Optimising the information and knowledge environment within the Leicestershire Constabulary

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Optimising the Information and Knowledge Environment within the Leicestershire Constabulary

by

Rachael Lindsay

A Doctoral Thesis

Submitted in partial fulfilment for the requirements for the award of Doctor of Philosophy of Loughborough University

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Abstract

Police forces in the UK have embarked on a recent Government initiative to implement mobile information technologies, which may be one of the most significant changes in policing history since the introduction of the two-way radio. The purpose of this research was to evaluate the impact of mobile technology on employees and existing information and knowledge intensive business processes within a UK police force, the Leicestershire Constabulary.

An interpretivist philosophy allowed an exploratory strategy towards evaluating the key impact of mobile technology. Broadly speaking, an action research approach was adopted, as the research contributed to the practical implementation of mobile technology along with development of existing theories. Focus groups and questionnaires were conducted with around 100 operational officers that were using mobile devices. Observational work shadowing was also conducted with a smaller number of officers to observe the impact of mobile technology in context. The research aim was further explored through interviews with a range of mobile technology project managers, senior police officers, non-operational mobile technology stakeholders and other organisations that are experienced in using mobile technology. The results were subject to largely thematic qualitative analysis to identify the key impacts of mobile technology.

The exploration of the impact of mobile information technologies on the existing information environment of a policing organisation has enhanced theoretical understanding of the key challenges and risks afforded by such technology. The study has shown that it can improve visibility levels, facilitate mobile knowledge sharing and increase access to real-time information; for society this may mean improved safety and protection. However for these significant benefits to be realised, the radical organisational and cultural change and barriers to acceptance that it brings must be managed effectively. A number of complex factors are entailed in the change process, and cannot be resolved through simplistic solutions and quick fixes that the UK Government originally intended but a long-term programme of change management. The factors identified in the study showed that existing theoretical models, such as Davis’ Technology Acceptance Model, must be extended to include elements that are not intrinsic to the technology in order to suit a policing environment. Instead of factors that related to the perceived usability or usefulness of mobile information technologies, it was found that organisational cultures and values, as well as the actions of senior management, were crucial in determining the success of the implementation of a new technology. In response to the research findings, the study developed an implementation toolkit for application across UK police forces to manage the radical technological change. The toolkit includes an evaluation framework and an adapted, holistic user acceptance model (H-TAM). The evaluation framework led to successful selection of a mobile data terminal solution with full access to systems used in the police station, thus allowing ‘anytime anyplace’ crime recording. The H-TAM is a high-level view of the key factors that should be addressed in order to overcome barriers to user acceptance of mobile technologies and the cultural change that it entails. The findings showed that the H-TAM is largely applicable within a variety of other UK police forces, with a range of device types and numbers, and rural and urban locations. Whilst other related studies have addressed the main factors to acceptance of technologies, they do not provide an integrated framework that can be applied in such a practical manner. Rather, the study has validated the notion that the introduction of technology must go beyond the technology and cover the people and processes associated with the technology in order to fully exploit the potential benefits.
Acknowledgements

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Figure 10.6.1: The Research Design and Contributions ........................................................................287
Publications

The research that is presented in this thesis has led to the following publications:


Two additional publications are currently out for review in the *Online Information Review* and the *International Journal of Information Management and Evaluation*.

The multi-facet research was also presented at the 2009 UK Academy of Information Systems Doctoral Consortium, where under intense questioning from one of the leading figures in the information systems domain, Prof. Ray Paul, commended the research as “Without doubt, the best PhD research at the conference”; and the author won the prize for the best paper at the Consortium.
Chapter One: Introduction

Chapter Preface

This chapter outlines the rationale and theoretical framework for the research. It explores specifically the importance of knowledge management in policing organisations, and outlines the need for mobile information and knowledge processes. It also provides detail of the organisational research context of the Leicestershire Constabulary prior to the introduction of mobile technology, which answers Objective two of the research. The aims and objectives of the research are presented as well as an overview of the remaining chapters.

1.1 Knowledge Management in a Policing Context

1.1.1 Problem Domain

Since the September 11th 2001 events in New York, policing organisations are increasingly realising the importance of sharing information. It is no longer acceptable to hoard information in silos. Davenport and Prusak championed the economic arguments for knowledge integration and have shown that poor knowledge management practices have the potential to lead to high costs as a result of knowledge gaps and deficient decision-making1. Jashapara recognises the principal task of knowledge management is to systematically exploit and share human knowledge by using the appropriate technology and techniques in order to enhance an organisational performance2. Although Brodeur and Dupont3 argue that knowledge work is viewed as a low priority for policing organisations, which tend to attract those dedicated to action rather than to reflection, the law enforcement profession is appreciating the value of information and intelligence4. Policing is unquestionably a knowledge-intensive activity. Holgersson5 studied the practice of police officers and identified numerous situations where knowledge is required, such as identifying potential suspects, communicating with people, solving disputes and using information technology to collect and analyse information. Equally, the research findings of Luen and Al-Hawamdeh6 establish that police officers come into an astounding amount of information, suggesting a need for police to be proficient knowledge workers. Ericson & Haggerty7 view a new paradigm in the police, where police produce and process knowledge. Information is held in a variety of sources and formats, which may present issues to officers including identification of the most efficient and timely

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4 Connors, T. Putting the 'L' into intelligence-led policing: how police leaders can leverage intelligence capability. International Journal of Intelligence and Counter-Intelligence, 2009, 22(2), 245.
manner to surface knowledge for problem-solving. Knowledge management (KM) principles may be applied to overcome these problems, (and are further discussed in Chapter two). Policing is therefore an organisational context that is likely to achieve significant benefits from enhancements to knowledge management practice of the application by technology and KM techniques.

Information and knowledge lie at the heart of most law enforcement activities. Academics have studied policing activities for the past 40 years and during this time research findings have challenged the notion that policing is primarily associated with patrolling the streets, as police officers must also gather intelligence. UK police forces hold increasing amounts of information and knowledge regarding suspects, victims and incidents which is vital in the decision making process of an investigation. A police officer relies on information, gathered facts and tacit knowledge developed from street experience in order to draw conclusions. Sharing this knowledge effectively is now recognised as critical to effective crime prevention, reduction and investigation strategies. Similarly, an empirical study by Glomseth et al. into the effect of knowledge sharing in police investigations within the Norwegian police force found that detectives must work together rather than in solitary to solve criminal cases such as terrorism, corruption and trafficking; knowledge sharing is critical in acquiring information for evidence in cases. However, policing organisations encounter significant barriers in effectively sharing knowledge. Claver et al. and Walker & Katz have argued that a bureaucratic culture is typical of public agencies because of the different activities they conduct in order to pursue a common goal. Similarly, White suggests most policing organisations are organised in the same way; consisting of a hierarchical command structure and authoritarian management style. The majority of employees can be found at the bottom level of the hierarchy, which may make it difficult for senior managers to tap into the entire wealth of knowledge held at the lower level. This can cause the flow of information to break down, with a danger of hindering decision-making. Gottschalk explored this concept further and found that 'in many police forces there is a command structure, rather than a knowledge structure. In the command structure, the higher-ranking officer is always right. In the knowledge structure, the knowledge is always right.' This demonstrates how vital knowledge of operational officers may be overlooked at the expense of the organisation.

Recent high profile incidents of failure in knowledge transfer between police forces and other agencies, and within operational units or departments have amplified the need to scrutinise the knowledge-sharing and communication patterns of police workers. These include the events of September 11th 2001 in the US and the Soham murders in the UK in 2002. In an important Government review of policing, the Flanagan Report recognises that 'high profile inquiries as a result of significant failings bring about a widely perceived view within the police service of the need for them to engage in

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bureaucracy at an unnecessary level\textsuperscript{16}. In light of the investigation into the Soham child murders, the Bichard inquiry sought to assess the effectiveness of the relevant intelligence-based record keeping and information sharing with other agencies\textsuperscript{17}. Likewise, the risks and inefficiencies associated with the compartmentalisation of information management within the 43 individual UK police forces, each with individual responsibility for the management of intelligence and knowledge gathered within their own area, led to a national strategy for police information systems (NSPIS). This initiative aims to provide common IT applications across all UK police forces so that information can be shared easily\textsuperscript{18}. Similarly, the Management of Police Information (MoPI) code of practice was introduced in 2005 to ensure information management is conducted in a consistent manner. Thompson said that ‘the transfer of information… is the lifeblood of the policing organisation… we need to ensure that the intelligence and information which we hold on people is fully accurate’\textsuperscript{19}.

The recommendations resulting from the aforementioned police strategies recognise the lack of common information technologies as the source of the problem of information sharing. Although important, databases and the structured data that reside within them present the problem of information overload and do not tap into the vast majority of information that exists throughout the law enforcement and intelligence communities. Unlike private sector business, which may produce a tangible good, police forces provide an intangible service\textsuperscript{20}. This service is delivered through interaction of police personnel with clients and other colleagues, usually in a social manner. Consequently, it may be argued the most important asset of policing is the knowledge of police officers and the need for their knowledge to be captured. Police officers work in a dynamic and complex operational environment. Such work requires the management and generation of vast quantities of information, which will often exist as tacit knowledge, based on an officer’s experience, know-how and skill. In their work on knowledge management in a policing context, de Laat and Broer\textsuperscript{21} conclude that more attention needs to be given to social processes rather than the more usual narrow focus on practice. Research studies by Huotari & Wilson\textsuperscript{22}, McKinnon & Bruns\textsuperscript{23} and Auster & Choo\textsuperscript{24} have pointed to a connection between the informal knowledge networks that exist within organisations (for example, who employees choose to sit with in the canteen at lunchtime) and the patterns of communication that take place. By engaging in informal social communication with colleagues, it is easier to learn about how a colleague solved a particular work problem, rather than relying on poor accessibility and timeliness of information systems. Officers may use their radio to contact an employee within their network who was responsible for a specific case and ask for the required information. As well as issues that are common throughout the majority of policing

\textsuperscript{17} The Bichard Inquiry. <http://www.bichardinquiry.org.uk/>, [22.06.04], [accessed 16.01.08].
\textsuperscript{18} Home Office Police Information Technology Organisation. NSPIS case study. <http://www.opengroup.org/public/arch/p4/cases/ukho/nspis.htm>, 01.08.96, [accessed 18.01.08].
\textsuperscript{20} Gottschalk, ref. 8, p. 7.
\textsuperscript{23} McKinnon, S. & Bruns, W. The information mosaic: how managers get the information they really need, 1992, p. 14.
\textsuperscript{24} Auster, E. & Choo, C. W. Environmental Scanning by CEOs in Two Canadian Industries. Journal of the American Society for Information Science 44.4 (1993), 196.
organisations, there are also specific knowledge management issues apparent within the research context of the Leicestershire Constabulary, including the need to mobilise knowledge, both of which are discussed further in the following two sections.

1.1.2 Research Problem: Mobilising Information and Knowledge Environments

The ‘transition from an information paradigm to the knowledge paradigm’ suggests that storage of information in databases and other early KM technologies are no longer sufficient to cope with a dynamic environment. According to Norris et al ‘new technology environments are transforming the way knowledge is experienced and transformed’, such as knowledge mobilisation via handheld devices.

Equally, Rao argues that ‘one of the most notable emerging trends is the increasing use of mobile information technologies to take KM to another dimension by bringing relevant knowledge directly to the fingertips of a company’s field workers.

Knowledge management has given great emphasis on how to make knowledge-intensive work more effective. The technical field of mobile technologies can be combined with the human aspect of the knowledge management field to make KM ubiquitous, often termed as mobile KM, changing the place where knowledge-intensive processes take place. Grimm has depicted the contribution that mobile information can make to KM (Figure 1.1.1), by combining the technical strengths of mobile information and the user-centred approach to KM.

![Figure 1.1.1: Contribution of Mobile Technology to Knowledge Management](image)

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The current use of the term ‘Mobile knowledge management’ is not yet very specific but is viewed by von Guretzky as decision-making on the spot, or spatially distributed business processes, which increase the time for data to be translated into knowledge (detailed further in the critical literature review; see North’s ‘knowledge stair’ – section 2.1.1). According to Grimm et al, mobile KM is relevant where ‘knowledge is associated while performing tasks, tasks necessitate out-of-office work and tasks necessitate communication’. Similarly, Skyrme suggests that mobile phones, laptop devices and personal digital assistants (PDAs) are increasing the scope for mobile information and knowledge management, whereby employees can access email and corporate information resources on the move and read them on a small screen. This argument is supported by Derballa and Pousttchi, who state that mobile information has a positive contribution to KM by reducing the time lag between knowledge creation and knowledge codification e.g. entering knowledge into a knowledge repository, especially important where time critical knowledge is vital to business operations and processes.

Within a dynamic environment, such as policing, it is necessary to update information systems virtually regardless of geographical restrictions. This notion is supported by Home Office statistics, which suggested that in 2007, English and Welsh police officers spent 56 million hours a year filling in paperwork. This equated to only 14 per cent of an average officers’ time being spent on patrol. Similarly, Borglund suggests that ‘information systems must be developed and designed to support access independently of the physical location of police officers and mobile data systems are one such option’. American police forces have adopted mobile technologies to access intelligence systems remotely for several years, and recently UK police forces are beginning to realise the potential gains of a mobile information strategy. For example, the Bedfordshire Constabulary in the UK provided handheld devices to its officers, which means ‘there is now a wealth of knowledge at officers’ fingertips, including briefing notes and task updates, as well as access to the Police National Computer, the Police Visual Handbook and the legal database, and they are on patrol for an hour longer each day.

Already it is clear that introducing mobilisation of information and knowledge processes will have a significant impact on work practices and existing business processes. In light of this, there has been recent debate in the media about the use of mobile computing in UK police forces. This was prompted by Governmental drivers, including a speech from the former Prime Minister in 2008 to equip 10000 police officers with handheld devices by the end of 2008. Subsequently, £50 million was invested into a

30 Grimm et al, ref. 28, p. 58.
32 Derballa & Pouttschi, ref. 25, p. 587.
35 Walker & Katz, ref. 13, p. 423.
36 Arnott, S. Police need more mobile IT. <http://www.computing.co.uk/computing/news/2198497/police-mobile>, 12.09.2007, [accessed 08.11.07].
37 The online TV channel for public service modernisation GBTV. Mobile tasking system increases productivity for Beds Police. <http://www.localgov.tv/cgi-bin/details.pl?action=prog&id=248>, n.d., [accessed 08.01.09].
38 Ibid.
mobile information technologies initiative for UK police forces\textsuperscript{40}. Sir Ronnie Flanagan, previous HM Chief Inspector of Constabulary, stated that ‘a leaner approach to policing is required, with the greater use of technology, particularly mobile technology, to free up Police time’\textsuperscript{41}. It has been estimated that the devices could save as much as £800,000 a year for the average police force\textsuperscript{42}, providing that forces implement them correctly in order to maximise their potential. As such, this is leading towards possible realisation of a theoretical ‘mobile knowledge management’ concept within the policing arena.

