Introducing Predictive Policing Technologies (PPT):

An Evidence-Based Case History

Written for Evidence-Based Organizational Change and Development (EBOCD)
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Introduction

This chapter presents the case of a 12-week pilot-study that sought to oversee the successful implementation of a 'predictive policing technology' (PPT) into a territorial police force in the North of England (West Yorkshire Police, referred to henceforth as 'the Force'). We critically reflect on the process of the evidence-based change and development initiative, the immediate impact of the initiative, and the research findings. In doing so we provide observations regarding the implementation and use of such technologies and the challenges they represent in relation to organizational change and culture. The question underpinning this research was, 'How can predictive policing technology be culturally embedded?' We hope that findings from this pilot can be applied more widely as others move to engage with similar technologies in other districts as part of further Home Office and policing initiatives (Grierson 2016).

Context and drivers of the initiative

The 12-week pilot that forms the focus of this case-study was the first phase of an ongoing organizational change project between the Force and a team of academics from a range of backgrounds and disciplines. The project is funded by the UK Home Office and forms part of

a wider strategy that sees academic expertise aligned with a range of challenges and crime-prevention initiatives identified in territorial police forces throughout England and Wales. The overarching aim of the collaboration is to facilitate the successful implementation of PPT, based on a number of regional and criminological factors.

The rationale for these initiatives was premised on statistical evidence which correlates the numbers of police officers available for deployment and patrol in relation to the statistics of reported crime. According to UK Home Offices figures, in 2009 the number of police officers in England and Wales stood at 143, 769. Following progressive cuts to the public sector, by 2016 this figure fell to 124, 066; a fall of 14% (Harrison 2015; *BBC News* 2016). Even though reported crime-rates tended to fall during this period, by December 2016 this trend had stalled and in some areas (such as fraud) it had reversed.[1] Consequently, police forces in England and Wales have come under increasing amounts of pressure to deliver more with less. A central challenge is that many forms of crime prevention are based around officers' presence preventing crimes being committed. Therefore, with decreasing numbers of "bobbies on the beat" (Hopkins 2015), the successful direction and presence of resources to the "right place at the right time" has positioned 'predictive policing technology' as a cornerstone for preventative crime measures in the new digital age of policing on both sides of the Atlantic (Holt 2017).

One response has been to consider the use of 'predictive analytical' software to aid the efficient and effective deployment of 'visible patrols' (Chainey, Thompson and Uhlig 2008). In recent years, a significant increase in the volume, velocity, veracity, variety, and value (Rahman and Aldhaban 2015; referenced in Rahman 2016) of data ('big data') has meant that organisations in a range of sectors have sought to leverage the data available to enable 'probabilised' decision-making processes (Allenby et al. 2014).

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The foremost expectation held by organizations regarding big data's potential is based around 'predictability' (Bughin, Chui, and Manyika 2010; Agarwal and Dhar 2014; Hashem et al. 2015). In crude terms, the size of data available is in positive correlation to the leverage against risk. In other words, the accrual and analysis of big data will provide the opportunity

[1] For more information on crime statistics and trends in the England and Wales, see https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/crimeinenglandandwales/yearendingdec2016, accessed June 2017

to move on from present action and past reflection towards a calculable future, derived from evidence-based data incorporated into an algorithm.

Predictive Policing

Predictive policing has become a key feature of what is known as 'Intelligence-led Policing' (ILP, (Ratcliffe 2016). According to Beck and McCue (2009, p. 22) predictive policing is concerned with '[t]he ability to anticipate the time, the location, and the nature of the crime' in order to '[support] the police manager's ability to proactively allocate resources – preventing or deterring crime through targeted police presence and enabling response by pre-positioning police assets when and where they are likely to be needed.' This approach is based on predictions derived when large data-sets are processed by an algorithm. The logic behind the algorithm is that certain types of crime follow predictable patterns and therefore resources can be deployed to prevent a crime or act as a deterrent through their presence in specific locations. The use of PPT requires a mediated delivery of the output of reported crime as intelligence through a variety of technologies – ICT, smart phones and apps.

