the preconditions for automated enforcement, then a step by step description of the enforcement chain indicating specific bottlenecks.
Recommendations are given to resolve these bottlenecks in order to improve the efficiency and efficacy of automated enforcement which will contribute to improvements in road safety.

2 PRECONDITIONS

Certain preconditions need to be met for automated enforcement to be effective. Some of these conditions e.g. a proper legal framework, are an absolute must. Others may have a slightly lower priority but nevertheless play a key role in the enforcement chain and a successful road safety strategy.

2.1 Legal preconditions

When prosecuting offending drivers with automated enforcement equipment a country needs to specifically incorporate such enforcement and its operational conditions into its laws and derived procedures since automated enforcement is inherently different from manual enforcement by police officers. An important starting point for automated enforcement is the choice between owner and driver liability. With owner liability the ultimate responsibility for violations registered with automated enforcement systems lies with the owner of the vehicle. It does not matter if he or she was not driving; the vehicle owner is liable for all the traffic fines. If the owner was not involved it is up to him or her to recover the fine from the actual offending driver. It also means that an image with license plate on a vehicle together with violation data such as time, location nature of the violation, etc. is sufficient for prosecution for example by means of a fine. With driver liability the driver is ultimately responsible. This means an image and/or video of a vehicle with a recognisable driver’s face and a license plate is required in order for a violation to be legally valid. Counties with driver liability (e.g. Germany, Switzerland, Denmark, Sweden, Poland and Japan) therefore usually take violation photos (sometimes also videos) from the front. Even with driver liability the license plate is used to identify the owner who is then asked to identify the driver if the owner was not driving at the time of the violation. The choice for owner or driver liability has great implications in various other areas. Prosecuting motorcyclists with a helmet is an issue with driver liability. Managing a demerit point driver license system provides some challenges with owner liability.

The European Transport Safety Council (ETSC) states that owner liability legal regimes contribute to road safety. Processing the huge number of violations resulting from automated enforcement programmes can be done very efficiently and with little or without human intervention by means of ANPR (Automatic Number Plate Recognition) under owner liability. Driver liability is labour intensive and operationally costly due to the matching requirement of the vehicle owner with the actual driver at the time of violation. Moreover, due to e.g. lighting conditions, glare and coatings on car windows, recognisability of the driver on the photo is often compromised, which reduces the prosecutability rate of the registered violations. According to data reported from the state Baden Württemberg in driver liability Germany, two-thirds of the image-based violation cases are stalled (including foreign vehicles and motorcyclists).

Other issues with need attention from a legal perspective include applying administrative law instead of criminal law for relatively common and light traffic offences. There is a
considerable risk that the huge number of registered traffic violations (annually around 10 million in the Netherlands) generated by a wide-spread automated enforcement camera programme could cripple the court system if they cannot be settled effectively and efficiently by means of fines under administrative law. With administrative law a violation is legally not pursued further provided a fine or rather administrative sanction is paid. Not paying this sanction in time will not result in a lengthy prosecution through the legal system. However, it leads to rapid increases of the fine based on clearly specified dates. If sanction payment is still not forthcoming it can, for example, be collected by impounding property or high-jacking the violator’s bank account. In the Netherlands a court appeal to an administrative sanction can only be accepted if the sanction amount is paid first. If challenged successfully, it will be refunded. Severe traffic violations (e.g. drunk driving, excessive speeds and violations resulting in crashes) remain subject to criminal law.

In some counties it is legally not possible to enforce a red-light violation with an enforcement camera, because this legally not defined (e.g. Japan). In some countries average speed enforcement (speed measured by two or more cameras over a certain distance) is not possible for privacy reasons (e.g. Germany), or simply because it has not been incorporated in the law yet (e.g. Poland, Slovenia). Revising such laws is a process which can take years and will cause delays in further improving road safety.