However, due to the hierarchical structure and bureaucratic culture of policing, barriers to mobilising information and knowledge may exist. It is suggested that the primary driver of bureaucracy is cultural\textsuperscript{43}; ‘organisational culture is historically determined, socially constructed and difficult to change’\textsuperscript{44}. Historically, paper-based systems have been used and the radical change to mobile computing breaks such historical norms, which may present resistance to change among officers. Umble & Umble suggest that ‘people have a natural tendency to be comfortable with the status quo and may be fearful of change’\textsuperscript{45}. Equally, previous research on mobilising information has concentrated on technical issues but had little consideration on human issues. A key argument within the KM literature is that the information and knowledge environment consists of three elements: people, processes and technology and a dynamic balance of each element is necessary to enable successful delivery of projects\textsuperscript{46, 47, 48, 49} (explored further in Section 2.1). Wilson identifies in his research into the use of mobile devices within the police, fire and ambulance service that many of the problems that surface are not related to the technology but the human issues\textsuperscript{50}. These include a loss of middle management power, since officers are able to make decisions from the provided necessary information; training needs and technophobia\textsuperscript{51}, which are ‘likely to bring about organisational change that needs to be managed’\textsuperscript{52}.

The issues relating to business processes and cultural change support the need to study the impact of mobile technology on employees and existing information and knowledge intensive processes. Indeed Wilson makes recommendations for research along similar lines\textsuperscript{53}. Several authors highlight a need for this research, which is discussed in Section 2.4.6. It is also important to investigate the perceived impact of mobile information technologies on informal information sharing (discussed in further detail in section 2.1.3). The few current studies within this area appear, to some extent, to lack theoretical value in that the findings are not linked to any theoretical concepts. Colvin and Goh\textsuperscript{54} seek to overcome this by offering a basic theoretical model of factors affecting technology usage in a policing context (see

\textsuperscript{40} Public Technology. Police get 50 million funding for handheld computers. <http://www.publictechnology.net/modules.php?op=modload&name=News&file=article&sid=15900>, 28.05.08, [accessed 11.06.08].
\textsuperscript{41} Flanagan, ref. 16.
\textsuperscript{42} Mills, ref. 27, p. 38.
\textsuperscript{43} Johnston, P. Slashed bureaucracy – don’t hold your breath. The Telegraph, 13\textsuperscript{th} September 2007. <http://www.telegraph.co.uk/news/uknews/1563000/Slashed-bureaucracy-Don't-hold-your-breath.html>, [accessed 09.06.08].
\textsuperscript{44} Hofstede, G. Cultures and organisations: software of the mind, 1991, p. 12.
\textsuperscript{50} Wilson, T. Information on the move: mobile data systems in the emergency services. Update, 2005, November, 41.
\textsuperscript{51} Ibid., p. 41.
\textsuperscript{52} Ibid., p. 41.
\textsuperscript{53} Ibid., p. 41.
\textsuperscript{54} Colvin, C. A. & Goh, A. Validation of the technology acceptance model for police. Journal of Criminal Justice, 2005, 33, 90.
section 2.3), but further research is necessary to bring together practical findings with a theoretical underpinning and to address findings in a wider manner. The matters discussed here form the basis and rationale for the research.

1.1.3 Organisational Research Context: The Leicestershire Constabulary

This section discusses the specific organisational and knowledge management context within the Leicestershire Constabulary.

Organisational Background and Structure

The Leicestershire Constabulary comprises over 2,300 police officers and over 1,200 police staff, responsible for providing a policing service to an area of 2,500 square kilometres that covers the counties of Leicestershire and Rutland. The population within this area is nearly one million, with a rich diversity of communities and policing needs. In 2007, the Constabulary reorganised its geographic policing areas from four to three areas, and reduced the number of Local Policing Units from 21 to 15. The Constabulary is therefore an organisation undergoing transition.

Figure 1.1.2 shows the organisational chart for Leicestershire Constabulary which is hierarchical in nature: the Constabulary is led by the Chief Constable, supported by a Deputy Chief Constable, two Assistant Chief Constables, a Director of Human Resources and a Director of Finance. The latter’s role encompasses strategic direction of Information Technology across the Constabulary. The Corporate Development department of the Constabulary (Figure 1.1.2) is responsible for the strategic planning and business change arrangements of the organisation and the mobile information project team sit within this Department.

Organisational Purpose

The primary purpose of the organisation is to ‘provide highly visible policing situated in the heart of communities through local policing units’\textsuperscript{57} and to ‘become information led, concentrating resources where our impact on vulnerability, offenders and criminality will be most effective to the benefit of all’\textsuperscript{58}. In order to achieve this purpose, specific knowledge and know-how is required.

Organisational Issues: The Current Information and Knowledge Environment

In 2007, the Leicestershire Constabulary embarked on a plan to review how it delivers its frontline services over the next five years. The Constabulary sought to review how it makes best use of all its resources, with the assistance of partners such as Loughborough University.

As part of this plan, important organisational practices that make up part of the information and knowledge environment of the Constabulary, such as business processes, were mapped and re-engineered in order to cut bureaucracy, allowing officers to spend more time on patrol engaging with communities. For example, the crime recording process before the introduction of mobile data within the Leicestershire Constabulary was considered to be sub-effective. Police officers arriving at a crime scene documented details of the crime onto a paper-based form, which often had duplicate entries of...
information such as the address entity of a record. This paper-based form was then faxed to the crime-reporting bureau, where trained operators in the bureau created a record on the local electronic crime and intelligence information system. Figure 1.1.3 summarises this process: -

![Figure 1.1.3: The current paper-based crime recording process within the Leicestershire Constabulary](image)

Process mapping research within the Force indicated there were 108,000 crime records populated on the crime information system in 2007. From personal observation of this process and interviews with members of the Crime Bureau, it can take a minimum of three days before crime details are entered onto the information system, and even then some information exists as scanned forms which can be difficult to search and can lack structure: information within the system can be held under differing vocabularies which makes it complex to locate or input the correct piece of intelligence.

In addition to the paper-based crime recording process, crimes that require further investigation (known as 'jobs') are given out to officers on paper and information regarding the job is communicated over a radio, which can sometimes cause delays in recording and sending information. Communication via a radio implies that information and knowledge may not be captured, other than the officers storing this information as tacit knowledge in their heads.

These factors contribute towards a lack of real-time information, which has the potential to have a detrimental impact on decision-making and the value of intelligence, which may be argued to have been a cause of recent high profile criminal occurrences (e.g. the Soham murders, 2002).

The Need to Mobilise the Information and Knowledge Environment

Police officers rely on timely and accurate information to cope with their workload, yet officers can only access this information whilst in the police station via information systems, consequently this reduces the numbers of visible officers on the streets. Therefore, changes and improvements in the
current information and knowledge environment are needed in order for the Leicestershire Constabulary to achieve effectively its organisational purpose. Complete and accurate information and knowledge are central to this. External organisations and the general public are placing demands on UK police forces to meet targets such as increased neighbourhood visibility and to provide a higher quality of service to their customers. Drivers for change include the National Intelligence Model\(^{59}\) (NIM), which is a requirement for policing, in order to provide effective use of information and knowledge. The effect of Governmental drivers for public services to become e-enabled (as outlined in Section 1.1.2) has led to all UK police forces working towards implementation of a mobile information system. As a result, it is anticipated that timeliness of knowledge, police visibility and customer satisfaction will increase.

**Summary of Research Direction**

The drivers for change mean that attempts to manage information and knowledge will cut across several processes and positively and negatively affect many individuals; therefore for this to work individuals within the Force must accept the need for change. By applying the principles of knowledge management, which embrace people, processes, technology and change, the research aimed to address a range of organisational issues including bureaucratic paper-based processes and low availability of real-time information. The research specifically focused on this by evaluating how mobilising a policing information environment impacts on employees and working practices and processes. The aims and objectives are discussed in the following section.

1.2 Aims & Objectives

1.2.1 Aim of the Research

The research aimed to evaluate the impact of mobile technology on employees and information and knowledge intensive business processes within the Leicestershire Constabulary. In doing so, it aimed to gain a theoretical understanding of technology acceptance and knowledge management within a policing context.

1.2.2 Objectives of the Research

The research aim was achieved by undertaking the following specific objectives:

1. Conduct a critical review of existing literature to understand the extent of research on mobilising information and knowledge processes. It was conducted as follows:
   - Review previous work relevant to knowledge management concepts and knowledge management in a policing context
   - Review literature on mobilising information and knowledge intensive processes within various organisational contexts including policing
   - Evaluate current literature on information seeking behaviours, especially within a mobile context
   - Examine current literature on data quality
   - Review research related to information technologies that can be used to support mobilising these processes
   - To critique theoretical approaches and research in evaluating the practice and use of mobilising information and knowledge processes

2. Understand the organisational context of policing and specifically of the Leicestershire Constabulary:
   - Analyse the current organisational processes that are used to share information and knowledge
   - Scrutinise the impact of these organisational processes on the effectiveness and efficiency of the Constabulary e.g. with regards to levels of bureaucracy
   - Analyse the key cultural and management issues that impact on information and knowledge processes within policing
   - Undertake a programme of organisational induction including observational ‘beat’ training and officer work-shadowing in order to gain an understanding of the organisational context
3. Produce an evaluation framework to enable police forces to select the solution that best matches their information and knowledge needs and user requirements: -
   • Review user requirements of mobile technologies through use of focus groups and questionnaires
   • Evaluate competing approaches by conducting a stakeholder analysis in order to ensure that the most significant users' needs are met
   • Evaluate solutions against user requirements using a feature analysis technique
   • Critique the framework in terms of representation of information for managerial decision-making purposes internally within the Constabulary and externally within other policing contexts
   • Evaluate the selected solution against solutions implemented within other police forces in order to ensure that the Constabulary has selected the solution that best meets a variety of requirements.
   • Determine recommendations regarding the adaptation and extension of evaluation approaches accordingly to allow effective decision-making

4. Evaluate police acceptance of mobile technology: -
   • Analyse the factors that affect the acceptance of mobile technology
   • Based on the findings of the above point, integrate the findings into theoretical approaches and models regarding user acceptance of technologies
   • Assess how well theoretical approaches and models fit within a real-world organisational policing context
   • Based on the results of the above point, propose changes in order to adapt and extend theoretical approaches that will develop a model that can be used for the implementation of mobile technology that suits the policing environment

5. Test the adapted user acceptance model: -
   • Assess whether the adapted model applies to the policing environment

6. Investigate the impact of mobile technology on existing information and knowledge sharing practices within the Constabulary: -
   • Evaluate the opportunities and challenges offered by mobile technology in terms of knowledge sharing via a longitudinal study of usage and stakeholder perceptions compared with findings of initial usage and perceptions from the evaluation study through adoption of a qualitative multi-method approach
   • Engage key lessons learnt from mobile information and knowledge sharing
   • Determine recommendations as to how the risks of mobile technology to knowledge sharing can be managed in order to maximise the benefits
7. Investigate the implications of mobile access to information systems for data quality and information literacy: -
   - Assess how data quality is measured within the Constabulary and what measures are used
   - Investigate reasons for the existing data quality levels amongst Constabulary personnel (IT personnel, police officers and those involved in monitoring data quality) Review with regard to data quality how often systems are changed, how they are structured and usability of systems, which will lead towards building up a picture of overall data quality
   - Determine the different strategies used to input data (and understand why officers sometimes make mistakes)
   - Evaluate search strategies employed by police officers
   - Evaluate the perceived level of information literacy amongst police officers
   - Determine recommendations to improve and assist with information literacy issues amongst operational police officers
   - Analyse the implications of mobile technology on perceived information literacy skills of police officers
   - Engage these findings to policing performance (e.g. increased accuracy of information, more time to attend other incidents, greater public confidence due to greater accuracy and timeliness of information and increased visibility).

8. Determine the impact that the implementation of mobile technology has had on business processes within the Constabulary

9. Produce a set of recommendations for interventions for any other similar organisations looking to mobilise their information and knowledge processes, based on findings from the previous objectives. This may help organisations in avoiding the issues by applying the lessons learned from the study without having to go through the complete mobilisation process and learn lessons themselves.

1.3 Outline Scope of the Thesis

The remaining chapters in this thesis are outlined as follows: -

Chapter Two is divided into four main sections: the first examines existing research in knowledge management in general and in policing; the second reviews literature related to structuring knowledge, data quality and information seeking behaviours; the third critiques work that currently exists on the topic of technologies that can be used to facilitate knowledge management, and the fourth analyses critically theoretical models that can be applied to examine acceptance of technologies within the general and policing contexts.
Chapter Three discusses the methods adopted, and the rationale for using the methods in question. The subsequent five chapters are devoted to presentation and integrated discussion of the findings of the different components of the research. Chapter Four discusses the development and application of an evaluation framework to enable police forces to select the solution that best matches their information and knowledge needs and user requirements. Having selected an appropriate solution, the first part of Chapter Five presents the findings regarding police acceptance of the selected mobile technology solution, and integrates and extends these findings in relation to existing theoretical models, leading to development of an adapted, holistic user acceptance model (H-TAM). The second part of Chapter Five exhibits and discusses the findings from the validation of the applicability of the H-TAM within other technological implementation contexts.

Chapter Six expands on a key finding from Chapter Five, whereby it was identified that a potential risk to officer acceptance of mobile technology was a potential loss of knowledge sharing. Subsequently, Chapter Six demonstrates the findings of research into what impact the mobile technology solution has on knowledge sharing within the Constabulary, and how this can be managed. Chapter Seven explores the implications of mobile technology for data quality and information seeking. In order for police officers to retrieve information from mobile information systems, it is important firstly for the information to be of good quality. Secondly, the overall positive impact of mobile technology on knowledge sharing identified in Chapter Six may hinge on the information literacy skills of police officers and quality of information. Chapter Eight scrutinises the overall benefits and risks of granting direct access to information on existing core information intensive business processes.