However, the success of PPT can be inhibited by two types of factors: factors relating to the predictive ability of the technology to identify the appropriate time and place of the officers' deployment, and factors relating to the technology's uptake, which are based on elements such as the views of the officers, their beliefs in evidence-based practice, the supporting systems that inform and direct them on patrol, and the management of compliance with these requirements. Often best intentions are thwarted through the unintended selection of inappropriate techniques (College of Policing 2015) or a failure of operational officers to be convinced of the value of patrol plans that are based on prediction, leading to a failure to comply with requirements and implement evidence-based crime prevention (Farrington et al. 2003) or lack of supporting systems and infrastructure that inhibits effective and efficient operational delivery. Our interest in this case study is primarily in the second type of factors, relating to the acceptance of the technology and the change in working practices that it entailed.

Organizational analysis: Making sense of technology acceptance

It is a commonplace observation that any attempt to bring about change in organisations may be greeted by a range of responses, from enthusiastic support to indifference or opposition (Beckhard and Harris 1987). A change may have different potential impacts on those affected

by it, and thus will be perceived as a positive development by some stakeholders, and as a negative imposition by others. Attitudes towards a change may be influenced by the manner in which it is introduced, and the extent to which those affected by it accept this method of introduction (Balogun et al. 2016).

Specifically in relation to changes concerning the adoption of new technology, the Technology Acceptance Model (TAM) (Davis 1986, 1989) proposes key factors that are likely to affect the behavioural response to the requirement to change (see Figure 1). Key factors influencing the take up of information technology by users are the perceived usefulness of the technology, and the perceived ease of its use. Later developments of TAM included social influence factors (from colleagues and bosses) that affected perceptions of usefulness and behavioural intention to use the technology (Holden and Karsh, 2010; Turner et al. 2010).

There is a lack of evidence-based accounts of TAM in police settings, but there is sufficient (Lindsay, Jackson, and Cooke 2011, 2014) to provide a framework for a model to apply in our case, adapted to fit the specific requirements and challenges presented by PPT in this context.

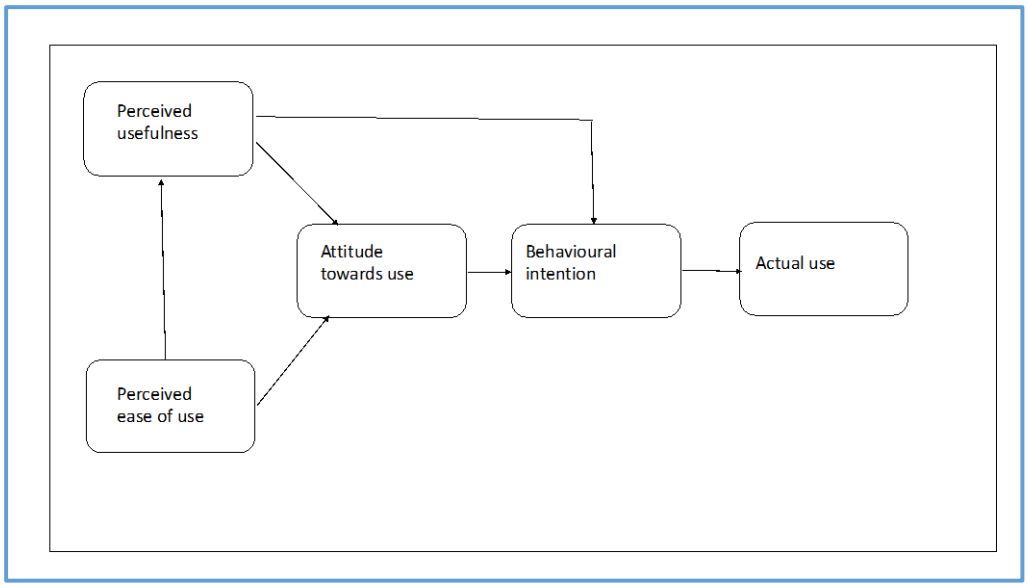

Figure 1: The TAM: (from Holden and Karsh 2010: 161)

The use of TAM as an analytical framework through which we could embark on a process of organizational sense-making is different from the methodology, which is outlined below. It is by working with TAM as an analytical framework that we could employ action modes of research (Raelin 2009) to help gain acceptance of the technology through the production of actionable knowledge (Argyris 1996) for its progressive implementation throughout the Force.