Another legal issue regards the validity of concurrent violations i.e. for how many simultaneous violations can a driver be fined in a single registration. In Switzerland, which has driver liability and front photography as violation evidence, a driver can concurrently be fined for seat belt, speeding, red-light and mobile phone use violations based on one photo. In the Netherlands with owner liability most red-light cameras also measure speed which can result in two simultaneous violations. In many counties one can only be legally fined for one violation. Such concurrent violation issues need to be legally defined when using automated enforcement equipment.

2.2 Legal integrity of the evidence

Besides a solid legal system for effective and efficient settlement of traffic violations the legal integrity of the evidence deserves attention. This integrity is an essential aspect of the enforcement chain and refers to two key aspects:

- Accurate, valid and all-inclusive measurements
- Evidence data integrity

Accurate, valid and all-inclusive measurements
To the violator in the beginning of the enforcement chain, but eventually also to the judge at the end of the chain there should be absolute certainty that e.g. the BAC (blood alcohol content) or speed of a violation is measured accurately. Moreover all violators should be treated equally which means all violators should be registered. If only certain violators are caught and others escape registration, feelings of injustice arise which could affect the public support for enforcement. This asks for equipment with high and error-free detection rates and highly accurate measurements. Should traffic violations be challenged in court judges and public prosecutors also need to be able to refer to independent and objective references which confirm such accuracy. In many countries such reference is provided by means of an official
certificate after a homologation of certification procedure for enforcement equipment, issued by an official government (recognised) institute (e.g. PTB in Germany, NMi Certin in the Netherlands or METAS in Switzerland*) involved in measurement accuracy. The legal use of enforcement equipment without an official homologation certificate confirming type approval is not allowed by many governments. In addition to this, regular (often annual) calibration is required to confirm that the measurements remain accurate. This calibration is especially important for speed enforcement and BAC testing equipment. For the legal system but also for the violator these procedures guarantee that measurements are accurate and that a true violation did indeed occur. A homologation and a up to date calibration certificate together with the qualifications of the person who installed or used the equipment used for violation registration provides a legal benchmark for accuracy and reliability. These can be used in court as reference by the public prosecutor in case of legal challenges to the validity of violations. A low success rate for legal challenges to traffic violations also discourages future challenges and thus reduces the workload of the legal system.

With respect to the above mentioned issue of legal equality, measurement institutes dealing with homologation increasingly require and test for example a 97 % vehicle detection rate and also need to confirm that e.g. 95% of passing vehicles are actually speed measured. This rate is measured under 24/7/365, night/day and various seasonal and weather conditions in test sessions spread over several days. After the violation, once the evidence by means of a photo is registered, the readability rate of the license plates is also of key importance. This issue is dealt with below in paragraph 3.4.

Separate from the measurement accuracy and detection rate, the measurement validity needs to be tested. Invalid readings (e.g. a car overtaken by a speeding vehicle is registered as violator) should be eliminated by either not registering such evidence or marking the registered evidence as invalid. Both invalid and inaccurate measurements will cause unjustly issued violation notices and could result in unwarranted fines, driving license suspensions and revocations and will undermine the credibility of enforcement and will thus hamper road safety.

Over the past years several digital camera enforcement programmes in various parts of the world with equipment of different manufacturers had to be terminated due to irregularities with measurement accuracy. This confirms the importance of homologation and regular calibration procedures.

Evidence data integrity
The evidence of a violation should be registered permanently and securely. With analogue wet film as evidence this was not such a big issue since there was only one original hardcopy negative which included all violation data. Tampering with this negative clearly leaves marks. However, this all changed with the introduction of digital enforcement cameras and the registration of digital image, video and violation data. Thorough homologations tests are required to confirm that digital evidence data complied with encryption, authentication and integrity standards during registration, transfer, storage and retrieval. Once registered there needs to be absolute certainty that violation data are confidential, secure, permanent, read-only and rendered invalid when changed. Reputable homologation institutes check for various aspects of data integrity as a condition for type approval of enforcement equipment.