Chapter Nine provides a high-level interpretation of the key themes of the thesis within a broad picture, and assesses the overall the readiness of modern day policing to undergo a technological change. It discusses what the overall results of this research might mean for implementation of technology within the policing context. Any limitations identified in the methods are also discussed here. Chapter Ten is confined to discussion of the final conclusions in response to the central aims and objectives of the study set out in Chapter One, and also suggests some recommendations to overcome barriers to the usage of mobile technology by the Leicestershire Constabulary. Areas for future research are also identified in this chapter.

The following flow chart (Figure 1.1.4) shows the structure of the report, the order and contents of the chapters, and the link between each chapter to allow consistent research. The dotted lines represent feedback for future research areas. This structure will appear at the beginning of each chapter.
Chapter One: Introduction

Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

Chapter 1
Introduction

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Objectives

Chapter 2.1
Literature Review: Knowledge Management: Background Context

Chapter 2.2
Literature Review: Knowledge Management: Structure

Chapter 2.3
Literature Review: Knowledge Management: Technologies

Chapter 2.4
Literature Review: Technology Acceptance Theories

Chapter 3
Research Methods

Chapter 4:
Developing an evaluation framework to select mobile technology

Chapter 5:
Adaptation of the technology acceptance model for policing

Chapter 6:
The impact of mobile technology on knowledge sharing in policing

Chapter 7:
Implications of mobile access to information systems for data quality and information literacy

Chapter 8:
The impact of mobile technology on business processes

Chapter 9:
Overall discussion

Chapter 10
Conclusions, Research Limitations and Recommendations

Future Research

Figure 1.1.4: The structure of the project
Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

Chapter 1
Introduction

Aims

Objectives

Chapter 2.1
Literature Review: Knowledge Management: Background Context

Chapter 2.2
Literature Review: Knowledge Management: Structure

Chapter 2.3
Literature Review: Knowledge Management: Technologies

Chapter 2.4
Literature Review: Technology Acceptance Theories

Chapter 3
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Developing an evaluation framework to select mobile technology

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Chapter 7:
Implications of mobile access to information systems for data quality and information literacy

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Chapter 9:
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Chapter 10
Conclusions, Research Limitations and Recommendations

Future Research
Chapter Two: Critical Literature Review

Chapter Preface

This Chapter determines what position the current literature takes and identify significant findings in connection with the research area and any unanswered research questions. This helped to ensure the work is original, in addition to recognising different theoretical and methodological approaches and any possible theoretical frameworks that can be used to underpin findings. The Chapter meets Objective one of the research (outlined in Section 1.2).

This chapter is divided into four sections. The first section examines existing theories on knowledge management principles in general and in policing, the second section reviews the literature on the need to structure knowledge and perspectives on data quality and information literacy, the third critiques work that currently exists on the topic of technologies that can be used to facilitate knowledge management, and the fourth examines various theoretical models that can be applied to increase understanding of user acceptance of mobile information technologies.

This section of the literature review will discuss the literature that currently exists on knowledge management within police forces. It will begin with providing the background context to general knowledge management principles and definitions followed by a discussion of themes in the literature in relation to the aims of the research.

2.1 Knowledge Management: Background Context

2.1.1 Data, information and knowledge

Karl Wiig defines KM as the ‘systematic, explicit, renewal and application of knowledge to maximise an enterprise’s knowledge-related effectiveness and returns from its knowledge assets’\(^1\). This sentiment is followed through to form a common theme throughout works on KM, including Jashapara\(^2\) and Newell\(^3\).

From the post-industrial society it may be argued that the economy has moved towards a knowledge economy. Alongside interest from academics and practitioners, it has become apparent that knowledge has become a critical success factor for business; evidence that the importance of KM is a significant issue for business can be demonstrated through examples of organisations implementing successful KM initiatives. Hoffman Roche, the Swiss pharmaceutical firm, estimates it saves over $1 million per day due to its KM activities, and Hewlett-Packard’s knowledge efforts have reduced customer-service related calls by two-thirds\(^4\). Demarest argued that firms without KM systems would be unable to

\(^2\) Jashapara, ref. 16, p. 309.
\(^3\) Newell, ref. 43, p. 16.
maintain a competitive advantage and lose market share to those firms practising KM\textsuperscript{5}. Therefore it is important to understand the terms ‘knowledge’ and consequently ‘knowledge management’

Knowledge results from processed information. The term knowledge can be defined as information that can be acted upon to create value and make decisions i.e. ‘actionable information’\textsuperscript{6}. Individuals deploy this actionable information for the solving of problems. One of the authors presenting this progression of value from data to information to knowledge is North\textsuperscript{7}. His ‘knowledge stair’ (Figure 2.1.1) shows how adding context to information creates knowledge that can be used for a purpose. This suggests the importance of knowledge being available to make informed and timely decisions. Webb defines knowledge as ‘an intellectual concept, referring to the condition of knowing or understanding something’\textsuperscript{8}. The statement ‘knowledge is power’\textsuperscript{9} by Francis Bacon in 1597 has had a big impact on subsequent work in the field of KM and may be used for justification of the advantages that can be gained through sharing and the manipulation of knowledge, which is principally the task of KM. Organisations within a knowledge economy are recognising that knowledge is a key asset to drive organisational success and to provide a competitive advantage. Thus the management of knowledge is essential to achieve an organisation’s objectives through the identification, organisation, dissemination and use of knowledge for effective decision-making.

![North's ‘knowledge stair’](image)

**Figure 2.1.1:** North’s ‘knowledge stair’\textsuperscript{10}

### 2.1.2 Types of knowledge

In contrast to the evidence that information and knowledge are distinguishable, knowledge can be classified by adopting a structuralist perspective, i.e. that there are two types of knowledge – tacit and explicit knowledge. Tacit knowledge is often referred to as ‘know-how’ and resides in individual’s heads, whereas explicit knowledge can be readily codified and communicated to others. The importance of this is that for a policing organisation’s knowledge to grow tacit knowledge must be shared amongst employees and documented. Research by Gorry reflected this sentiment by demonstrating the importance of sharing knowledge in the public sector, which enabled workers to reflect the quality of service they provide\textsuperscript{11}. In accordance with the SECI model of knowledge creation, knowledge begins as

\begin{itemize}
  \item Signs
  \item Data + syntax
  \item Information + semantics
  \item Knowledge + interpretation/ context
\end{itemize}

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\textsuperscript{6} Tiwana, A. *The knowledge management toolkit: orchestrating IT, strategy, and knowledge platforms*, 2002, p. 4.

\textsuperscript{7} North, K. *Knowledge oriented management: adding value by knowledge*, 1999, p. 6.


\textsuperscript{9} Bacon, F. *Religious meditations, of heresies*, 1597.

\textsuperscript{10} North, ref. 7, p. 6.

tacit knowledge inside an employee’s head and is converted to either explicit knowledge through externalisation, or to another form of tacit knowledge through socialisation. Figure 2.1.2 shows the Socialisation Externalisation Combination Internalisation (SECI) model with business techniques that may facilitate knowledge sharing:

![Diagram of SECI model](image)

**Figure 2.1.2: The SECI model of knowledge creation**

### 2.1.3 The knowledge lifecycle

Knowledge is intangible and thus in order to fully exploit its potential it needs to be appropriately managed. Based on the observation that the creation and use of knowledge may be viewed as a continuous cycle, a common framework can be applied to understand how it can be managed. One such framework stems from the concept known as the ‘knowledge lifecycle’. There are several variations of knowledge lifecycles, for example knowledge lifecycle work associated with Davenport & Prusak\(^{13}\), Despres & Chauvel\(^{14}\), Gartner Group\(^{15}\), Jashapara\(^{16}\), Nissen\(^{17}\) and Rowley\(^{18}\), nevertheless the differing versions all share considerable similarities in that there appear to be four distinct stages through which information and knowledge pass: creation, capture, sharing and codification\(^{19}\). A diagram detailing the cycle is shown in Figure 2.1.3. In summary, the model suggests that as knowledge is shared, new knowledge is created. The codification of knowledge leads to acquisition of new knowledge.

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\(^{19}\) Despres & Chauvel, ref. 14 , p. 4.
Figure 2.1.3: The knowledge lifecycle

At the knowledge creation stage of the cycle, knowledge resides in the individual and not in the collection of information, thus the human dimension of organisational knowledge creation is important. Knowledge can be created in a number of ways, which are detailed in the SECI model of knowledge creation. With regards to tacit knowledge, informal knowledge networks may be beneficial in the process of knowledge creation, through the socialisation aspect of the SECI model (see Fig. 2.1.2). Wright defines knowledge networks as 'a learning network composed of people who are not necessarily acquainted with each other personally, but who share a common technical language and problem environment'. Cohen & Prusak insist that the resource of most competitive advantage for an organisation is social capital, formed by networks and communities where people collaborate based on trust, since 'knowledge networks dramatically influence the uptake of trends and ideas'. With regards to the relationship between knowledge networks and knowledge creation, Augier and Vendelo suggest that 'in the knowledge society access to all new knowledge is a critical factor to all firms'; loose and informal networks among organisations may represent significant sources of new knowledge. The mobilisation of information and knowledge processes may impact on this process, as police officers may have less opportunity to return to the station, and potentially less opportunity to share tacit knowledge. As Davenport argues, offices allow frequent and unplanned face-to-face communications, which convey not only information content but also attitudes, levels of motivation and concerns, and offices provide a place to socialise and absorb the culture of the organisation; virtual offices may have a negative impact on the creation and sharing of tacit knowledge. Therefore it will be important to examine the impact of mobilisation on knowledge sharing within the Leicestershire Constabulary and to make recommendations to allow access to new knowledge; Davenport recommends that if virtual offices are to be established,

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20 Jashapara, ref. 16, p. 4.
21 Nissen, ref. 17, p. 30.
23 Ibid., p. 66.
30 Ibid., p. 6.
the organisation should ‘create planned events for communication (e.g. meetings, shift briefings) and allow information sharing through electronic distribution’\textsuperscript{31} to allow the creation and storage of explicit knowledge. With regards to creating explicit knowledge, techniques such as taxonomies and controlled vocabularies may be applied in order to ensure each item is entered into databases and emails\textsuperscript{32} in a standardised way, which will improve retrieval accuracy of knowledge further along the cycle. Since the mobilisation of information and knowledge processes will allow direct entry onto police information systems it will be especially important to maintain and improve data quality levels. Existing research about knowledge structuring techniques are discussed further within the literature review (refer to section 2.2 of this Chapter: Knowledge management: structure’).

Knowledge capture may be described as ‘an applied brain drain’\textsuperscript{33} whereby an individual’s thoughts and experiences are captured. Hansen \textit{et al}\textsuperscript{34} argue that two strategies exist for knowledge capture: non-computerised methods known as a personalisation strategy and computerised methods known as a codification strategy. A knowledge codification strategy involves categorising knowledge to make it accessible to others, through the use of tools such as a corporate intranet containing discussion forums and online training sites, and document management systems that allow effective retrieval of documents\textsuperscript{35}. To improve ease of retrieving knowledge techniques may be applied to structure knowledge, such as taxonomies, which are discussed further within the literature review. The focus of a codification strategy is on capturing explicit knowledge through investment into ICT. However, these tools need to be maintained and may be limited in generating meaningful insights from data. Such a strategy may not fit the capture of tacit knowledge and alternatively a personalisation strategy may be used\textsuperscript{36}. Various methods may be used to achieve this, including expert interviews, on-site observation and brainstorming to name but a few\textsuperscript{37}. It is important to note that the emphasis at this stage is on the individual and therefore the use of technology is less important in assisting the capture of knowledge.

Knowledge networks may be effective in exploiting the human aspects of knowledge capture, as discussed previously.

Once knowledge has been created and captured from individuals, the next stage is to move it around the organisation\textsuperscript{38}. This involves knowledge sharing, and can be achieved through the application of technology or of people. In large organisations such as the Leicestershire Constabulary, information technologies can help but they can be slow moving and be prone to a high level of bureaucracy\textsuperscript{39}, therefore the main emphasis should be on the organisational culture. Culture is the values and norms that bind an organisation together\textsuperscript{40}. Many organisations can be hostile to knowledge sharing due to a blame culture: employees may feel that ‘knowledge is power’ therefore are reluctant to share knowledge with others for fear of credit of work being given to another employee\textsuperscript{41}. To overcome this barrier senior

\textsuperscript{31} Ibid., p. 6.
\textsuperscript{32} Davenport & Prusak, ref. 22, p. 54.
\textsuperscript{33} Awad, E. M. & Ghaziri, H. M. \textit{Knowledge management}, 2003, p. 146.
\textsuperscript{35} Ibid., p. 107.
\textsuperscript{36} Ibid., p. 109.
\textsuperscript{37} Ibid., p. 109.
\textsuperscript{38} Despres & Chauvel, ref. 14, p. 4.
\textsuperscript{40} Lemken, B., Kahler, H. & Rittenbruch, M. \textit{Sustained knowledge management by organisational culture. Proceedings of the 33\textsuperscript{rd} Hawaii International Conference on System Sciences}, 2000, 64.
\textsuperscript{41} Jashapara, ref. 16, p. 199.
management of an organisation may choose to implement a long-term initiative to create a knowledge culture. A knowledge culture is a way of organisational life that motivates employees to create and share knowledge for the enduring success of an organisation. A knowledge culture is typically built on trust. Trust relates to accepting vulnerability and assessing whether to expose oneself to situations where the possible damage may outweigh the advantage. High levels of trust are necessary to facilitate the levels of communication required for employees to be willing to share tacit knowledge and information and generate learning within an organisation.

At the knowledge codification stage, knowledge resides within the organisation and not the individual. The knowledge codification stage may be defined as the organisation and representation of knowledge for effective transfer to support decision-making and organisational objectives. In other words, it aims to put organisational knowledge into a form that makes it accessible to those who need it.

### 2.1.4 Knowledge Management Concepts

Thus so far the literature has highlighted that a range of strategies, tools and processes are essential to allow the progression from data to knowledge and from tacit knowledge to explicit knowledge, and to support the process of the knowledge lifecycle. This is essentially the primary role of KM. As Collison & Parcell explain, KM involves ‘nurturing the culture and the technology to get employees talking’. KM combines the fields of learning and organisational development, human resources and information technology, as summarised in Figure 2.1.4.