The case

An algorithm was developed by a university-based technology team that processed reported crime data for a specific area and generated maps of streets deemed to be at higher risk of further crime, thus indicating priority areas to patrol. The technology was designed to update the maps every 24 hours and to communicate them to the teams of officers responsible for patrolling the area via a tailored application on their hand-held devices (smartphones).

The project was funded by the Home Office, and a project manager within the Force liaised with the range of officers who would be involved, and with academics from three universities, who were active in developing and analysing the project. A specific inner city area was chosen to pilot the technology. The focus of the first pilot was chosen by the senior leadership team for the division, and was the crime of domestic burglary.

Action research (Raelin 2015; Rigg and Coghlan 2016) provided an overall framework for understanding and guiding the project: a collaborative approach was taken to working with police officers at all levels of the Force, to design the pilot, to monitor progress and to address emergent problems as they arose, at the same time generating knowledge as evidence for use in a progressive and cyclical process, starting with diagnosis, questions and planning, leading to action taking (Lewin 1946) and generating actionable knowledge for wider dissemination (Argyris 1996) .

Meetings were held with senior officers (superintendent and inspectors) responsible for the pilot area, to discuss the working of the project, and to seek from them a statement of their aims in taking part. From these meetings, three key indicators of success were named:

- a reduction in burglary from dwellings;
- a reduction in calls for service;
- an increase in public confidence.

A meeting was also held with a group of sergeants, to discuss the project and to emphasise the importance of their role. What little research there is on police acceptance of mobile technology (Lindsay, Jackson, and Cooke 2011, 2014) highlights the influential role of sergeants. Further briefing meetings were held between the project manager, a member of the university research group, and individual sergeants and the police constables (PCs) and the police community support officers (PCSOs) who would use the maps as they patrolled the streets.

The pilot was scheduled to last for 12 weeks. The PCs, PCSOs and the sergeants were asked to use the maps and to report back on their experiences on a regular basis. During the pilot period, 16 meetings were held with sergeants and the officers in their teams at the start of their shift, allowing learning about the working of the technology to be shared with the group and the university researchers. The articulation of what was being learned enabled evidence to emerge of what was working, and what was helping or hindering. The experiences and perceptions of the PCs and PCSOs were sought in a group setting, and then some further information was gathered from each sergeant in a separate interview. Some meetings were also attended by an inspector or the superintendent, to gather information and to contribute to the evaluation.

In the first part of the pilot phase, selected officers in each team were asked to use the technology, and their time was protected (‘ring-fenced’) and overtime was approved where necessary. In the second part of the pilot, this ring-fencing was relaxed, and the technology was used by a wider range of officers in the team. Both approaches were evaluated to assess which was more effective.

As the pilot proceeded, different aspects of the use of the technology were discussed and evaluated. Action was taken to make improvements and deal with difficulties, and longer term actions were identified for future implementation. Information from the team meetings, and from meetings with other officers, was analysed through thematic analysis (Braun and

Clarke 2013), allowing the emergence of evidence that could be used in further phases of the project. From this the research team augmented the basic elements of a Technology Acceptance Model (TAM) for use in future phases of the project.

Findings

Certain themes emerged from our discussions with the users of the new system. Of particular interest were factors that appeared to help the system to work, and factors that hindered the system, and thus influenced adoption by the users.

Throughout the pilot, officers engaged in processes of sensemaking regarding the new technology, and made adjustments to the ways in which the technology impacted on the work of officers.

Minimal requirements for adoption were the support of senior managers (the Chief Constable, the divisional superintendent and inspectors) and the availability of resources. The early meeting with the divisional superintendent and inspectors, where measures of success for the pilot were discussed and agreed, was an important step. The support of this group of senior managers was also signalled by individuals attending some of the feedback meetings with sergeants and officers.

Resourcing challenges were partly eased by funding from the Home Office for the project, which enabled the project manager to provide the necessary smartphones for PCSOs, and enabled the divisional superintendent to authorise overtime during the pilot period. Resourcing still remained an issue, however, with operational calls on the time of PCs and PCSOs potentially conflicting with the requirements of the system, and some officers seeking time off rather than more overtime. There is a tension between spending time on crime prevention - 'proactive policing' (Clarke 2006) - and spending time reacting - 'reactive policing' (Scott 1998) - to reported incidents. This tension between 'proactive' and 'reactive' strategies is central to evidence-based policing matrices (Lum, Koper, and Telep 2011).