2.3. Operational preconditions
Since most automated enforcement is initially based on recognising vehicles by means of license plates an accurate up to date vehicle and owner registration database is of extreme importance for automated enforcement and thus road safety. This also applies to countries with driver liability legal systems, since no matter who was driving; the initial point of contact is always the vehicle owner.

Similar importance pertains to a high-quality driving license database to verify the validity of driving authorisations and, when applicable, the related demerit points of the driver in question. This is in particular relevant for driver liability countries. Demerit points are subtracted in connection with the severity of a violation and may result in driving license suspensions. In owner liability jurisdictions fine notices are usually sent out without consulting a driving license registration data base. Arranging proper access regimes to such databases for authorities involved in enforcement is crucial. A complicating issue, also in light legal equality, is how to deal with violations involving foreign vehicles. This is an issue high on the EU agenda in Brussels. For example in the Netherlands violations committed by German, Swiss and Belgian drivers are effectively enforced through arrangements with the authorities in these countries.

In many countries license plate databases are much more than a link between the license plate, owner and address. They also include other data on vehicle type, length, width, weight, axles, engine size and type, exhaust systems and emissions, etc. This offers the authorities alternatives to manage traffic effectively. Amsterdam effectively keeps trucks with polluting diesel engines out of the city centre with an environmental zone system based on engine and particle filter information from the license plate database. Violating trucks are fined. Dedicated bus lanes and stations squares can be kept car and truck free in a similar way.

2.4. Funding and broad political support

The huge losses, due to road crash casualties, injuries and damage, fail to get sufficient media and political attention possibly due to the fragmented and gradually creeping nature. Despite the significantly higher annual casualty figures compared to aircraft and train crashes these losses remain relatively hidden. In a way we seem to take these for granted as the price we have to pay for economic development, freedom and mobility. Economic growth often follows a pattern whereby initially the development priority is on expansion of infrastructure. Attention for road safety comes later when the increased motorised mobility facilitated by the focus on infrastructure leads to unacceptably high casualty and injury figures. The Commission for Global Road Safety cites the low political priority of road safety in low and middle income countries. It seems many politicians and bureaucrats see extending and widening a road network as an investment benefitting economic development, whereas improving the safety of it is seen as cost. The World Bank also stresses road infrastructure improvements, capacity building to address systemic weaknesses and attention to vulnerable road users as key policies to improve road safety in low and middle income countries.

The huge human and material losses should justify politicians’ attention at an earlier stage, but they also make economic sense. Still, road safety is not really a national election winner and it is next to impossible to score electorally by vowing to improve road safety by increasing automated enforcement. Some politicians find that backing higher speed limits, for some reason often equated with increased mobility and reducing traffic jams, makes
electorally more sense than backing road safety and enforcement for the sake of saving lives. Even in the Netherlands, one of the most road safe countries in the world, a higher speed limit on motorways recently featured as an election issue, and as a result was increased from 120 to 130 km/h. This occurred despite calculations by the consultancy Goudappel Coffeng that 130 km/h would add 15 victims to the annual traffic death toll. One populist party even suggested 140 km/h. In Germany, despite many speed restrictions on Autobahns in urban areas, a nationwide speed limit remains politically out of the question. However, there are objective reasons for politicians to advocate and promote more effective enforcement. The connection between automated enforcement and the benefits to road safety is tested and confirmed in many academic publications. The Economist stated ‘The cost of the cameras was repaid fivefold within a year in accident reduction and savings in medical treatment.’

Automated enforcement requires funding i.e. considerable investment in human resources, equipment, systems and publicity. It also needs amendments to several laws, involving complex negotiations between several ministries and other government bodies. Since political attention for road safety and automated enforcement does not come naturally it needs publicity and advocacy to create awareness and strong public support. This in turn should motivate voters for road safety and thus politicians. This happens in Western countries at a community level which, in case of speeding, is further strengthened by the fact that traffic noise and pollution negatively affect the quality of life.