![Figure 2.1.4: The main elements of KM, the ‘KM toolkit’ (adapted from Rao)](image)

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44 Ibid., p. 56.
45 Davenport & Prusak, ref. 22, p.68.
47 Rao, M. *Knowledge management tools and techniques: practitioners and experts evaluate KM solutions*, 2005, p. 34.
As previously mentioned in the section under the definition of data, information and knowledge, effective KM strategies within the private sector are vital in providing companies a competitive advantage. In the public sector organisations are not driven by profit and therefore may choose to adopt a KM strategy to allow them to increase efficiency without increasing the level of resources. For example, the UK’s Department for Business, Enterprise and Regulatory Reform (formerly known as the Department of Trade and Industry) has realised the value of KM, as they noted faster and better informed decision-making, improved customer service and increased productivity by adopting a KM strategy\(^{48}\).

Research by Edwards \textit{et al}\(^{49}\) identifies three possible solutions to knowledge management: people as without people knowledge may not exist or be useful, as the conversion from information to knowledge is a human process, thus staff retention and training is vital; processes for example paper-based specifications; and technology can be a useful tool to act as a gateway for knowledge, such as incident history and suspect knowledge to support day-to-day work. The people aspects involve training, development, recruitment, motivation, job design and cultural change\(^{50}\). Processes may be regarded as a set of documented steps with clearly defined roles and activities for people to perform, while technology is the application of science and body of information systems knowledge that is used to extract information and fashion tools\(^{51}\). In other words, focusing strongly on the technological element may undermine people issues\(^{52}\) thus limiting their use in business; many high-profile systems have failed due to unrealistic expectations from end users causing low adoption levels. It has been suggested that ‘virtual office arrangements are less than optimal, meaning that early adopters of virtual offices questioned and rejected their new arrangements\(^{53}\). Despite the arguments in favour of mobile information technologies, which suggest a need to focus on the human aspect and factors that affect user acceptance; ‘how to outfit the frontline will be a key strategy and research focus area in the coming years’\(^{54}\). This notion is explored further in Section 2.3.

###  2.1.5 The importance of knowledge in Policing

One of the most productive authors regarding KM in a policing context, Gottshalk, argues that ‘KM as a field of study is concerned with improving the process of sharing, creating, capturing and understanding knowledge. Hence, KM has direct relevance to policing\(^{55}\). KM is now being recognised as a significant element to the success of crime investigations and policing organisations, as well as private sector organisations. A key challenge is to access and use this knowledge effectively. Similarly, Collier argues that effective KM is as important to policing as any other organisation in order to improve performance, because ‘the actions of its human resources are dictated by knowledge’\(^{56}\) e.g.

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\(^{50}\) Quintas \textit{et al}, ref. 46, p. 388.  
\(^{51}\) Gongla & Rizzuto, ref. 48, p. 848.  
\(^{52}\) Australian Government Information Management Office, ref. 47.  
\(^{53}\) Davenport, ref. 25, p. 4.  
\(^{54}\) Rao, ref. 27, p. 19.  
governmental priorities and criminal behaviour. As a result police organisations have become more proactive and intelligence-led by looking at connections between crime characteristics, such as modi operandi or geographic locations, in order to create a crime pattern analysis. With reference to the ‘knowledge stair’ this suggests the use of existing information to apply knowledge effectively. Police must be knowledge workers to allow them to perform in this proactive manner: police officers use explicit knowledge for decision-making e.g. police general orders or standard operating procedures and apply tacit knowledge through the application of skills. As a result, Collier argues that high levels of police assets exist as intellectual capital (IC) since training, knowledge sharing, hierarchical redundancy and potential danger to lose IC is apparent within police organisations. Swedish officers involved in semi-structured interviews agreed on the ‘importance of information in police practice…which is used to support decision-making legally and tactically’. In the same way, an investigation by Holgersson et al into how patrol officers in Sweden apply knowledge, involving 6000 hours of participant observation and 2000 interviews, found that the tacit knowledge base of a police officer is deep and wide ranging in order to carry out their job effectively. The empirical data from the study is divided into categories based on a grounded theory approach, which is represented within a model showing the knowledge base of officers (Figure 2.1.5).

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57 North, ref. 10, p. 6.
60 Collier, P. M. Valuing intellectual capacity in the police. Accounting, Auditing & Accountability Journal, 2001, 14(4), 441.
The model demonstrates the importance of tacit knowledge for police officers and Holgersson suggests that knowledge ‘should be understood as a resource that should be managed’. Furthermore, the research recognises the need to further investigate what knowledge police officers carry, as a gap.

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Ibid., p. 59.
Ibid., p. 59.
has been created in the literature by current research regarding police knowledge as a matter of training rather than as a dimension of tacit knowledge\textsuperscript{65}.

2.1.6 Knowledge sharing mechanisms in policing

More importantly, the use of networks and knowledge communities are identified as a key element to share knowledge\textsuperscript{66}. A study by Berg \textit{et al}\textsuperscript{67} into the roles that police managers play in creating a context for knowledge sharing suggests that knowledge sharing mechanisms within the Norwegian Police include informal mechanisms, such as talk, unscheduled meetings, electronic bulletin boards and discussion databases whilst formal knowledge sharing tools include videoconferencing, training sessions, organisational intranets and databases. Moreover, the survey findings within the study reveal that the most important role in creating a context for knowledge management is the networking role, which indicates the importance of knowledge sharing in policing\textsuperscript{68}. Correspondingly, Borglund reports that ‘police officers find that the informal communication channel around the coffee table, within the police vehicle, during physical training etc, are occasions when vital information is spread…at every work shift change, police officers traditionally share work-related information with each other’\textsuperscript{69}. Allen \textit{et al} report similar findings within several UK police forces in that ‘local knowledge is best passed on person to person e.g. geography of the local area, or where the homeless can get a bed for the night’\textsuperscript{70}. Van Laare \textit{et al} also find that police officers feel complex issues cannot be transferred via the Intranet and that close cooperation between specialists and different neighbourhood teams is necessary\textsuperscript{71}.

2.1.7 Summary

The literature in this Section has demonstrated that knowledge sharing is vital to the success of policing and may therefore support the need to investigate the impact of mobile technology on knowledge sharing within the Leicestershire Constabulary. Having established the need for further research regarding knowledge management within a mobile policing context, the next section of the literature review critiques current research regarding the structuring of knowledge, which is an important consideration within a mobile environment.

\textsuperscript{65} Ibid., p. 51.
\textsuperscript{66} Ibid., p. 58.
\textsuperscript{68} Ibid., p. 280.
\textsuperscript{69} Borglund, ref. 61.
\textsuperscript{71} Van Laare, J., \textit{et al}. A social simulation game to explore future coordination in knowledge networks at the Amsterdam Police Force. \textit{Production Planning and Control}, 2006, 17(8), 563.
Chapter Two: Critical Literature Review

Chapter Preface

This section will discuss the literature that currently exists on the topic of structuring knowledge. It will begin with an argument about the problems surrounding the availability of vast amounts of information with regards to information overload, leading towards an argument about how and why information needs to be structured.

2.2 Knowledge Management: Structure

2.2.1 Information Overload

Information Collection

A general consensus throughout the literature on information overload suggests that its occurrence is apparent within any information-rich environment\(^1\)\(^2\). For example, in a survey into the information usage of scientists within a pharmaceutical organisation, Bawden et al\(^3\) found that over half of the scientists strongly agreed that they experienced information overload when using an information system. This sentiment is carried through to be true in policing organisations, where ‘investigation involves sifting through hundreds of suspects and thousands of tips’\(^4\).

In their study of the Singapore Police Force, Luen and Al-Hawamdeh argued that police officers follow a general framework in order to complete their daily activities, which features the heavy use of information. In this framework, officers capture and document information, systematically organise the captured information and store information for efficient retrieval\(^5\). In order to understand information overload from the data capture perspective it is important to understand the various formats in which information can exist. Information can be collected and disseminated as text, images, graphics, sound recordings, video or through face-to-face communication\(^6\)\(^7\). In order to complete their daily activities, specific types of information that are collected by police officers include images, such as fingerprints, DNA samples and photographs of suspects and stolen items; sound and video recordings to take statements from victims and witnesses, CCTV; face to face information such as public accounts, crime details and shift briefings; and text-based information, the majority of which exists as records, including crime records, intelligence reports, call logs, operational information and written policies and procedures.

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With this framework in mind and the different types of information demonstrated by the examples above, it is easy to see why police officers spend increasingly less time dealing directly with crime. Therefore the various formats of information used in policing may be one contributing factor towards the problem of information overload.

### Complexity of Information Sources within Policing

The numerous types of information that are used within policing mean that different information systems are needed to hold this information. Edmonds and Morris, through their review of the literature on information overload, identify that when there are several sources of information to attend to at once, information users become stressed, which affects their decision-making. Bjorner makes an interesting analogy of today’s information environment with a leaking tap, which “streams data from thousands of faucets… molecules of information are pushed at us from myriad sources.” This argument is supported by Bawden, who suggests: “the greater amount of information sources available both internally and externally means that ever more discrimination is needed when dealing with it.”

With the common theme surrounding complexity of sources in mind, it is important to consider the impact of this within a mobilised policing information environment. Collier suggests that information is held both within national systems used by all UK police forces and local systems used by individual UK police forces. Information is entered onto and stored within a number of sources; nationally these sources include the Police National Legal Database (PNLD), which allows local access to national police products and processes including legal definitions and powers of arrest. The Police National Computer (PNC) is a text-only database which provides information about suspects and vehicles: the database can identify suspects that have previously been convicted (with links to fingerprints and DNA) and the status of vehicles by accessing the Driver & Vehicle Licensing Agency’s (DVLA) vehicle registration records, which enables an officer to know whether a vehicle is taxed, insured, stolen or if the driver holds a full driving licence. The IMPACT Nominal Index (INI) is a system that allows sharing of suspect information throughout UK forces. Forensic information is stored on the police national DNA database and the national system for fingerprint identification (NAFIS). National information to support major investigations, for example serial murders, multi-million pound fraud cases and major disasters, is held on the Home Office Large Major Enquiry System (HOLMES).

At a local level, explicit information sources include the local force Intranet to access policies and procedures, and individual force computer databases. These individual force computer databases include the command and control system, the crime management system and the criminal intelligence.

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13. Ibid., p. 444.
15. Collier, ref. 12, p. 444.
system. The command and control system is utilised within Leicestershire Constabulary to hold records of incidents and assign officers to those incidents. The crime management system allows the recording of crime details and officers access the criminal intelligence system to gain background on prolific offenders within Leicestershire Constabulary’s geographical boundaries. This is supported through a study by Borglund\textsuperscript{17} into the operational use of electronic records in police work, who identifies that Swedish police officers access several information systems: one that manages criminal investigations, one that manages crime reports, one that manages legal weapons, and a command and control system that manages all police activity, along with an intranet and email system for internal information sharing.

In order to put the suggested problem into context it may be useful to use an example scenario. A crime has occurred in the city centre of Leicester, one of the suspect’s names is given over the radio. The attending officer would like to know further information about the suspect, including any previous convictions, a risk assessment, and obtain a photo of the suspect. To obtain a history of the suspect the officer can access the PNC, INI and command and control systems. Photographs of suspects are held within the crime management system. Therefore accessibility of information is a major issue for officers, due to a multiplicity of sources. This is an issue previously acknowledged within a US police force by Chen\textsuperscript{18} and within a large UK insurance firm by Simpson and Prusak\textsuperscript{19}. Wilson suggests that police services ‘have a range of different legacy systems that provide much of the key information, which makes police officers blind to local intelligence when they cross another area\textsuperscript{20}, and information sources from different parts of the organisation should be integrated. Similarly, Van Laare \textit{et al} comment that police officers find it difficult to access available knowledge because it is distributed over numerous handbooks, reports, local projects and recommend that more information needs to be held within a central repository\textsuperscript{21}. The implication of a complex number of information sources within a mobile environment is recognised by Allen \textit{et al}, who argue that ‘one of the key issues in police information systems is the integration of data from different sources: this is particularly important for officers who are mobile workers, since switching from one system to another on a small, portable device, possibly involving separate log-on and passwords, is not feasible\textsuperscript{22}.

The fact that there is a complex range of sources of information within the policing environment is not an issue that has gone unrecognised. The Bichard enquiry on the Soham child murders of 2002 recognised the reality of storing information in a multitude of sources, formats and in an unstructured nature as a major risk to the police service\textsuperscript{23}. The inquiry sought to assess the effectiveness of the relevant intelligence-based record keeping and information sharing with other agencies\textsuperscript{24} and as a result, systems such as the IMPACT nominal index have been implemented. However, despite this recognition, the vast number of national and local systems demonstrates that officers have numerous sources to

\textsuperscript{17} Borglund, E. Operational use of electronic records in police work. \textit{Information Research}, 2005, 10(4), paper 236. [available at \url{http://informationR.net/ir/10-4/paper236.htm}], [accessed 02.01.09].
\textsuperscript{20} Wilson, T. Information on the move: mobile data systems in the emergency services. \textit{Update}, 2005, November, 41.
\textsuperscript{23} HMIC. Progress report to Sir Michael Bichard from Her Majesty’s Inspectorate of Constabulary. \url{<http://www.bichardinquiry.org.uk/pdf/Report_back_to_Sir_Michael_Bichard.pdf>}, 01.12.04, [accessed 19.02.08].
\textsuperscript{24} The Bichard Inquiry. \url{<http://www.bichardinquiry.org.uk>}, [22.06.04], [accessed 16.01.08].
search and update. Indeed the complexity of sources within the policing environment may allude to the previous identification by Edmunds and Morris of information users becoming stressed when there are several sources to attend to at once\(^\text{25}\). This may become even more apparent with the mobilisation of information and knowledge processes. In theory, such technology should enable officers to input data directly into force systems. However, with the complex number of sources that need to be updated information overload may be detrimental to the idealised efficiency of this process, and additionally may have a negative effect on data quality. Collins supports this notion by suggesting that employees responsible for strategic decisions or answering a specific question ‘spend an enormous amount of time traversing the maze of disconnected applications and systems’\(^\text{26}\). Research by Hughes and Jackson into the influence of technical factors on the effective use of information in a policing environment argues that before the introduction of computers into police stations, the level of information overload may have been significantly lower\(^\text{27}\). The reason for this is officers did not have access to all information systems; data perceived to be important were forwarded to central offices for storage by a ‘collator’\(^\text{28}\), who ensured that operational officers received and recorded only the important information. It could be claimed that the proposed introduction of mobile information technologies in vehicles will cause officers to fulﬁl the role of collator themselves. Although this could offer a greater level of autonomy to officers, the complexity of sources available may make fulfilling this role difﬁcult whilst trying to provide an operational presence to the public. In a recent news article, it was reported that the mobile technology solution within the Leicestershire Constabulary ‘allows officers to access more than 70 separate IT systems’\(^\text{29}\).