Beyond these minimal requirements, of support from senior managers and sufficient resources, major themes arising from discussions with officers concerned the perceived value of the system, which was closely linked to its perceived credibility. Credibility concerned a) the perceived likelihood of the accuracy of the system, b) the perceived plausibility of actual predictions, and c) the effectiveness and reliability of the technology.

In initial briefings for the sergeants and officers, and in subsequent meetings with them, the project manager explained the theory behind patterns of domestic burglaries, using practical examples and demonstrating a good understanding of police approaches to this type of crime. She was also able to explain the volume and type of data that was used by the algorithm, and could give examples of similar systems being used elsewhere. She and the university researchers also emphasised that they wished to get feedback from officers as the pilot

progressed, in order to learn how the system could be improved, accepting that adjustments would probably need to be made.

In the early stages of the pilot, queries were raised by some officers about specific predictions, where maps showed locations that did not appear to contain likely premises, or conversely where maps did not indicate a location close to a recent reported crime. In one meeting, officers openly queried the value of the algorithm as compared to the knowledge they had gained through practical experience. The project manager regularly explained that the information from the algorithm should be used alongside the assessment of experienced officers as to which areas to patrol. The question of whether this technology should complement the judgement of exeperienced officers rather than over-ride it is an important issue in acceptance and operation. As a result of feedback, some adjustments were made to how the algorithm generated maps.

A limitation of the system in the pilot phase was that very little additional information was provided – such as the reason why a particular location had been highlighted for preventive policing. Some officers said that more up-to-date intelligence reports should accompany the patrol plans, to give them a sense of why they were being asked to patrol certain locations, so that the technology could complement their 'craft' and 'beat knowledge'. During the pilot phase, however, it was not possible to link the patrol plans with intelligence in a timely manner.

The effectiveness and reliability of the technology was a third aspect of credibility. Technology teething problems in the early days of the pilot resulted in the maps not changing every 24 hours, as promised, but remaining the same for two weeks. The credibility of the system suffered early damage as a result.

The perceived value of the system was affected by perceptions of its credibility, but also by another factor: was it effective – was it actually deterring crime?

Deterrence of a crime such as burglary through showing police presence is normally only evidenced in retrospect. During the pilot, officers patrolled the streets indicated by the maps, in addition to their other duties. They were encouraged to be observant and to point out potential risks – such as windows left open – to householders. However, it was not clear to

them at the time they were patrolling whether they were being effective in deterring crime. As one sergeant said: 'If you are wandering around and nothing's happening, it's hard for people to see that they are doing a good job'.

Figures on burglaries and incidents were gathered and analysed at the end of the pilot period. The results were:

- in the pilot area, burglary dwellings (ie domestic burglaries) had fallen relative to the same period the previous year, from 274 to 202 crimes: a reduction of 35.64%
- in the pilot area, burglary dwellings had fallen relative to the previous three months, from 253 to 202 crimes: a reduction of 25.25%
- in the whole district, these crimes had risen relative to the same period the previous year, from 986 to 998: an increase of 1.2%.
- in the whole district, these crimes had risen relative to the preceding three months, from 989 to 998: an increase of 0.9%

Of course, these figures need to be treated cautiously: we are not able to draw firm conclusions on causal links between the project and the figures, but these were at least some positive signs, and they reinforced senior managers' support for the project. Within the teams led by the sergeants, ways of working with the technology had evolved and become accepted. For example, it was found more effective to allocate PPT maps throughout the whole team, rather than ring-fence the time of particular individuals. As one sergeant said at the end of the pilot period: 'It's become part of daily business now.' The review by senior officers at the conclusion of the pilot suggested that the briefing of officers against Patrol-Wise maps had become considered 'normal business' with discretion left to sergeants and officers, which is continuing.

