TreadMatch: The application leaving an impression on Footwear analysis

A report about the implementation of TreadMatch into Staffordshire Police and comparing it to other forces experiences



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## Introduction

TreadMatch is an application developed by Bluestar to extend the functionality of the National Footwear Database (NFD) by allowing a physical scanner to gather footwear impressions during the detention process in custody (Bluestar, n.d.). Its purpose is to make the processing and analysing of footwear faster and easier by linking the case information from NICHE (the police records management system) to the digital impressions/photographs that the custody detention officers (CDOs) have taken of the tread pattern and, in a matter of minutes, sending it over to the footwear department to code, verify and upload to the NFD. Currently, only a few Police forces use TreadMatch (only South Wales and West Yorkshire Police that I am aware of), with most other forces still using printscans. However, recently Staffordshire Police have implemented TreadMatch, and so this report is going to look at the implementation of the application, how Staffordshire Police have adapted to it and how this compares to other forces and how they use it.

## Before TreadMatch

Before TreadMatch, printscans were used for recovering people’s footwear in custody. This involves pressing the undersole of the footwear onto a chemical ink pad and then placing the recently inked undersole onto specialist paper, resulting in an ink print of the tread pattern being left on the paper. All information is then filled out on the back, including URN, the custody officer who produced the impression, the shoe brand and size. This is the most common method used by the Police in the UK for retrieving shoe impressions (Pavlou and Allionson, 2009).

The physical copies produced are posted to the dedicated department for footwear and digital copies (photos of the impressions) are sent via email. Once received, the scans are manually recorded on an Excel spreadsheet where the officer involved is noted, as well as the crime, where it happened, shoe brand, size and pattern code. To retrieve the pattern code, a manual search on the NFRC is conducted. This involves analysing the impression and selecting descriptors that relate, such as a circular pattern on the heel and a 4-sided shape on the toe. Niche is then used to find the arrest details, and these are also inputted into the spreadsheet.

Once the spreadsheet has been updated with the submission, an input on the NFD is created. Historically, this has involved manually creating the input and having to fill out all the sections about the crime, then uploading the scans and adding in information about the shoes, including type, size, pattern code and intelligence value (which is identified using the national top 50 footwear patterns graph).

After the submission has been completed, it goes through second checking, where it is checked that all the information needed is inputted and that the information is correct. The footwear pattern is also checked and verified that both people agree that the pattern matches. Once everything is checked and it is agreed that it has been completed correctly, it is uploaded onto the NFD and the spreadsheet is updated with who completed second checking, when it was done, and how many days it has been since processing.

Most forces would have followed a similar method to the one explained for creating and processing printscans, although specific details like filling out the Excel spreadsheet might not have been conducted by all forces, as this was specifically Staffordshire Police’s method for printscans and so details/processes may change between forces.

## How TreadMatch works

TreadMatch is used to link up and gather information from multiple applications to speed up the process of gathering and analysing footwear impressions. It does this by linking with the Force software NICHE, to gather crime information and auto-fill the relevant boxes within the custody record. The CDO then has to log-on, and either take a photo of the shoe undersole (by tuning the camera on and arranging the shoe in the right position within the photobox) or take an impression (by asking the detainee to walk across the scanner ensuring their foot is in the middle of the pad). Once the impressions have been taken, information about the shoe (such as brand and size) is filled in, and then the officer is presented with similar pattern impressions, with the option to select a matching pattern. Once a pattern or the option of no pattern is selected, the file gets sent over to the footwear department through the NFRC in real-time. The footwear department is then able to log in to the NFRC and check that all information is correct and verify the selected pattern to select a pattern themselves, if one hasn’t been selected. Once completed and the patterns have been verified by an individual who didn’t select it, it is submitted to the NFD. As soon as footwear gets added to a record, the officer in charge also gets a notification to inform them that footwear has been added to their case.