Technological endeavours to overcome this have been implemented in the past, for example the development of a single search interface that integrates different data sources; namely COPLINK in the US and GENIE in the UK, but these are aimed at improving retrieval of information and are not created for the input of information into systems, which may be a time-consuming task.

Information Maps

In the literature, methods have been suggested for representing the complex information landscape of an organisation. For example Klein and Prusak\(^{30}\) suggest an information map, similarly Stewart\(^{31}\) suggests the creation of a knowledge map. Information mapping was originally developed by technology vendors for a variety of industrial ﬁrms such as insurance and retail companies to provide a formal representation of an organisation’s knowledge. Firms such as IBM and American Express have developed information maps to identify where information exists\(^{32}\). An initial search of the literature suggests that information mapping method had not been previously applied within policing, although it is recognised that a large proportion of organisations do not publish their maps. The search of the literature

\(^{25}\) Edmunds & Morris, ref. 2, p. 19.
\(^{26}\) Collins, H. Corporate portals: revolutionising information access to increase productivity and drive the bottom line, 2000, p.3.
\(^{28}\) Ibid., p. 66.
\(^{29}\) BBC News. Technology has police on the beat. <http://news.bbc.co.uk/1/hi/england/leicestershire/7804847.stm>, 30.12.08, [accessed 06.01.08].
\(^{31}\) Stewart, T. A. Your company’s most valuable asset: intellectual capital. Fortune, 1994, 130(7), 70.
highlighted that Surrey Constabulary had conducted an information audit\textsuperscript{33}, but this did not indicate details of an information map as such. Based on the discussion so far, Figure 2.2.1 represents the numerous types and sources of information available within Leicestershire Constabulary through a high-level information map. In short, this demonstrates the vast number of sources police officers must access for different types of information.

\textbf{Figure 2.2.1:} High-level information map of the information types and sources within the Leicestershire Constabulary

\textsuperscript{33} Oma, E. Information strategy in practice, 2004, p.118.
Data Quality

Data quality has emerged as a major issue due to its potential severe impact on organisational effectiveness\(^\text{34}\). There are many different views and definitions of data quality, but a generally accepted definition within the literature is ‘a product, service, or datum X is of higher quality than product, service or datum Y if X meets customer needs better than Y’\(^\text{35}\). In other words, data quality involves meeting the needs of those dependent on information for decisions, such as customers.

Within the literature, there are many attributes that contribute towards data quality. A systematic review was conducted on 21 items of literature relating to data quality in order to analyse the most common attributes of data quality. This analysis (Table 2.2.1) revealed that the most common attributes of data quality are accuracy, completeness, timeliness, relevance, understandability, accessibility and consistency. The terms within this Table are the exact terms chosen by the authors themselves, even where some terms have the same meaning (for example ‘accuracy’ and ‘precision’).

\begin{table}[h]
\centering
\caption{Evaluation of data quality attributes}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline
Data quality & Accuracy & Accessibility & Believability & Completeness & Conciseness & Consistency & Contextual Clarity & Concurrency of Redundant or Distributed Data & Definition Conformance & Data Integrity & Data Interpretability & Data Reliability & Data Rightness or Fact Completeness & Data Security & Data Structure & Data Timeliness & Data Usability & Data Validity & Data Understandability \\
\hline
\hline
Umar et al\(^\text{36}\) & x & x & x & x & & & & & & & & & & & & & & & & \\
Wang & Strong\(^\text{37}\) & x & x & x & x & & & & & & & & & & & & & & & & \\
Ballou & Pazer\(^\text{38}\) & x & x & x & x & & & & & & & & & & & & & & & & \\
Cappiello\(^\text{39}\) & x & x & x & x & & & & & & & & & & & & & & & & \\
English\(^\text{40}\) & x & x & x & x & x & x & x & x & x & x & x & & & & & & & & & \\
Lee et al\(^\text{41}\) & x & x & x & x & x & x & x & x & x & & & & & & & & & & & \\
Parker et al\(^\text{42}\) & x & x & x & x & x & x & x & x & & & & & & & & & & & & & \\
Forslund\(^\text{43}\) & x & x & x & & & & & & & & & & & & & & & & & \\
Miller\(^\text{44}\) & x & x & x & x & & & & & & & & & & & & & & & & \\
\hline
\end{tabular}
\end{table}

\(^{35}\) Ibid., p. 280.
\(^{36}\) Ibid., p. 279.
Chapter Two: Critical Literature Review

The accuracy dimension can be defined as the correctness of data with respect to real life. Completeness relates to the degree to which values are present in data collection and sufficient. The attribute of timeliness measures whether the information is available within the required timeframe of the user, whilst the level of relevance indicates whether the information addresses the users needs. The attribute understandability refers to how easy it is to comprehend the information. The level of accessibility determines the degree to which information can be retrieved when required, and consistency ensures that two or more data items do not conflict with each other. Cellco argues that

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The accuracy dimension can be defined as the correctness of data with respect to real life. Completeness relates to the degree to which values are present in data collection and sufficient. The attribute of timeliness measures whether the information is available within the required timeframe of the user, whilst the level of relevance indicates whether the information addresses the users needs. The attribute understandability refers to how easy it is to comprehend the information. The level of accessibility determines the degree to which information can be retrieved when required, and consistency ensures that two or more data items do not conflict with each other. Cellco argues that

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50 Smith, K. Public sector records management, 2007, p. 11.
56 Olson, J. E. Data quality: the accuracy dimension, 2003, p. 25.
57 Parker et al., ref. 42, p. 7.
58 Forslund, ref. 43, p. 517.
59 Al-Hakim, ref. 49, p. xv.
60 Ibid., p. xiv.
‘dirty data’ is causing major problems with data warehouses i.e. many users are retrieving wrong information from their data warehouses. Similarly, Redman\(^62\) suggests that the impact of poor data quality include ‘customer dissatisfaction, increased operational cost, less effective decision-making, and a reduced ability to make and execute strategy’. The most important point here may relate to the ability to make decisions, as echoed in a report by Mayberry\(^63\) who suggests that ‘data quality problems cost U.S. businesses more than $600 billion per year’ and an ‘inability to make sound decisions based on accurate information’. English, who is a major author in the field of data quality issues, reports that ‘the business costs of non-quality data...may be as high as 10 to 25 per cent of revenue of an organisation’\(^64\).

Previous research has recognised the importance of data quality within a variety of sectors. For example, Umar \textit{et al}\(^65\) identified lessons learned from a large scale case study conducted in the telecommunications industry. The study found the key issues affecting data quality included inconsistency among systems i.e. the same information does not exist in all required systems, poor system architecture causing silos of information, lack of standardisation for data entry and a lack of data and information standards. Similarly, the issues of multiple sources of data were apparent within a study of enterprise resource planning system implementation by Xu \textit{et al}\(^66\), along with misrepresentation of information due to different interfaces between systems. However, in light of the discussion in Chapter 2.1 on the difference between data, information and knowledge, much of the literature here does not make such distinctions. Throughout this Chapter the words are not used with the precise definition outlined in Section 2.1.1. Gendron & D’Onofrio\(^67\) found that data quality was of particular importance within the healthcare industry and the key attributes of data quality discussed previously were felt by healthcare managers to be of relevance to conducting operational activities successfully. Within a wider context, Fisher & Kingma\(^68\) argue that poor data quality led to poor decision-making during the major disasters of the Challenger US shuttle and the shooting down of the Airbus by USS Vincennes.

These messages learned from previous studies are relevant for modern police forces, whereby in order to exploit information provided by technology and correlate this to trace suspects, better quality data is fundamental so that all information gathered can be applied and reused to new situations\(^69\). This is emphasised by Baumber\(^70\), who suggests that a key concern for police forces is the quality of information stored in their IT systems, as within 43 individual police forces there are 270 different IT systems in operation. It is suggested that disclosure of inaccurate information may place a person at personal risk, and a common issue is that information retrieved is inadequately recorded or verified\(^71\). In other words, good quality data is necessary in order to make good quality decisions based on the data collected. As previously discussed, police officers are heavily reliant on information to conduct their core


\(^{63}\) Mayberry, M. Data quality: before the map is produced. \textit{Directions Magazine}, 8\textsuperscript{th} September 2002. \texttt{<http://www.directionsmag.com/print.php?article_id=250>}, [accessed 01.06.09].


\(^{65}\) Umar \textit{et al}, ref. 34, p. 284.


\(^{68}\) Informatica. Implementing data quality metrics and standards to enhance crime-fighting throughout the force’s jurisdiction and beyond. \texttt{<www.informatica.com/INFA_Resources/cs_humberside_police.pdf>}, 2008, [accessed 01.06.09].


\(^{70}\) Baumber, S. \textit{The IMPACT Nominal Index: an asset for child abuse investigators?}, MA dissertation, De Montfort University, United Kingdom, 2007, p. 16.

\(^{71}\) Ibid., p. 23.
operations and so data quality is a fundamental aspect of ensuring successful problem solving. However, allowing officers direct access to information via mobile technology may have implications for data quality. Baumber concurs that the introduction of technology to increase access to information may also lead to information quality becoming a priority for the police service. As previously discussed, there is a complex range of sources that officers have to update within a time-critical environment. It is therefore important to understand how officers input information into commonly used information systems and to investigate the use of tools to aid the entering of information (see section 2.2.2). It is also important to understand the perceptions of data quality, the perceived level of data quality and the reasons for this level of quality. It appears that little research has been done before in this area, yet recommendations are needed to manage data quality levels within a mobilised information environment, in order to allow the Constabulary to align with the Management of Police Information (MOPI) code of practice. In line with the review of the data quality literature, MOPI states that police information should be accurate, adequate, relevant and timely. This is supported by a report by the Audit Commission, which states that ‘police forces need to sustain and embed high standards of data quality through effective procedures and systems’. Their findings showed that the data quality of Leicestershire had improved in 2006/07 to a grading of excellent from a grading of fair in 2005/06. However, little evidence is available to indicate the perceptions of data quality following the mobilisation of policing processes.

Information Literacy within Policing

The discussion thus far highlights the vast number of sources and types of information which officers access to complete their duties. This raises concerns over how officers find and retrieve the relevant information when they need it under critical circumstances, and how they go about doing this. Without doubt, one of the most widely discussed areas under the umbrella of information overload is information literacy (IL). Keenan and Johnston define IL as ‘the ability to recognise when information is needed and to locate, evaluate and use the required information effectively’. With information being delivered to police officers through multiple channels and in a wide variety of formats this task may sometimes be challenging.

Zurkowski first used the term information literacy in the 1970’s to address the needs of people working in a technological environment, with main interest stemming from libraries. Now IL is recognised as a key factor to developing a learning organisation and economic development. A review of the literature indicated that research into IL has seen a move away from a traditional library focus and has more recently been applied to practitioners, especially since an increasing number of organisations have become reliant on information to achieve their organisational goals. An instance of research where IL has

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73 Ibid.
74 Ibid.
been heavily studied is in educational settings, through the use of qualitative methods such as observation task analysis. Findings suggest IL is pertinent to allow students to learn from sources that are relevant and academic and thus should be integrated into the curriculum. However, as noted by Virkus, Muir & Oppenheim, Oman, Cheuk and de Saulles, few studies have been done into IL in the workplace. The UK government has encouraged the use of communication and technology within organisations but little emphasis has been placed on incorporating IL into the employee skill set. These authors provide a general agreement that without employees possessing a satisfactory level of IL skills, organisations may face additional unnecessary costs. Cheuk suggests employees are ‘unable to retrieve information effectively from information systems’, as they have not been provided with sufficient training in building advanced search strategies such as use of Boolean operators, which means valuable information may be left unused at the possible detriment of the success of their organisation.

A relatively small number of research studies have been conducted to identify the level of information literacy and search capabilities within divisions of global policing departments. Despite officers ranking information systems as the major source for relevant information, the findings from a range of studies provide evidence for Cheuk’s argument in that officers rated their ability to build a search strategy below average. Research by Borglund into the use of electronic records in police work suggests that ‘all information systems are designed with some database solution, enabling quite advanced search functionality’, which suggests that officers should possess information literacy skills to fully utilise this search functionality. Similarly, mobile technology users in other UK police forces felt that continuous support and help in building appropriate search strategies was required, since ‘skills in inputting information into mobile data terminals (MDTs) were such that the accuracy of the information retrieved could be compromised as a result of their lack of IT skills’. In other words, according to police officers’ personal perception their information skills are weak. Northrop et al go some way to explain this

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84 Oman, J. Information literacy in the workplace. *Information Outlook*, 2001, 5(8), 34.
87 ibid, p. 68-79.
88 Borglund, ref. 17
93 Borglund, ref. 17.
by suggesting that few police officers receive formal training in the use of computerised search systems and they have to rely on co-workers or train themselves\(^95\). However, the contributions of these studies may be criticised in that the evidence for these findings are opinion based on qualitative information regarding officer’s perceptions rather than from a factual quantitative study. Al-Daihani & ur Rehman\(^96\), Baker\(^97\) and Northrop et al\(^98\) concur further research is needed to understand the information seeking behaviour of police officers, and recommend the enhancement to user interfaces of police information systems in order to improve search efficiency. An improved, integrated search interface (COPLINK) previously developed for law enforcement took into account how officers build search strategies and demonstrated that it improved search performance over traditional search interfaces\(^99\). This supports the recommendations argued by Al-Daihani & ur Rehman, Baker and Northrop et al regarding user interface of police information systems. Similarly, Lee County in Florida adopted a Judicial Inquiry System, which queries and correlates results from 13 state and national data sources\(^100\). Prior to the adoption of the system, ‘bailiffs were required to log into numerous computer systems to acquire information on a subject’s criminal history and any local, Florida, out-of-state or federal warrants\(^101\). The effectiveness of the single search interface is apparent in that within the first week of implementation in Lee County, 141 warrants were identified that led to 16 arrests\(^102\). In addition, the qualitative methods used by Chen\(^103\) provide a richer understanding of the problem situation than the use of questionnaires to identify perceptions, which is also the case for previous research conducted into IL in education.

Whilst Cheuk’s work has some limitations in that it does not provide a quantitative figure to the cost of this issue, its main value is that it highlights the importance of establishing a level of IL within a workplace. In contrast, de Saulles survey of IL amongst UK small-medium enterprises suggests that the time wasted searching for information represents a significant organisational productivity cost, estimated at $5.3m per year\(^104\), although the research fails to consider how efficient employees are as searchers or how they search for information. Furthermore, many other studies have reported similar findings. Figure 2.2.2 shows a survey by the Delphi Group\(^105\) who found that many information workers spend two to four hours per working day looking for relevant information, which calculates to 25 per cent or more of an eight-hour working day. Davenport & Prusak\(^106\) report that managers spend 17 per cent of their time (six weeks a year) searching for information. Tedmori et al\(^107\) find that 45.5 per cent of senior police officers spend between one to five hours per day searching for information, which is lower than the findings

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\(^{95}\) Northrop et al, ref. 49, p. 269.