France remains one of the best recent examples of the positive effects that strong political support can have on road safety. Remarkable progress has been made since 2002, a landmark year in French road safety policy. In the wake of a personal statement by President Jacques Chirac, the Interdepartmental Road Safety Committee (CISR) adopted a comprehensive plan in December 2002 to install a nationwide network of automatic speed enforcement systems and to fully automate the enforcement chain for driving offences, in particular for speeding offences. Effective curtailing of speeding by means of increased mobile and in-vehicle police enforcement, the nationwide enforcement camera project (more than 2,100 fixed and 900 mobile speed cameras at the end of 2012), the efficient processing of the violations notices and the effective fine collection process is believed to be the principal reason for the considerable drop in the number of road deaths and injuries which was the French government’s aim in 2002. Various aspects of the comprehensive speed enforcement strategy in France are extensively documented in publications of L. Carnis.

2.5 Publicity and advocacy for more awareness and public support

In many countries strict enforcement, especially with a lack of publicity, may create a serious backlash in the electorate and various media. Examples of this are well-known in e.g. Germany, the UK and the Netherlands. Regions in the UK therefore have detailed documentation on criteria for the location, operation, visibility and notice of speed cameras. Automated enforcement as a standalone activity runs a serious risk of being seen as a tax or a limit on freedom. This notion is actively encouraged by various media and by reports on huge amount of fine revenues collected. The fact that such revenues often benefit the ministry of finance or the general municipal account does not help. Showing a financial relationship with road safety or infrastructure improvements would.

Few people object to enforcement in their own neighbourhood and in front of the school of their children, the YIMBY (Yes In My Back Yard) effect. However, further away from home,
while trying to be in time for a meeting, the mood changes and a negative perception towards automated enforcement takes over.

Continuous communication on enforcement benefits by means of publicity, education and advocacy to create better road safety awareness and more public and political support for enforcement is essential for its long term success. Regular publicity campaigns about the reasons for and results of enforcement programmes are a crucial part of a balanced road safety strategy.

3 THE ENFORCEMENT CHAIN

The enforcement chain is a sequence of events and actions from the initial observation of a violation to the final verdict of a judge in court of justice on that violation. As mentioned above, with the advent of camera enforcement, especially with digital cameras, the importance of this chain became more prominent, mainly because (digital) technology takes the place of a police office in court. When escalated by a violator, the judgement of a police officer on a traffic violation prevails over that of the violator in court. However, when that judgement is transferred to a technical device, i.e. an enforcement camera with digital processing and transfer of evidence data, a wide range of issues are introduced which demand close scrutiny of the various links in enforcement chain.

Why is this enforcement chain so important, especially with automated enforcement? Enforcement works best when the violator is notified quickly of a violation and if the punishment, mostly the payment of a fine, is executed quickly. Collection of a fine can be a difficult laborious process if the violator is not willing to pay. Therefore, it has to be absolutely clear to the violator that there is no escape from this penalty. Eventually, he or she will be ordered to appear before a judge at the end of the chain and that the escalated fine will be collected by whatever legal means possible.

News of an ineffective enforcement chain travels fast. If violators can afford to skip punishment, the number of violations will increase rapidly and road safety suffers. Apart from this issue ineffectiveness and inefficiencies can appear in several parts of the enforcement chain also with potentially negative effects on road safety. It is therefore important to analyse each link of this chain for potential bottlenecks. The automated enforcement chain consists of the following links:

- Detect
- Measure
- Decide on violation
- Register
- Transfer
- Store evidence
- Process evidence, issue and send ticket
- Receipt of ticket
- Provide evidence upon violator's request
- Collect fine
- Remind violating party
- Court
3.1 Detect

A high detection rate is a key item at the start of the enforcement chain. Registering all passing vehicles is important since only then all potentially speeding vehicles can be caught. Legal equality is compromised if, due to a low detection rate, not all passing vehicles are detected.