TreadMatch is also able to run an intelligence search, which checks the detainee's record for trigger offences (decided by the force). If one is found, it then runs a geographical area search within a set mile radius (can be changed for each force) of where the initial offence was committed to see if a footwear impression with a similar tread pattern was recovered from another scene. If one is found, then it allows the CDOs to decide if they should recover the person's footwear whilst they are still in custody, if they believe the match is enough that the offences could be linked. An intelligence report is then also sent to the officer in charge of the case and to the relevant department that deals with footwear evidence to inform them of the connection. They are then able to see if they agree that there could be a match and possibly link the scenes together.

Some additional features on TreadMatch are that it will highlight records on the custody system to indicate when their time in custody is running out and so their footwear impressions need to be taken soon. It can also communicate with Socrates if needed, and if the auto search for a pattern doesn’t work, then a manual search can be conducted.

TreadMatch is fully configurable, and so forces can change the settings to match the parameters which they wish to set on it and have the application set up to best suit them. This can be seen with Staffordshire and South Wales Police later in the report, as both forces have it set up differently. TreadMatch also has an offline mode that can be used if the Wi-Fi goes down. In these instances, the impressions are taken, but rather than linking to the application and attaching them to the custody record, they can be saved to the computer (recommended to be saved with the case number in the name) and then later uploaded onto the record when the Wi-Fi is back up.

## Explaining different forces situations

Staffordshire’s implementation and use of TreadMatch will be mainly compared to South Wales’, as they were also contacted and visited as part of this report. West Yorkshire were also contacted about their use of the application, but they replied saying that they had “temporarily paused the rollout of TreadMatch due to a potential IT issue associated with the scanners” that they were using. They were unable to explain further what the issue was and what scanners they were using. They originally stated that they were hoping to have it back online by May, but it’s looking like it will be July at the earliest. There may be other forces that use TreadMatch, but when Bluestar was contacted asking which forces are currently using it, they replied stating that they were unable to disclose this information. South Wales and West Yorkshire are only known as they were mentioned during the training day that was attended at Staffordshire Police and with West Yorkshire not using the application at the moment, South Wales was the only force used for comparison throughout the report.

It also should be noted that Staffordshire Police do not have a dedicated footwear department, like South Wales does, and so when talking about Staffordshire Police specifically, the Forensic Case Management Unit (FCMU) will be stated, as this is the unit that deals with footwear evidence and submissions at Staffordshire Police. When talking about both Staffordshire and South Wales Police, the term footwear department will be used to save confusion due to the different force structures.

## Staffordshire Police’s timeline and setup

On the 13th of December 2024, Bluestar held a Treadmatch training at Staffordshire Police HQ to educate officers before the software was installed later that month. This training was available for people in FCMU and for CDOs from both the North and South custody suites. They were explained how the application works and what it does, then shown how to use the photobox and upload images and information onto a submission and what would happen to the submission after it had left the custody team.

On the 17th of January 2025, TreadMatch and the photobox were installed into both custody suites, with the software going live on the 22nd of January 2025.

After which, they started using the photobox to photograph footwear undersoles in custody, but as of the 13th of February, not everyone had been trained and so some officers were still using printscans. At this point, they had also started to experience issues with the application, which are explained in more detail later.

Staffordshire Police have the photobox set up in their drug room within the northern custody suite, but it is placed in the processing room in the southern custody suite. The CDOs then take photos of a detainee’s shoes, using the photobox, and upload the photos onto the person's record before submitting it, the submission is then received by FCMU through the NFRC. They then run the automated intelligence search for similar patterns, and once a matching tread pattern has been selected, it is verified by another staff member and submitted to the NFD. Staffordshire Police do not use the geographical area search feature or the creation of information packs because at the time of creating this report, they had not had TreadMatch long enough to refine all the settings and only wanted to use the application on a base level.

As of the 25th of April, all CDOs had been trained on TreadMatch, and so they were no longer using printscans but still had all the equipment in case TreadMatch went down. They are aware of the offline mode that TreadMatch offers, but keep the Printscan equipment in case there is an issue with the whole system and a non-digital format is needed.