\(^{96}\) Al-Daihani & ur Rehman, ref. 89, p. 624.

\(^{97}\) Baker, ref. 90.

\(^{98}\) Northrop, et al, ref. 91, p. 272.


\(^{100}\) Reuters. Lee County, Florida adopts active warrant alert system to increase justice information sharing. <http://www.reuters.com/article/idUS136792-08-Dec-2008-MW20081209>, 09.12.08, [accessed 07.01.08].

\(^{101}\) Ibid.


\(^{103}\) Ibid., p. 281.

\(^{104}\) de Saulles, ref. 86, p. 73.


\(^{106}\) Davenport, T. H. & Prusak, L. Information ecology: mastering the information and knowledge environment, 1997, p. 76.

Delphi’s research. Research by Spiers\textsuperscript{108} does not provide a quantitative figure, but finds that respondents within the East Midlands Ambulance Service are concerned about the volume of emails as a result of the introduction of mobile technology, which reflects an apparent level of information overload.

Other than the work described in the previous paragraph by Chen \textit{et al} and Tedmori \textit{et al}, little research has been conducted into how operational police officers look for information and the time spent in looking for this information, and the effect of techniques to structure knowledge on cost and time in retrieving information within a policing context. As suggested by Al-Daihani in one of the few studies into IL of police officers, human capabilities are most critical in exploiting information rather than availability of the information systems\textsuperscript{109}.

This research sought to investigate the issues of information overload and information literacy within a mobilised policing information environment and make recommendations to tackle these issues. Such data may provide a contrasting picture against existing research about the information literacy of police officers.

\textit{Question #2 – "How much time do you spend each day searching for information that is critical to your job performance?"}

\textbf{Figure 2.2.2: Delphi Group Survey Results}\textsuperscript{110}

\textsuperscript{108} Spiers, G. The psychological contract and the Blackberry wireless communication device: Blackberry – friend or foe? MBA dissertation, Nottingham Trent University, United Kingdom, 2008, p. 80.
\textsuperscript{109} Al-Daihani & ur Rehman, ref. 89, p. 624.
\textsuperscript{110} Delphi Group, ref. 105.
2.2.2 Reducing Information Overload: Structuring Knowledge

The issues of information collection, complexity of sources and information literacy within policing demonstrate that there is a need to structure information and knowledge in order to reduce information overload and increase employee productivity. Gilchrist & Mahon\textsuperscript{111} suggest more than a simplistic approach is required. The adoption of IT applications such as SAP only address a small number of specific issues and do not lend themselves to dealing with unstructured data and knowledge, or business intelligence. Supporting evidence for the structuring of information within policing can be found with the recommendations of Luen and Al-Hawamdeh\textsuperscript{112}, who suggest that information must be captured in a standardised format to allow effective storage and dissemination: ‘one of the key factors in the successful implementation of knowledge management is the efficient organisation of knowledge and corresponding knowledge documents. By organising such knowledge in a logical and consistent manner, police officers will be able to retrieve it quickly and efficiently and be better able to understand the knowledge and its relationship with other areas of work’\textsuperscript{113}.

Whilst work conducted within a policing context by Allen & Shoard\textsuperscript{114} suggests that mobile information technologies can help to reduce information overload, as they assist in spreading the load of information, their work is primarily focused on the effects of email rather than the structure of information; Koniger & Janowitz\textsuperscript{115} contend a lack of structured information, not the amount, is causing information overload. They suggest structured information should allow efficient selection of information. As previously suggested in section 1.1.2, information held within the crime and intelligence information system can lack structure: information within the system can be held under differing vocabularies which makes it complex to locate or input the correct piece of intelligence, which may become more apparent with the introduction of mobile information technologies. This problem statement therefore presents issues such as how it can be managed and techniques available to structure knowledge.

Knowledge Structure Technique: Taxonomy

Grove\textsuperscript{116} comments the term taxonomy has its origins in biology and the life sciences, where the technique was used to arrange and classify organisms and objects. There are many definitions available of taxonomy and its application to numerous contexts means there is no agreed definition. However, a comprehensible definition is given as ‘a systematic way of organising knowledge, providing a hierarchical structure of concepts, using terms that help in the development of a common language to aid knowledge sharing’, which supports the development of the knowledge cycle (see section 2.1.3).

The usefulness of taxonomies has given rise to application within several other disciplines, including computer science and information science. During the past few years, taxonomies have seen a rise in interest in many KM implementations. Research by Marwick into the challenges in converting human knowledge contends ‘individuals will demand a structured display of information that uses

\textsuperscript{111} Gilchrist, A. & Mahon, B. Information architecture: designing information environments for purpose, 2004, p. xix.
\textsuperscript{112} Luen & Al-Hawamdeh, ref. 5, p. 315.
\textsuperscript{113} Ibid., p. 315.
terminology they regularly use\textsuperscript{117} and this demand will lead to ‘a proliferation of taxonomies in many KM applications’\textsuperscript{118}, since taxonomies support the processes of the SECI model by making explicit knowledge more accessible. Similarly, Gilchrist\textsuperscript{119} and Wyllie\textsuperscript{120} suggest the main reason to explain why the technique has attracted interest is because they assist users in finding the information they want, which supports a core argument presented throughout the literature. Likewise, Grove points out ‘the explosion of information available over the Internet and private intranets has exceeded the ability of simple keyword searches to retrieve information; many have now turned to classification schemes to help users find information’\textsuperscript{121}. Although several authors corroborate the benefits of taxonomies in locating information to overcome the problem of information overload\textsuperscript{122 123 124 125}, none of these studies provide sufficient depth and primary data to support their argument. Furthermore, an in-depth search of the literature surrounding the cost-benefits produced few results (see appendix 1), despite there being numerous papers in support of the use of taxonomies. This may present a gap for future research, especially since there is little evidence of the cost-benefits of taxonomies within a policing context.

Nevertheless, a small number of comparative experiments have been conducted by Uddin & Janeck within an educational setting\textsuperscript{126} and by Muddamalle within a soil research setting\textsuperscript{127}. The common aim of these two experiments was to evaluate the performance of different search interfaces, mainly those with taxonomy of classification scheme against those without a classification scheme. Key strengths of these experiments include the use of a sufficient sample size and that evidence is based on quantitative analysis of measures, such as task completion times and recall and precision of results, rather than qualitative user perceptions. The findings of these experiments demonstrate that structuring techniques, such as a taxonomy, may produce cost savings for an organisation due to the time saved in searching for information. It may be argued that further experiments should be conducted to identify whether the same applies within wider contexts such as policing, which to date has not yet been proved.

**Knowledge Structure Technique: Ontology**

An ontology is another knowledge structure technique. The term is borrowed from philosophy, where an ontology is a specific account of existence. More recently ontologies have been used to categorise information within artificial intelligence systems\textsuperscript{128}. Gruber defines the technique in the context of knowledge sharing as a system that describes concepts and the relationships between them; it is a specification for making ontological commitments i.e. an agreement to use a vocabulary in a way that is

\begin{footnotesize}
\textsuperscript{118} Ibid.
\textsuperscript{120} Wyllie, J. Taxonomies: frameworks for corporate knowledge, 2003, p.4.
\textsuperscript{121} Grove, ref. 116, p. 2773.
\end{footnotesize}
consistent with respect to the theory specified by an ontology. For example, the ‘intelligent care (i-Care) electronic services’ document outlines the utilisation of web technologies that improve the quality of health care for an ageing population. It applies an ontology to show the relationship between four major concepts: device, home portal, participant and service, as shown in Figure 2.2.3. To illustrate the point of an ontology, the iCare ontology is arranged as follows: for the concepts of device, this can be categorised into non-electronic and electronic devices; for electronic devices there is different hardware e.g. handheld devices, sensors and objects and for the concept of participant there are different roles e.g. family, carer, friend involved in the iCare portal environment.

![Figure 2.2.3: Ontology of i-Care](image)

Ontologies have seen wide application to the healthcare environment. Practitioners within this arena appreciate the importance of developing formal representations of medical terminology, in order to allow the reuse of clinical information and to integrate different information sources including medical records, decision support systems and management information systems. This integration is only possible if there is a common language, which can be shared amongst information systems for representing what clinical users have done; this is recognised as a key challenge. Within a police setting, Li & Yang recognise that ‘the major difficulties to the retrieval of relevant information are the lack of explicit semantic clustering of relevant information and the limits of conventional keyword-driven

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132 Ibid.
search techniques (either full-text or index-based). A number of prominent efforts to provide a formal representation of medical concepts have been based on the development of ontologies; for example the GALEN program is among one of the largest such efforts. Similarly, the Transparent Access to Multiple Biological Information Sources (TAMBIS) is another example of an ontology, which describes a wide range of bioinformatics concepts. Soergel corroborates that ontologies are now seeing increasing use to help users to cope with the vast amount of information available through networked systems, including databases and the Web, as they support information retrieval by providing visual representations of a concept and pre-defined search terms. As a result of these benefits, application areas are disparate; in addition to application in medical information environments, ontologies are also used in mechanical engineering, electronic commerce, geographic information systems, and legal information systems to assist barristers to convert legislative documents into XML documents. Conversely, despite the benefits of ontologies and their wide application, the development of ontologies to assist users of policing information systems scarcely appeared in the literature. However, Li & Yang developed a ‘thesaurus-like, semantic network knowledge base, which can aid in semantics-based crosslingual information management and retrieval’ within the Hong Kong police force. Therefore the research investigated the attitudes towards the use of such techniques, along with the structuring of existing systems within the Constabulary to identify whether the use of a common language is apparent.

### 2.2.3 Summary

The literature review in this chapter has found that police officers experience levels of information overload, and must be able to handle a complex range of information sources in order to complete their operational duties. A small gap for research emerged with regard to investigating how police officers prefer to input information into numerous electronic information sources, in order to ensure efficient data entry and data quality levels. It established that data quality dimensions are important in ensuring sufficient quality data and information within a mobile information environment, so that correct decisions can be taken based on the data. Further, this section has highlighted the importance to investigate the perceptions towards data quality within the Constabulary and reasons for this data quality. In order to retrieve information from a complex range of sources, the literature demonstrated the need for information literacy skills amongst police officers, which proved to be a relatively new area for research.

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134 Rector et al., ref. 131, p. 229.
142 Li & Yang, ref. 133, p. 273.
To support data entry and information retrieval within a mobile environment, this part of the literature review highlighted a need to investigate the application and perception towards the use of tools, such as controlled vocabularies, within a policing context. The next section of the literature review critiques work that currently exists on the topic of technologies that can be used to facilitate knowledge management.
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Chapter Preface

This section will discuss the literature that currently exists on the topic of technologies that can be used to facilitate knowledge management. It will begin with a broad discussion of knowledge management technologies, followed by how technology is enabling mobilisation of knowledge leading towards an argument about key challenges for implementing such technologies into an organisation.

2.3 Knowledge Management: Technologies

2.3.1 Technologies and Knowledge Management

Many authors recognise that information and communication technologies are an important element of knowledge management and organisations have embraced KM technologies within the past ten years. For example, Jashapara provides a current, integrated approach to define knowledge management as ‘the effective learning processes associated with exploration, exploitation and sharing of human knowledge (tacit and explicit) that use appropriate technology\(^1\) and cultural environments to enhance an organisation’s intellectual capacity and performance\(^2\). It is generally accepted that technologies will play some part in knowledge management: many authors have written about the application of software in knowledge management, such as Junnarkar & Brown\(^3\). Early technologies were used to locate expertise, such as online corporate yellow pages and document management systems and email, thereby supporting the knowledge creation and sharing phases of the knowledge lifecycle (see section 2.1.3). Research surveys of firms introducing knowledge management initiatives demonstrate the predominance of technological implementations, such as implementing an intranet, data warehouse, decision-support system or groupware\(^4\)\(^5\). Knowledge management focuses on humans and tacit knowledge as an organisational asset and it may be argued that technologies assist in capturing this knowledge. With regards to Nonaka \(et\ al\), technologies may be used to support the SECI model of knowledge creation (see section 2.1.2): for example teleconferencing technologies assist the socialisation phase, emailing technologies assist the externalisation phase and intranets and information systems support the combination stage.

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\(^1\) Italics added by researcher for emphasis.


2.3.2 Technologies and Policing

It is argued that technology has had a great influence on police practices and assisting in their knowledge related work. Technology is currently used to support policing in several ways, such as database systems to record crime details and geographic information systems to profile the characteristics of local policing environments, crime profiles and police performance to provide increased intelligence, as found by Ashby & Longley’s study at Devon & Cornwall Constabulary. Manning notes that the introduction of the two-way radio and mobile data terminals into patrol cars has increased the capacity to respond to crimes. Similarly, a research survey by Chan of 506 Australian police officers identified that 72 per cent felt that information technology had made a great difference to police work and provided ‘the capacity to follow a more problem-oriented style of policing.’ Manning notes that the introduction of the two-way radio and mobile data terminals into patrol cars has increased the capacity to respond to crimes. Similarly, a research survey by Chan of 506 Australian police officers identified that 72 per cent felt that information technology had made a great difference to police work and provided ‘the capacity to follow a more problem-oriented style of policing.’