All detection methods have their advantages and disadvantages. High detection rates are possible with reliable and durable detection methods such as inductive loops or radar. If installed properly (loops) or mounted at sufficient height (radar) the overall disadvantages of these detection methods (e.g. weather conditions, wear and tear, dirt from passing vehicles or occlusion (blockage of a violating vehicle by another vehicle)) are quite limited. Although accurate, other methods such as video and piezo, laser and low mounted radar all suffer disadvantages with light conditions, weather, occlusion, soiling, durability or sensitivity to damage, which reduce detection rates.

3.2 Measure

After detection of a vehicle its speed needs to be measured. Obviously, this needs to be done correctly with a legally pre-defined accuracy. Proper type approval of all enforcement equipment with produces measurements should be independently verified by a government or government authorised organisation. Equipment accuracy is of prime importance since steep fines can be issued and driving licences may be revoked on behalf of the police or ministry of justice. This has potentially serious consequences for the involved violator, especially for professional drivers where employment contracts can be at stake. Such decisions can only be taken with absolute certainty about the correctness of a measurement. Homologation, certification and regular calibration guarantee that measurements for e.g. speed or BAC taken with enforcement equipment are accurate and correct, and ultimately, also admissible in court as evidence.

Is should be noted that the increasingly popular average speed enforcement systems (section control) calculate the speed based on accurate time measurement and not by measuring speed at a certain location. Measurement is not relevant for red light enforcement. Detecting the passage of a vehicle during a red light phase is crucial here and can be observed since both the vehicle and traffic light can be seen in the image and video.

3.3 Decide on violation

If a person or vehicle is measured to exceed a legally set limit in traffic this should result in a violation. In case of speeding, deciding on a violation is based on the comparison of two speed values by the enforcement camera i.e. the speed limit and the registered speed. Also here all violating vehicles should be treated in the same way. When enforcement equipment misses and fails to decide on speeding vehicles this will result in legal inequality. On the other hand, the same applies to vehicles, which were registered as speeding and violating but were not. Proper homologation and calibration procedures will filter out such issues.

With new radar technology and the higher data processing capacity of the latest enforcement cameras multiple concurrent violations can now also be handled. This means that
accurate decisions accompanied by solid evidence can be taken of e.g. three vehicles speeding or going through a red light at the same time and location.

3.4. Register

After a positive decision on a violation the image and data relevant for that violation need to be registered real-time in a correct, secure and unchangeable way. When properly registering evidence data the use of cryptography is vital. Cryptography includes encryption, authentication and integrity. This allows for respectively multiple reads only by authorised persons (encryption), data originating from the right source (authentication) and no tampering with data by anyone (integrity). Records of non-violating vehicles need to be discarded, but depending on the country may also be kept longer e.g. for criminal investigations. Here a related issue comes up. How long can data of non-violating vehicles be kept by the violation camera? In light of privacy, such registration and storage issues need to be legally defined.

In Germany a privacy issue prevents the implementation of average speed enforcement technology. This is based on the argument that data of innocent drivers cannot be registered, which means data registered at the first camera of a section control system would violate German privacy regulations since it is not know if a driver passing this camera is going to violate the speed, which can only be decided by a second camera.

Often the license plate data from the registered image file are already processed and read in the enforcement camera by ANPR software and digitally included in the evidence file. The result of the reading of licence plates from the image is accompanied by a figure indicating confidence level which specifies the certainty of the registered reading. Confidence levels below a predetermined threshold will need additional manual processing which is costly.