## South Wales’s timeline and setup

South Wales have had TreadMatch since around 2020/2021, but at that point, they were not using all aspects of the application (partially because not all of them were available at the time). It is only since November 2024 that they have fully taken advantage of all the features by starting to use the information packs. Unlike Staffordshire Police, South Wales has a dedicated footwear department and so can dedicate more time and resources to footwear evidence. This allows them to be able to take footwear from everyone who is entered into custody, rather than only taking trigger offences, for example, in 2024, they took nearly 19,000 footwear impressions. Their setup for TreadMatch also differs from Staffordshire Police’s as South Wales use a specialist scanner to recover impressions of the detainee’s shoes, rather than photographing the undersole. They learnt about the scanner after a Chinese company (EverSpry) approached the Metropolitan Police with it and footwear experts from multiple forces were invited down. Initially, the scanner came with software that they were also trying to sell, but this was not different to what the Police used prior and so forces were only interested in the scanners. From this meeting, it was determined that some forces would buy the scanners for collecting footwear impressions, as they allow for digital impressions to be taken. They work similarly to the digital fingerprint machine used by many custody suites throughout the UK, which consists of a screen, a light, and a scanner with a pad placed over the top. When the detainee steps onto it from heel to toe, the tread pattern of the detainee's footwear is scanned and then sent to TreadMatch. The scanners are placed in all the processing rooms in each of their custody suites (South Wales Police force has 5 custody suites), where the CDOs use them to take impressions of a detainee’s footwear. Although in an instance where a detainee has come in with no footwear on, which has happened a few times, there is an option to select that no impressions were taken and state why.

The impressions are then uploaded onto the record and CDOs can run the automated intelligence search, which presents 25 similar footwear patterns to them and allows them to choose the matching pattern before submitting the record to the footwear department. Although this is not needed to submit the record, if the CDO is unable to select a match for whatever reason, they can submit it to the footwear department without a match selected. If this is the case, the footwear department can run the search and select the pattern themselves. But if a matching pattern has been selected, the footwear department just needs to verify that the pattern matches and agree with the selection before submitting to the NFD. Whilst doing this they also fill out a paper form, stating which custody suite created the impressions, if it has been coded, if it was coded correctly, if the manufacturer was included, and if the footwear department had to use the auto search to find a matching pattern (this is to monitor custody suites interactions with the application and their success rate when coding the impressions).

To make the footwear department's job easier, they had a code exhibit screen added, which appears as a clipboard icon when searching through the submissions and allows the team to quickly verify a pattern match without needing to open the case file. It does this by loading a smaller separate window on top of the list of submissions, which only shows the case file number, the impressions taken by the CDO, and the match selected by them. Even if a match is not selected, it will still appear in this list and will only show the impressions taken with no matching image. Multiple members of staff are also able to use this at the same time, as once a case's footwear impressions have been shown to one individual, it is assigned to them, and another staff member will be assigned a different case.

In the instances where a match is selected, without the footwear department needing to view the record the CDO can run an intelligence search, which they have set to search the detainee’s record for a burglary offence (the force has decided to narrow down the search to only include burglaries, as too many results were appearing without the search being narrowed). If one is found, then a geographical area search is conducted, and they also have it set up so that intelligence packs are sent out if needed.

Initially, when implementing the software, they didn’t tell CDOs about the offline mode and told them to use printscans if the software goes offline. They have stated that they regret doing this, as when they were later shown it, they were fine using it and preferred it as a backup rather than taking printscans.

South Wales have worked hard to configure all the settings so that they work for them and have also communicated with Bluestar to help resolve any issues and better learn how to take full advantage of the application. This allows them to use the application in its intended manner and to its full potential.