Furthermore, Brown and Brudney concur that the effects of IT are favourable with regards to enabling benefits of a learning organisation, such as improving policing problem-solving abilities. Syson concurs that knowledge sharing in policing enables officers to learn from one another and consequently the organisation is able to work more effectively and become a learning organisation. However, these findings are only supported by a survey and further qualitative research (e.g. a focus group) may have provided further insights into the impact of IT on policing. The growth and value of knowledge management technologies in policing is represented by a four-stage model (Figure 2.3.1) suggested by Gottschalk. He suggests the first stage involves provision of technology that enables an officer’s personal efficiency, such as word processing software. The second stage involves technology that allows officers to locate people with specific knowledge, such as intranets and yellow pages. The third stage of technology provides access to information stored in documents, such as reports and emails. Business intelligence is the focus of the fourth stage, whereby officers access a system to solve a particular problem. His later research suggests that the fourth stage creates the greatest value to a policing organisation, or a ‘value shop’, an organisation that creates value by solving unique problems, which requires technology to manage the volume of information. Chen et al’s research corroborates the fourth stage suggested by Gottschalk via the development of a system that facilitates information and knowledge sharing in police work and analyses linkages amongst various aspects of a crime. Despite

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7 FACSys case study - Leicestershire Constabulary: FACSys makes history in fighting crime and improving public quality of life. <http://www.techland.co.uk/index/facsys_case_leics>, [1999], [accessed 01.09.07].
12 Ibid.
13 Syson, H. Knowledge sharing in the UK police service – a research study, MSc dissertation, Loughborough University, United Kingdom, 2007, p. 20.
there being much discussion in favour of the benefits of applying technologies to policing, Chan also notes that the traditional and rigid structure of policing can sometimes present difficulties to implement change\(^{17}\). Allen \textit{et al} concur with the notion of change, suggesting that ‘forces are attempting to introduce a technology as a tool, rather than considering the effect of that tool on the work process of those who use it. As a result, complex issues of organisational change and even the need for individuals to change their work habits are ignored’\(^{18}\). This is a key issue of this research and is discussed further in sections 2.3.3 and Chapter 2.4.

\includegraphics[width=\textwidth]{figure_2.3.1.png}

\textbf{Figure 2.3.1: Stages of growth model for knowledge management technology\(^{19}\)}

\subsection{2.3.3 Mobile Technologies and User Acceptance}

Many organisations are realising the importance of mobilising their information and knowledge environments: NASA’s Chief Knowledge Architect claims ‘knowledge anywhere, anytime and on any device is critical in this day and age’\(^{20}\); Buckman Laboratories have found ‘wireless solutions can help employees communicate easily in real-time and function across space and time’\(^{21}\); and Gigi Wang, senior vice-president for Communications and Internet Research contends ‘we are now seeing the emergence of the continuous economy – across space and time, across organisational and personal boundaries’\(^{22}\).

Knowledge mobilisation is now established within several different organisational contexts, such as engineering where Boeing’s engineers use laptops and wireless networks to improve access to

\begin{footnotesize}
\begin{enumerate}
\item Chan, ref. 10, p. 156.
\item Gottschalk, ref. 15, p. 185.
\item Rao, M. Knowledge management tools and techniques: practitioners and experts evaluate KM solutions, 2005, p. 18.
\item Ibid., p. 18.
\item Ibid., p. 18.
\end{enumerate}
\end{footnotesize}
complex documents on the move; for telecommunications where Bell Canada technicians use wearable computers enabling them to instantly tap office expertise while they are on top of a telephone pole; and in the pharmaceutical industry where Snyder Healthcare sales force uses a mobile-enabled knowledge management system to provide access to tools for reporting, distributing samples and capturing signatures via handheld computers. Snyder Healthcare found that compared to previous paper-based methods, accuracy of data capture increased and the time taken to provide reports to clients decreased from 60 days after a sales visit to ten days. Other pharmaceutical companies adopting portable computers for their sales force have found they allow employees to spend more time with customers and flexibility in dispatching workers to customer locations, which in turn creates cost savings. Davenport estimates that ‘total mobility schemes allow cost-savings, due to reductions in office space, of between 25-67 per cent’.

Mobilising information and knowledge processes of policing organisations will grant police officers direct access to information previously accessed only by radio communications or by returning to a police station to use a desktop computer. Now police officers can access information related to entities such as suspects, car registrations, warrants of arrest and will be able to record statements, view photographs and capture signatures and fingerprints electronically while on the go. Consequently, the highly bureaucratic nature of policing may be altered, by reducing the need for lengthy paper-based processes and call operators to relay information. Sir Menzies Campbell, former leader of the Liberal Democrats UK political party, concurs that police officers have become bureau-cops. It is not uncommon for officers to write details of individuals (e.g. addresses) approximately sixteen times in the course of an incident.

Figure 2.3.2 shows a typical mobile data terminal, whilst Figure 2.3.3 represents the average amount of paperwork a police officer requires to conduct their daily duties.

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23 Ibid., p. 19.
24 Ibid., p. 19.
26 Ibid., p. 6.
28 Ibid.
Supporting empirical evidence for the argument regarding the mobilisation of information and knowledge processes (as discussed in section 1.1.2) can be found in Jorgenson\textsuperscript{30} and Honeybourne et al\textsuperscript{31} into mobile knowledge management within a healthcare environment who argue that the combination of technological advances with knowledge management processes may result in more effective patient treatment, as clinical information can be provided at the point of need. Patient care is affected by knowledge availability in order for the correct decisions to be made, which is a similar case to policing. However, the research also found that participants of the study did not initially use their PDA very often; usage was greatest when ease of use was simple as clinicians did not have time to learn how to use software and found it easier to obtain information from a colleague rather than an impersonal technical device\textsuperscript{32}. Similarly, Lu et al\textquoteright s review of handheld computer adoption in healthcare found that the adoption rate for physicians in the USA and Canada is 40 per cent and wider organisational and institutional adoption is relatively slow, because a lack of organisational support and training and usability issues contribute towards a lack of motivation to use the devices\textsuperscript{33}. In other words, the level of adoption may depend on the organisational culture and employee attitude towards change. Furthermore, Alloni et al\textsuperscript{34} report that a handheld device in a surgical ward was initially used by few members of staff, but the majority continued to use paper-based methods despite the advantages of recording information electronically; in the longer term more reluctant members of staff accepted to use the handheld device. This demonstrates a risk in that many organisations believe introducing technology into their organisation

\begin{itemize}
\item\textsuperscript{30} Jørgensen, J. Knowledge management in health information environments. <http://capping.slis.ualberta.ca/cap07/JayJorgensen/page2disc.htm>, 2007, [accessed 25.03.08].
\item\textsuperscript{31} Honeybourne, C., et al. Knowledge in the palm of your hands: PDAs in the clinical setting. Health Information Libraries Journal, 2006, 23, 52.
\item\textsuperscript{32} Ibid, p. 55.
\end{itemize}
will assist in the knowledge lifecycle of capturing, storing and sharing knowledge, yet as suggested by Strassman, the link between ICT investment and business performance is weak\footnote{Strassman, P. A. Taking a measure of knowledge assets. Computerworld, 1998, 32(4), 74.}.

Research by Collier takes a negative stance with regard to the impact of technology in policing, suggesting that police officers rely on tacit knowledge more to complete their duties\footnote{Collier, P. M. Policing and the intelligent application of knowledge, Public Money and Management, 2006, 26(2), p. 113.}; similarly Ng & Ang\footnote{Ng, P. T. & Ang, H. S. Managing knowledge through communities of practice: the case of the Singapore Police Force. International Journal of Knowledge Management Studies, 2007, 1(3-4), 364.} argue that IT is in itself insufficient to manage knowledge and turn their attention towards nurturing communities of practice\footnote{Wenger, E. Cultivating communities of practice: a guide to managing knowledge, 2001, p. 45.} for sharing tacit knowledge in order to enhance the learning of an organisation. This notion of the role of social and organisational issues becoming threatened by technology is followed through in research by Edwards \textit{et al}\textsuperscript{39} where the importance of informal knowledge sharing systems has not previously been recognised by policing organisations and is perceived by some officers as a barrier to communication. Whilst the knowledge management literature recognises the value of information knowledge sharing systems, there is a danger of these being undermined and this could become more apparent when mobile technology is implemented. In contrast to arguments presented earlier in this section in favour of the impact of technology with regards to enabling more effective decision-making to realise the benefits of a learning organisation, Northrop\textsuperscript{40} found that computerisation did not advance decision-making. Likewise, Edwards states that technology increased the quantity rather than the quality of information available and this presented officers with the risk of information overload\textsuperscript{41}. Whether these risks are true for this research was investigated in this study. User acceptance is a key theme of the literature and must be taken into consideration when implementing a mobile information system into the Leicestershire Constabulary.

\subsection*{2.3.4 Summary}

Within this section of the literature review, it was shown consistently that technologies can be used to facilitate activities of knowledge management. For example, intranets and information systems may support codification of information and knowledge, whilst teleconferencing technologies, for instance, may aid the sharing of information and knowledge. Examination of literature within this area in a policing context found that technologies have played a role in assisting the information and knowledge related activities of policing, including the two-way radio to share knowledge, and database systems to record crime related information. Despite the apparent benefit of technologies to knowledge management, it is argued that the traditional and rigid structure of policing can make it difficult to implement new technologies. Coupled with previous research that contend technologies can have a negative impact on knowledge management (for example damage to informal tacit exchange and information overload), it is thus important to examine the factors that may influence the acceptance of mobile technologies within the Leicestershire Constabulary. The next section of the literature review

\textsuperscript{36} Collier, P. M. Policing and the intelligent application of knowledge, Public Money and Management, 2006, 26(2), p. 113.
\textsuperscript{40} Edwards \textit{et al}, ref. 39, p. 123.
continues this theme by critiquing existing theories that can be used to evaluate the impact of mobile technologies on employees within the Leicestershire Constabulary.
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Chapter Preface

This Chapter aims to critique theoretical models that can be applied to examine acceptance of technologies. It reviews the application of these models within a broad and a policing context.

2.4 Models that can be applied to Analyse Technology Acceptance

Various theoretical models can be applied to examine how users come to accept and use a technology. Venkatesh & Davis comment that ‘despite impressive advances in hardware and software capabilities, the troubling problem of under-utilised systems continue’\(^1\), so it is therefore important to understand the conditions under which technology will be embraced. According to Gallivan\(^2\) several theories have been advanced and have been used in research to explore this issue. Investigations of theories have been abundant in the information systems literature. Amongst these theories are the Diffusion of Innovation Theory by Rogers\(^3\), Theory of Reasoned Action proposed by Fishbein & Aijzen\(^4\), the Technology Acceptance Model developed by Davis\(^5\), the Task-technology Fit Model by Goodhue & Thompson\(^6\) and the Unified Theory of Acceptance and Use of Technology model (UTAUT) by Venkatesh \textit{et al}.\(^7\). The theories originate from behavioural intention theory, whereby an individual’s intention to adopt a technology is a conscious act\(^8\), and are examined in the following sections.

2.4.1 Diffusion of Innovation Theory

According to Rogers, diffusion may be defined as ‘the process in which an innovation is communicated through certain channels over time among the members of a social system… messages are concerned with new ideas… which means that there is a degree of uncertainty’\(^9\). The presence of uncertainty means there are a number of alternatives associated with the occurrence of an event and the relative probability of these alternatives\(^10\).

The diffusion of innovation theory studies how, why and at what rate new technologies spread through cultures, such as the adoption of personal computers in the 1990’s. Winston comments that ‘regularities in the pattern of innovation and diffusion suggest a model for all such changes… repetitions

\(^1\) Venkatesh, V. & Davis, F. D. A theoretical extension of the technology acceptance model: four longitudinal field studies. \textit{Management Science}, 2000, 46(2), 186.
\(^3\) Rogers, E. M. \textit{Diffusion of Innovations}, 2003, p. 22.
\(^9\) Rogers, ref. 3, p. 1.
\(^10\) Ibid., p. 6.
can be seen across a diverse range of technologies\textsuperscript{11}. Figure 2.4.1 shows that the theory begins with a small number of ‘early adopters’, who then grow to include secondary and tertiary adopters, who are more sceptical and conservative towards adopting an innovation due to uncertainties and may demonstrate different characteristics to the early adopters; the theory found people were more likely to adopt technology if their well-respected peers had adopted.

![Figure 2.4.1: The diffusion of innovation theory\textsuperscript{12}](image)

Rogers notes that ‘diffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system... when new ideas are adopted or rejected leading to certain consequences, social change occurs\textsuperscript{13}. A good example of this notion is the QWERTY keyboard, which has been universally used since 1873 and was originally invented to slow down typists who typed too fast and jammed typewriters. Despite the fact that the keyboard layout takes twice as long to learn and makes the user work 20 times harder than necessary\textsuperscript{14}, it is still used in the manufacture of most keyboards today. The DVORAK keyboard is a more efficient keyboard layout, yet almost no one adopted the DVORAK keyboard. This demonstrates how superior technological innovations do not diffuse themselves; even when the innovation has obvious advantages\textsuperscript{15} adoption may be affected by peers.

Whilst some innovations such as mobile phones and video cassette recorders required only a few years to reach widespread adoption in the US, other new innovations such as the metric system and

\textsuperscript{12}Rogers, ref. 3, p. 11.
\textsuperscript{13}Rogers, ref. 3, p. 6.
\textsuperscript{14}Ibid., p. 8.
\textsuperscript{15}Ibid., p. 10.
seat belts in cars required decades to reach complete use and be adopted by tertiary adopters, due to the characteristics of innovations\textsuperscript{16}. With regard to these characteristics, the diffusion of innovation theory has five elements:

- Relative advantages; the degree to which an innovation is perceived to be better than the one it supersedes.
- Compatibility; the degree to which an innovation is perceived as being consistent with existing values, past experiences and needs of potential adopters.
- Complexity: the degree to which an innovation is perceived as difficult to understand or use.
- Trialability; the degree to which an innovation may be experimented with on a limited basis.
- Observability; the degree to which the results of an innovation are visible to others – the easier for individuals to see the results of an innovation, the more likely they are to adopt it, for example solar panels diffused more quickly than personal computers\textsuperscript{17}.

The adoption of computers was slow; initially they were only used by the military and were large and expensive, for the first two decades (1960-1980) usage of computers in households was relatively low but by 1994 one-third of US homes owned a microcomputer\textsuperscript{18}. This demonstrates how as the use of a computer grew from a basic counting device to storing information and then to allowing interactive use and networked computers\textsuperscript{19}, the relative advantages, compatibility, complexity, trialability and observability elements of the theory became apparent in increasing the rate of adoption.