In connection with license plates some crucial issues affecting efficiency and effectiveness of the enforcement chain come up. The clarity, uniformity and readability of a license plate affect the quality of the registered evidence. For instance large black letters on reflective white or yellow plates with a predictable syntax and font get the highest ANPR rates. Good license plates, high quality camera hardware and ANPR software can result in read rates of 90% and higher. Crucial with ANPR is not only a high read rate but also low error rates, for example better than 0,1%. It allows for full automated processing of tickets (e.g. France and the Netherlands) and limited manual involvement. This cuts processing costs significantly. Some countries (e.g. South-Korea and the Netherlands) have changed the license plate format, material, font and/or syntax to accommodate for this.
Recently, the AAMVA (Association of American Motor Vehicle Administrators) also issued a report with detailed recommendations for various aspects of license plate design to benefit readability in light of more effective enforcement and homeland security.

3.5. Transfer

After registration the evidence data need to be transferred from the enforcement camera to a central server which, depending on the organisation, can be located with the police, municipality, central or regional government organisation or even with a private company. Transfer of these data files should be subject to the above mentioned cryptography conditions. These data can be transferred by means of a fixed data line, WiFi or 3G broadband mobile phone connection. Depending on the authorised procedures some countries opt for exchanging data storage devices (e.g. hard disks, memory cards or USB sticks) similar to exchanging wet film cartridges with analogue enforcement cameras.

3.6. Storage

Violation evidence data are transferred to a secure data storage location where they need to be kept for longer term storage (also ref. 3.4.) to issue the violation notice or ticket but also for future reference by for example the violator, public prosecutor or judge. Such data need to be properly backed up or mirrored at a different second location to be secure in case of calamities.

3.7. Process evidence, issue and send ticket

The evidence, which consists of image (with red-light violations sometimes also video) and violation data, requires further processing in the back office to prepare tickets for issuing. There are considerable variations in the operations and functionalities of back offices e.g. depending on the legal framework and process architecture. License plates in violation images may need to be read if they have not been processed in the violation camera. Depending on the process license plate data may need to be keyed in or confirmed visually by an authorised person, even though the error rate of this manual procedure is considerably higher than automated processing with ANPR.

Most driver liability countries which need to identify the driver in the image process all tickets manually. Lighting conditions of the license plates and drivers faces are quite different and need to be adjusted to produce credible evidence. Due to these requirements prosecutability rates for driver liability countries are considerably lower than for owner liability countries. The opposite applies to processing costs per ticket. However, new technology is about to be introduced which analyses the clarity of the license plate and the face in the photo and thus allows for automated processing of front photography images in driver liability jurisdictions.

Matching license plates with the owner’s addresses through consultation and matching with the vehicle or license plate registration database together with matching the violation
with a fine or penalty are key processes taking place in the back office. Several countries struggle to build and maintain an accessible, correct and up to date registration database. If a vehicle is sold and gets a new owner at 15:46 on a given day, it needs to be registered as such to prevent pollution of the database. An incorrect database will result in fines for the wrong owner or person and affects public understanding for enforcement. When the owner’s address is found and the violation data matched with the legally set fine for the violation in question the ticket can be issued and sent.

A combination of owner liability, administrative law, good license plates, high quality cameras, hardware and ANPR software allow countries like France and the Netherlands to annually process millions of violations from automated enforcement cameras with limited or no human intervention from one national ticket processing and fine collection centre. However, when not organised and managed properly these huge volumes of incoming evidence files from cameras can also create major operational bottlenecks which can affect or even shut down enforcement programmes and thus hamper road safety.

3.8. Receipt of ticket

After sending out a violation by means of a notice it needs to be received. This all sounds quite logical but governments need to arrange that ‘not receiving’ such notice or letter will not be an acceptable reason for ignoring the violation notice and thus for crippling this link of the enforcement chain. Depending on the quality of the postal delivery registered mail may be considered but in most countries regular mail is used. However, this means a legal and procedural arrangement needs to be made which implies that sending a violation notice implies receipt of the same. This again stresses the necessity of an accurate vehicle owner registration database including owner’s addresses as a requirement for effective enforcement.