## The advantages seen

Both forces have identified many advantages of using TreadMatch, the main one being that it is less time-consuming because an input on the NFD is automatically created with crime information being filled in, and the impressions immediately link to the individual. This creates a lot fewer boxes that need to be filled in, making the process more seamless and allowing footwear to be processed quicker. By information needing to be input less, it also means there is less chance for information to be mistyped, creating fewer continuity issues.

By the process being done digitally, it also decreases cost as previously, forces needed to pay for the paper and ink pads used for printscans. This cost increased when the current printscan pads were brought in, as forces have found that they dry out a lot quicker. Even when Wi-Fi is not available, the offline mode allows forces to save the impressions onto the computer and upload them later when the system is back up. The digital aspect also allows searches to be done a lot quicker, as the characteristics of the tread pattern do not have to be manually inputted, instead the impression can be automatically searched. South Wales have then used this to allow their CDOs to conduct the automatic search and select a similar tread pattern, with no prior footwear analysis training. South Wales have said that their CDOs are coding the impressions just over 40% of the time and when doing so are selecting the correct code 85% of the time. This then makes the footwear departments job easier and allows for more footwear impressions to be processed. As a result of processing everyone’s footwear that enters custody, South Wales have been able to gather more robust frequency data on how common different footwear types are. It also gives everyone more practice at their specific roles within the process as they are having to do them more often. South Wales has arranged their setup so that everyone’s job at each stage has been narrowed down, making it simpler for everyone involved in the process and making the process smoother as everyone only has a small part to play.

South Wales have been able to identify more advantages of the application from using more of the features. From using the geographical area search and intelligence packs, they can easily compare offences and possibly identify linked series burglaries more easily due to this feature. The results of this search allow the CDO to decide whether they need to recover the person's footwear whilst they are still in custody, making the recovery easier and saving police time having to track the individual down and find the same footwear. Even if it turns out that the footwear is not needed or the possible match was incorrect, recovering the footwear and it not being needed poses a low risk, as the footwear can then just be returned to the individual.

From the custody’s point of view, both sets of CDOs have enjoyed using TreadMatch and have experienced many advantages from using it. They have stated that it saves them time, and the process is a lot simpler than creating printscans. Both sets of custodies took a little bit of time to adjust to it, but especially in Staffordshire’s case, they feel fully competent in using it after a few months and they have gotten better at finding the best position to angle the footwear in to allow the tread pattern to be seen.

## The issues seen and solutions developed

Both Staffordshire Police and South Wales Police have had issues with TreadMatch since implementing it, with both forces finding that all cases were being pulled through from TreadMatch rather than just the cases with footwear attached. Therefore, everyone who gets logged into custody is currently coming through the system, rather than only the relevant cases. Currently, Staffordshire Police's resolution to this is by using the mini magnifying glass icon, as it is only present when footwear photos are attached to the case. They have been told that this can be fixed by contacting Bluestar but have not done so yet. However, South Wales order the cases by custody date so that the most recent cases appear at the top. They also had the code exhibit screen added as a solution to this issue, as only cases with footwear attached appear.

Although, South Wales have had issues with their code exhibit screen, as once a case has been checked (verified), it doesn’t mark itself as coded, and so for it to be marked as verified, the officer must open the full record to manually mark it so that it appears as completed. They currently don’t have a solution to this as it is a minor inconvenience, and they are in talks with Bluestar to resolve this issue.

Another common issue they have both experienced is that cases were getting delayed and not coming through straight away. This is supposed to happen in real time, but instead, cases are taking a few days to come through. Staffordshire have no resolution to this, but South Wales is getting a new version of Bluestar to make the data transfer easier, as this is an ongoing issue.

Both forces have also encountered low engagement from their custody officers, as not all crimes for which they want footwear impressions are being taken. Staffordshire have also commented, saying that they are only getting 30% of footwear from the offences that they should. This is not helped due to shift patterns, as not everyone working at custody had been trained on TreadMatch within a month of the application going live. South Wales has been able to increase this by monitoring how much each custody suite interacts with the application and keeping a record of it. They have also got the custody sergeants to keep an eye on it and ensure that their CDOs are interacting with it, and currently, they have all custody suites interacting with it over 70% of the time.