Discussion

A variation of the Technology Acceptance Model, the PP-TAM Version 1, was developed in order to analyse the process in this case (see Figure 2). Sensemaking was a constant process, influenced by previous experiences and by attitudes expressed by colleagues, as well as by communications with the project manager and more senior officers. The perception of the extent to which the technology impacted on everyday performance in a positive way, or a negative way, affected perceptions of ease of use, as did resourcing. A key influence on perceived usefulness is the extent to which those involved in the project value the technology,

and a critical process is the extent to which various actors, technologies and maps can be enrolled into the activity.

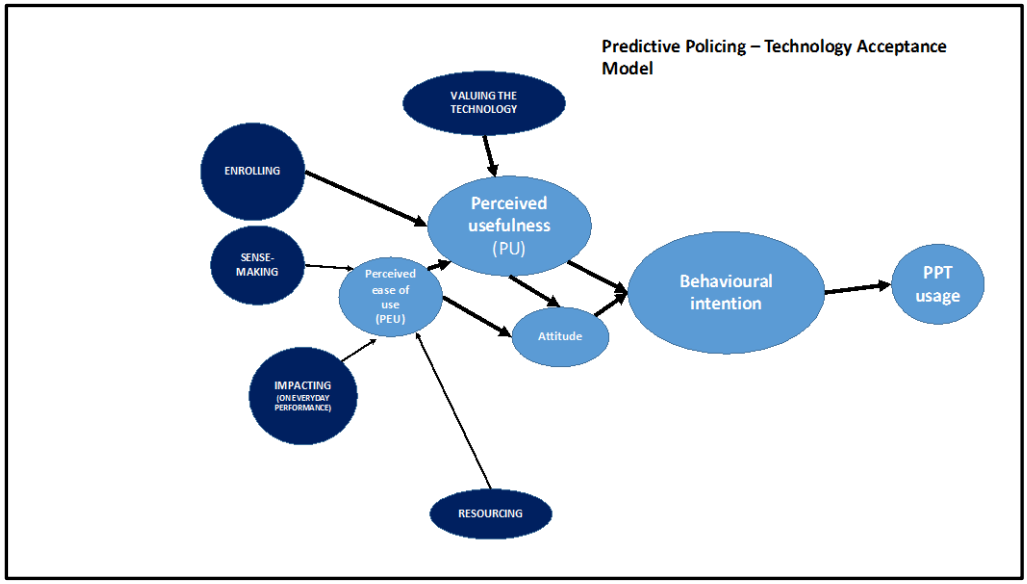

Figure 2: A PP-TAM

Evaluation

It is difficult to determine the extent to which the theory underpinning TAM was successful in our attempt to implement the predictive technology. As stated the principles underpinning the core of the model have been adapted by others to meet the specific organizational formations and challenges of the Force's culture and structure. Indeed, the quantitative success story that can be told by the comparative figures are only indicators of success. Moving forward, what we have is a working PP-TAM that can continue to be adapted as new data related to the new organizational, methodological, technological and criminological challenges that are faced moving forward with the future phases of the project.

Old insights, new applications

A central challenge that the pilot uncovered was the view of the technology as something that should *complement* rather than *determine* the conduct of the officers on the beat. At first this might appear to be an obvious and mundane observation. There are certainly more than enough accounts of technologically-oriented organizational change initiatives taking a technological determinist view to development needs. However, moving forward, this

challenge is a factor to be reiterated and considered further due to its organizational pertinence regarding the reception to the technology by the Force. This is principally due to the hierarchical structure of the Force and the officer's conduct being channeled by response to 'commands' and the direction of patrol-plans based on intel. As we move forward with the next phases of the project, there are specific challenges as we transferred to different districts, crime-focuses, organizational dynamics (non-ring-fenced provisions) etc. However, underpinning all of these is the essential factor of complementarity in the success of the technology in this pilot phase. This is something that others can learn from, both within the specific Force we are engaged with and more widely as others move forward with similar technologies in other regions as part of wider Home Office and policing initiatives (Grierson 2016).

Conclusion

In this chapter we have provided a case to show how action modes of research, principally action research and action learning research could both support learning of participants and provide evidence to develop a PP-TAM. While the model consists of abstract concepts, it is made meaningful in the context of continuing work within the Force and beyond through its connection to the evidence.

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