Research has shown that the earlier the driver is confronted with a violation the better the effect of enforcement is for correcting driving behaviour. In owner liability countries technology allows for an almost immediate notice of a violation by means of and e-mail or SMS text message if the owner opts in to have an e-mail address or mobile phone number registered in the vehicle owner registration database.

3.9. Provide evidence upon violator’s request

Many vehicle owners who have received a violation notice may want to see the evidence i.e. the image and/or video with the violation data such as speed, location, time, etc. Such information can be sent by mail or offered by means of internet access. In countries with driver liability and front photography the passenger side is blocked out for privacy reasons.

When providing an image and/or video and violation data as evidence over the internet, other relevant information which further backs this evidence can also be offered. This could include data on the homologation and calibration of the relevant enforcement equipment and anonymous credentials and training data of the police officer in question. After reviewing the various pieces of solid evidence over the internet the violator can be given the option to move to a fine payment function.

A key aspect which should be presented to a violator is information on why enforcement takes place, and more specifically, why on the violation location. For example: “The road
stretch where speeding with your vehicle was registered is speed enforced since 3 casualties, 9 injuries and 7 crashes occurred here in the past 5 years”.

3.10. Collect fine.

Similar to the violation notice, fine collection should be effectuated as early as possible to maximise the effect of enforcement as a road safety instrument. To encourage timely payment the violation notice should clearly specify the fine escalation scheme and collection process on the notice should the violator not settle the fine within the set due date.

In 2010 the Dutch Central Fine Collection Agency (CJIB) collected almost 96% of the roughly 11 million fines issued within one year. In France the Centre National de Traitement (CNT), a similar centre in Rennes, collected 80% of the 4.5 million issued fines within 45 days in 2010. Most of the violators pay over the internet.

3.11. Remind violating party

As part of an efficient fine collection process and to maintain the efficacy of the enforcement chain payment reminders need to be sent automatically to overdue violators. In the Netherlands the traffic fine is increased by 50% with a first payment reminder if the initial due date of eight weeks is missed. A second reminder doubles the initial fine if the first reminder did not result in payment. If a second reminder is not effective coercion methods will be implemented. This coercion process should be well-defined procedurally and legally authorised. It should also be an out of court procedure. Coercion methods include: using a bailiff, withdrawing fines directly from bank accounts, seizing of tax credits, impounding vehicles, invalidating driving licenses, etc.

3.12. Court

If all the above fails, and to conclude the automated enforcement chain as the final link, the violator should always know that a judge will ultimately be made available at the end of the process for a verdict. To prevent backlogs and subsequent acquittals due to a court overload, the preceding links of the automated enforcement chain should be organised and managed in such a way that the number of violation cases ending up in court should be kept to the absolute minimum.

Successfully implementing automated enforcement needs efficiency and efficacy of the entire enforcement chain together with compliance of some essential legal and operational preconditions. However, enforcement can never work effectively as a stand-alone activity. Only in concert with continuous communication, education, publicity and advocacy to promote public and political understanding and support for enforcement it can contribute to its ultimate purpose: improving road safety.

4 CONCLUSION

Authorities starting with or increasing automatic enforcement in their jurisdiction should carefully consider the full scope and implications of their project. It all seems quite simple and straightforward. However, the automatic enforcement chain is full of pitfalls which could
lead to a sub-optimal or even wasted investment in enforcement resources which would negatively affect road safety. Extensively analysing the various requirements and processes for each step in the automatic enforcement chain is essential. Such analysis may result in time consuming changes and adjustments e.g. in laws, organisations, processes and procedures. Special attention should go to issues in connection with political and administrative support, license plates and owner and driver registration databases, legal procedures, hard & software integrity, certification, evidence & ticket processing and fine collection. Only a properly working automatic enforcement chain in concert with effective and continued publicity about its background and results can deliver optimal enforcement benefits and thus facilitate further improvements in road safety.

REFERENCES