As a separate issue, Staffordshire have identified that all the information being inputted from custody might not be transferring over. Currently, the shoe size and MO for the cases are not coming through on the NFRC. It is unclear whether these are being inputted at custody or if they are just being missed and so that’s why no information is transferring through. This information is needed for the submission to be added to the database, but this is not a major concern, as the FCMU can input it.

From the custody side, the custody suites at Staffordshire Police have had everyone who has been in custody within a set period (the past few days) appearing on their system rather than only the people who have been checked into custody that day. To work around this, they can search a specific person's custody number in the search bar to find the record they need, although it makes it harder for them to check if everyone who needs their footwear taken that day has been done, as people who are no longer in custody appear on the list. Although this is an issue which only Staffordshire police have had, when South Wales were asked about it, they mentioned that it may be an issue with the settings and they leave each custody suite to sort through their own lists, even if footwear has not been documented there is a button to declare this and then state why. Therefore, they may need to do this for all the old records of detainees who have already left custody, to start their list from fresh and this should resolve their issue.

A brief overview of the issues seen and their solutions is seen in Table 1 below.

|  |  |  |  |
| --- | --- | --- | --- |
| Issue | If Staffordshire (S) or South Wales (SW) were having the issue | Staffordshire’s solution | South Wales’s solution |
| All cases, including ones without footwear attached are being pulled through | Both | Look for a mini magnify glass icon as it only appears if footwear images are attached to a file. | Order cases by custody date so most recent ones appear first and had code exhibit screen added. |
| Cases are not being transferred straight away | Both | No solution | Communicated with Bluestar to get an updates version to help resolve this. |
| Low engagement from CDOs | Both | No solution | Monitored engagement and are keeping on top of interaction stats. |
| Not all information is being transferred over | S | No solution | N/A |
| Cases are not being marked as completed once verified on code exhibit screen | SW | N/A | Open the full record and mark it as verified. |
| All detainees from custody within a set period of time are appearing, rather than only current detainees | S | They use the search option to search the individual’s custody number and recover the record they need. | Could be settings issue or just need to state that footwear was not documented for old records. |

Table 1: The issues seen from using the application and the solutions that both forces have come up with to resolve them.

As seen, many of Staffordshire Police's issues do not have a solution, and the solution that they have found was a temporary fix, whilst they were still getting used to the application. Whilst South Wales have found long-term solutions from having the application for longer and working with Bluestar to help resolve their issues.

When implementing the application, both forces experienced other minor issues, these have not been mentioned as they were just expected inconveniences that occurred from setting up a new application. This included things like setting up the error message for the scanner so that it tells CDOs when the pad needs changing and ensuring that all CDOs are trained on the software.

## Comparison between the force’s uses of TreadMatch

As shown previously in the report, Staffordshire and South Wales Police have TreadMatch set up differently and use it to different extents. Staffordshire Police only use some parts of the application, due to how their force is set up and how they wish to conduct their analysis, whereas South Wales uses the application as intended by utilising more of the features. The main difference between the forces is their choice of process for creating the impressions, with Staffordshire Police using a camera and photobox whilst South Wales use a scanner. This results in South Wales submitting impressions to the NFD, which fits in with the majority of other submissions on there, whilst Staffordshire submit photographs of the undersoles. This may make the comparison between the footwear processed from custody to impressions left at a scene harder because if the undersole is black or has raised sections of the pattern, it will be difficult to tell which aspects of the tread pattern will be shown on an impression. Therefore, it limits the usefulness of the submission.

South Wales’s setup is a lot more structured, mainly because they have had the application for longer and so have had time to find a process that works. Although this process has a lot of moving parts which need to be managed for each stage to work. This does create extra work, keeping on top of each stage, but the reward for doing so (being able to take 19,000 impressions in a year) is worth it. They can recover this many impressions by taking footwear for every offence (rather than only trigger offences, which Staffordshire does), as it doesn’t cost them anymore to take impressions from every offence, because physical resources are not being used up. Even if they are unable to verify a pattern for every set of impressions taken, they are at least in the database and can be completed at a later time.

Both forces kept the equipment for completing printscans in case they were needed, with Staffordshire using them for a little while after implementing the application and South Wales not informing their CDOs of the offline mode initially. South Wales have now got rid of this equipment because the new pads dried out too quickly, causing them to need to be replaced after only a few uses. South Wales did run a test on this, finding that if closed and just returned to where they are stored, they only last for around 60 prints. But if placed back in their plastic seal, creating an air-tight environment, then they can last for around 700 prints. Although many CDO officers forget to do this, and the pads cost around £100 each and so when it was only being used now and then and would only last around 3-4 weeks, the cost was adding up for not much gain.

Whilst South Wales’s setup is how the developers intended the application to be used and they can recover more intelligence from their methods, it is unlikely that Staffordshire would be able to replicate this. Due to Staffordshire Police being set up differently and not having a dedicated footwear department, they would be unable to process as many impressions as South Wales are, because the staff members within the FCMU have multiple other jobs to complete and so can't spend as much time on footwear. For these reasons, Staffordshire Police may benefit from allowing their CDOs to run the automated search for patterns and possibly find matching patterns, so that all the FCMU have to do is verify the matches, making their job easier and quicker. But this is also unlikely to be possible as unlike South Wales, Staffordshire only has 2 custody suites (whereas South Wales has 5) and so their custody suites get very busy and CDOs don’t have a lot of spare time to be able to do this (even though it is a quick process). The possibility of this is not helped that the Northern custody suite for Staffordshire currently has its only photobox within the drugs room at their suite, and so if someone else is using the room for drug checking, then footwear impressions cannot be taken until the room is free.

Overall, neither force has a better setup, as both setups have been tailored to suit each force's needs and structure. After Staffordshire Police have had TreadMatch for longer, they may decide to use more of the features available and change their setup to better accommodate this, but currently, both setups work for their forces, and TreadMatch has improved footwear impression processing for both forces.

## Recommendations for Bluestar

From conducting this research, the recommendations for Bluestar are to keep working with Police forces to help develop the software. Currently, the additions and changes that have been made to the application as a result of working with South Wales (and possibly other forces which are not known about) have resulted in useful changes that have made the application better for forces to use. By continuing to utilise feedback from police forces, it will tailor the application more to force standards and ensure that the software is intended to fulfil its purpose for the target audience (Police forces).

## Recommendations for forces implementing TreadMatch

For any forces looking to implement TreadMatch, they need to consider what the risks of using it are especially if it goes wrong. During the early stages of using a new software, it is likely that issues will arise, but if issues are still occurring later on, then the application’s results could be affected, causing a greater risk. As with many applications which Police Forces implement, it needs to be fully researched, and a plan needs to be made as to how much of the application is initially going to be used before the software is installed. As part of this, initial configurations for the settings should be decided so that the installation is smoother and the application can be tested from the beginning.

For the custody side, both Staffordshire Police and South Wales have found that little training is needed for CDOs to be able to understand the application. Staffordshire had 4 of their CDOs (2 from each custody suite) attend the initial training from the developers and from which they were able to train up everyone else at each of their custody suites (even people on other shift patterns) within a few months, by pulling a colleague aside when they were free and showing them the setup. South Wales’s CDOs have also been able to correctly select tread pattern matches, without any prior training in footwear analysis.

It is also recommended to use this report to educate the footwear department and custody suites on the application before installation, and to help fully plan how the footwear impression process will work with TreadMatch involved, as the report mentions the majority of aspects that need to be considered. After implementation, the report is also useful to find solutions to possible issues that might have occurred and provide other forces to get in contact with if support is needed, without having to contact Bluestar.

## References

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