The validity of the theory is demonstrated in research by Ryan & Gross\textsuperscript{20} regarding the diffusion of hybrid seed corn amongst farmers and in an investigation into the factors that affect information system process innovations\textsuperscript{21} using a qualitative case study approach whereby it was found that several factors recognised in the diffusion of innovation theory affect adoption of hybrid seed corn and information system process innovations. The theory cuts across many scientific fields, such as economics, politics, consumer behaviour, marketing and psychology to allow scholars to apply empirical research findings in the form of higher level generalisations of a more theoretical nature, which appear to fit with the diffusion paradigm\textsuperscript{22}. In contrast, a study by Yang \textit{et al}\textsuperscript{23} within a manufacturing and financial context found that management characteristics, such as age and interests of the Chief Information Officer, greatly affect the rate of adoption within of technology an organisation, which suggests that external factors may need to be taken into consideration. Nevertheless, Lundblad identifies an opportunity to more fully extend Rogers’ work into the organisational setting\textsuperscript{24}. Thus the DOI theory may be of important consideration for the potential success of the mobile information project within the

\begin{thebibliography}{9}
\item\textsuperscript{16} I\textit{bid.}, p. 15.
\item\textsuperscript{17} I\textit{bid.}, p. 16.
\item\textsuperscript{18} Winston, ref. 11, p. 236.
\item\textsuperscript{19} I\textit{bid.}, p. 237.
\item\textsuperscript{20} Ryan, B. & Gross, N. C. The diffusion of hybrid seed corn in two Iowa communities. \textit{Rural Sociology}, 1943, 8, 15.
\item\textsuperscript{22} Rogers, ref. 3, p. 106.
\item\textsuperscript{23} Yang, K. H., \textit{et al.} Adoption of information and communication technology: impact of technology types, organisational resources and management style. \textit{Industrial Management and Data Systems}, 2007, 107(9), 1273.
\item\textsuperscript{24} Lundblad, J. P. A review and critique of Rogers’ Diffusion of Innovation theory as it applies to organisations. \textit{Organisation Development Journal}, 2003, 21(4), 63.
\end{thebibliography}
Leicestershire Constabulary: based on the findings it may be useful to identify users for the pilot who are the 'early adopters' of technology i.e. those of a younger age to create 'champions' for the mobile devices, which is a key aspect of knowledge management, and then reinforce this adoption to each succeeding level.

2.4.2 Theory of Reasoned Action

The theory of reasoned action considers attitudes towards performing a certain behaviour, which are determined through individual beliefs of the consequences of behaviour, and the desirability of these consequences. The model also considers the subjective norm i.e. an individual’s perception of whether people important to the individual think that the behaviour should be performed, thereby affecting the level of motivation to perform an action. Figure 2.4.2 summarises the theory, which the technology acceptance model is based on. Its main criticisms include a lack of consideration towards the limitations of an individual’s intention to act, such as time, organisational/ environmental limits and unconscious habits.

![Figure 2.4.2: Theory of reasoned action](image)

2.4.3 Technology Acceptance Model

The technology acceptance model (TAM) intends to identify the factors that facilitate integration of technology into an organisation and discover why users accept or reject a technology. Based on adaptation of the theory of reasoned action, which is a more generalised theory, the TAM is the most widely used model for identifying factors that contribute towards acceptance of a technology. The theory suggests that when users are presented with a new piece of technology, a number of factors influence their decision about how and when they will use the technology. To explain this, two perceived attributes or measures are used: perceived usefulness (PU) and perceived ease of use (PEOU) (see Figure 2.4.3). Davis states that perceived usefulness is whether the technology will enhance the user’s job performance, and perceived ease of use relates to whether using the system will be free from effort.

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26 Ibid.
27 Davis, ref. 5, p. 320.
28 Ibid., p. 334.
A critical review of the TAM by Legris et al concluded that the model explained about 40 per cent of the variance in computer usage, which may prove it to be a useful theoretical model. Similarly, Venkatesh and Davis note that the TAM appears to be more strongly used than other models such as the theory of reasoned action: ‘as of January 2000 the Institute for Scientific Information’s Social Science Index listed 424 journal citations to the two original journal articles that first introduced the TAM; in ten years the TAM has become a powerful, robust model for predicting user acceptance’. Findings from Bagozzi et al indicate that the level of uncertainty in a new technology means that people form attitudes towards trying to learn to use the new technology before using it in a real-world scenario. This suggests it may be important to identify initial user perceptions and compare with perceptions at a later period in time.

Several researchers have replicated Davis’ original study to provide empirical evidence for relationships that exist between the two measurements (PU and PEOU) and system usage. The integrity of the TAM is demonstrated through empirical research, which extends the model to different settings, providing consistency and good re-test reliability, confirming the validity of the original Davis model (see Money and Turner who researched adoption of a KM information system, Huang et al’s research into the adoption of mobile learning amongst students, Liang et al’s and Chau & Hu’s studies within a healthcare setting and Mirvis & Sales). According to these research findings PU and PEOU are dominant determinants of usage.

However, it has been argued by Money & Turner and Huang et al that external variables must be considered when applying TAM in another context, and thus further research into the factors affecting

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31 Venkatesh & Davis, ref. 7, p. 187.
36 Chau & Hu, ref. 8, p. 229.
38 Money & Turner, ref. 33.
39 Huang et al, ref. 34, p. 595.
usage of technologies is needed. Ferret & Splenhauer⁴⁰ argue that the introduction of change into a police institution is only beneficial if the profession sees them as beneficial in terms of material gain, status and symbolism, in other words external factors mediate a successful change.

Similarly, Legris et al (Table 2.4.1) reviewed TAM empirical research and found a high level inconsistencies suggesting that the postulation of TAM that external variables intervene indirectly by influencing PEOU and PU are not sufficient to predict IT adoption⁴¹. They recommend that TAM is integrated into a broader model that includes organisational and social factors in order to improve TAM’s predictive capacity⁴². It is acknowledged by Orlikowski and Hofman⁴³ that the effectiveness of a change process relies on the interdependence between the technology, the organisational context and the management style used to manage the change; thus suggesting that it is important to study the external factors because they are the ultimate drivers of usage yet they have received little attention in the literature. Moreover, Burton-Jones & Hubona challenge the assumption that TAM fully mediates external variables, through user beliefs and found that including the direct effect of external variables can improve predictions of technology usage by up to 250 per cent⁴⁴. This was measured by identifying the frequency a user reported usage of a system over a period via a questionnaire, and calculating the percentage change between inclusion and non-inclusion of frequencies. Therefore adapting the TAM to include external variables such as management style and organisational culture may enable development of a more effective adoption strategy, which is more closely aligned with the expectations of users within any organisation looking to successfully implement a new technology.

Table 2.4.1: Review of TAM application

<table>
<thead>
<tr>
<th>Author</th>
<th>Context of study (including type of technology)</th>
<th>Participants</th>
<th>Newness of technology</th>
<th>Number of points of measurement</th>
<th>Cross-sectional or longitudinal analysis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huang et al.⁴⁵</td>
<td>Application of the TAM to explain and predict the acceptance of mobile learning i.e. users access learning material via mobile devices (e.g. PDA).</td>
<td>313 undergraduate and graduate students in two Taiwan universities.</td>
<td>Participants were new to the technology.</td>
<td>One (an online survey)</td>
<td>Cross-sectional</td>
<td>TAM can be employed to predict the user acceptance of mobile learning; allowing access to information anytime and anywhere was found advantageous to users and so increased acceptance.</td>
</tr>
</tbody>
</table>

⁴¹ Legris et al, ref. 30, p. 197.
⁴⁵ Huang, et al, ref. 34.
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<tr>
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<th>Newness of technology</th>
<th>Number of points of measurement</th>
<th>Cross-sectional or longitudinal analysis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liang et al(^{46})</td>
<td>Extension of the TAM to predict actual PDA usage in health-care</td>
<td>Unknown</td>
<td>Participants were relatively new to the technology.</td>
<td>Unknown</td>
<td>Unknown</td>
<td>The extended TAM explained 61.6 per cent of the variance in healthcare professional’s PDA usage.</td>
</tr>
<tr>
<td>Chau &amp; Hu(^{47})</td>
<td>An investigation into technology acceptance by individual professionals through examining physician’s decisions to accept telemedicine technology.</td>
<td>408 physicians in Hong Kong healthcare setting.</td>
<td>Participants were new to telemedicine technology.</td>
<td>One (using a questionnaire)</td>
<td>Cross-sectional</td>
<td>Physicians are fairly pragmatic; acceptance decisions are rooted in the usefulness of technology rather than its ease of use.</td>
</tr>
<tr>
<td>Yi et al(^{48})</td>
<td>Development of a wider understanding of technology acceptance of PDAs by individual healthcare professionals, through integrating elements of TAM &amp; innovation diffusion theory to create a new model.</td>
<td>222 physicians in Eastern state of USA.</td>
<td>Relatively new; physicians had been voluntarily using PDAs to access medical pharmacy information, case logs and care documentation. Healthcare industry is relatively slow at adopting IT but physicians are realising their value.</td>
<td>One via a questionnaire.</td>
<td>Cross-sectional</td>
<td>Integrated model with additional elements explains 57 % of a physician’s intention to accept PDAs (consistent with Chau &amp; Hu’s study – see previous page). Subjective norm and PEOU contribute the most towards physicians’ intentions to use a PDA. Social networks are useful in exploiting the subjective norm and training/implementation strategies will exploit benefits &amp; enhance PEOU.</td>
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\(^{46}\) Liang, et al, ref. 35.  
\(^{47}\) Chau & Hu, ref. 8.  
<table>
<thead>
<tr>
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<th>Cross-sectional or longitudinal analysis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirvis &amp; Sales</td>
<td>An examination of the impact of computer technology on the workforce and workplace in a large manufacturing firm and a publishing company.</td>
<td>1000 employees in large manufacturing firm and 1400 employees in large publishing company, to contrast findings.</td>
<td>Participants were new to the technology.</td>
<td>Three; over a three year period. Used a survey.</td>
<td>Longitudinal</td>
<td>Found that a top-down implementation approach in manufacturing firm had less success on acceptance that bottom-up approach in publishing firm.</td>
</tr>
<tr>
<td>Colvin &amp; Goh</td>
<td>An exploration of why patrol officers embraced or rejected computer technology i.e. mobile data terminals, in order to validate the TAM in a policing context</td>
<td>430 patrol officers within a large west coast US city; majority aged 26-40 years old with average of 10.35 years of computer experience.</td>
<td>Participants had been using the technology for 12 months.</td>
<td>One via a questionnaire instrument and observations i.e. work-shadowing.</td>
<td>Cross-sectional</td>
<td>PEOU, information quality and timeliness were the most important components of technology acceptance by police officers, in order to prevent fatal outcomes.</td>
</tr>
<tr>
<td>Legris et al</td>
<td>A critical analysis of research that uses TAM in order to identify the benefit in using TAM to explain system use (rather than not using a model to explain system use).</td>
<td>Literature review used; review of articles published between 1980 and 2001 that use TAM as an empirical study, respect the integrity of TAM have a well-described method and results are complete (22 articles in total).</td>
<td>N/a for literature review method</td>
<td>N/a for literature review method</td>
<td>N/a for literature review method</td>
<td>No single empirical study incorporated all the different combinations of elements of the TAM but all elements are measured in at least one study. Each study showed positive results but with a high number of inconsistencies, suggesting that these variables are not sufficient to predict IT adoption.</td>
</tr>
</tbody>
</table>

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49 Mirvis & Sales, ref. 37.
50 Colvin & Goh, ref. 6.
51 Legris et al, ref. 30, p. 192.
Chapter Two: Critical Literature Review

<table>
<thead>
<tr>
<th>Author</th>
<th>Context of study (including type of technology)</th>
<th>Participants</th>
<th>Newness of technology</th>
<th>Number of points of measurement</th>
<th>Cross-sectional or longitudinal analysis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dishaw &amp; Strong&lt;sup&gt;52&lt;/sup&gt;</td>
<td>An evaluation of an extended TAM model that includes task-technology fit constructs (i.e. software that provides benefit) to identify analyst’s intentions to use software maintenance support tools</td>
<td>Analyst programmers within a financial, insurance, aerospace and manufacturing industry.</td>
<td>Participants were relatively new to the project.</td>
<td>Two; one at the start of the software maintenance project and one during the project.</td>
<td>Longitudinal</td>
<td>Extending TAM with task-technology fit (TTF) constructs provides better and more useful results alone; the integrated model explains greater variance of usage than TAM or TTF alone.</td>
</tr>
</tbody>
</table>

However, it is important to note the findings of Fichman, who reviewed 18 technology adoption studies and argued that applying the TAM to an organisational setting where users are mandated to use the technology may produce negative results<sup>53</sup>. Since the usage of mobile information technologies within the Leicestershire Constabulary carries subtle pressure for officers to use technology this issue is important to bear in mind. For reasons such as those suggested in Fichman’s results, Davis refined and retested the TAM model to examine in more detail the effect of social influence on behavioural intention. The significant difference of Davis’ new model is that it extends to include social influence elements such as voluntariness and image. Voluntariness measures whether a system’s use is mandatory or not, and image measures individual’s perceptions that using an information technology will affect their appearance to important individuals. Analysis of empirical research suggests that in situations where use of information technology was voluntary, the influence of peers on behavioural intention was insignificant. Conversely, when system use was mandatory the influence of peers (subjective norm) on behavioural intention was greater. This may be an important consideration for the implementation of mobile information; super users or champions may be beneficial in increasing user acceptance. However, as Yang<sup>54</sup> suggests, the management characteristics can also have a bearing on the level of use and as previously discussed further research into the effect of other external factors is needed<sup>55</sup>.

The evidence suggests that the Technology Acceptance Model is a robust and widely applied model, which is an important consideration when applying a theory within a relatively new research context of policing. The purpose of the model aligns closely with the research objective of analysing the

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<sup>54</sup> Yang, et al, ref. 23, p. 1273.

factors that affect acceptance of mobile technology, and therefore was selected as the main theory for application within the research.

2.4.4 Task-Technology Fit model

The task-technology fit model by Goodhue & Thompson\(^{56}\) contends that information technology is more likely to have a positive impact on individual performance and be used if the capabilities of the technology match the tasks that the user must perform. Dishaw and Strong suggest its main focus is on the match between user task needs and the available functionality of the information technology\(^{57}\). Unlike other models that concentrate on the early stages of a users’ intention to use a technology, its focus is later in the outcome chain on actual use\(^{58}\). The task-technology fit is measured through the deployment of a survey containing a seven-point Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’, with questions relating to eight factors which include quality, locatability, authorisation, compatibility, ease of use, production timeliness, systems reliability and relationship with the users\(^{59}\). The theory has been applied to the evaluation of a diverse range of information systems, including e-commerce systems. These benefits would suggest that the model is appropriate to use in evaluating the implementation of mobile information into the Leicestershire Constabulary, as it could potentially be applied to identify how well the technology supports policing tasks. However, Dishaw & Strong suggest that the model does not focus on the attitudes towards the new technology; users regularly utilise information technology they feel negative towards since it may enhance their job performance\(^{60}\). Since the Constabulary are aiming to establish a positive attitude towards mobile information in order to increase user acceptance, this model will therefore not be used in the research.

2.4.5 Unified Theory of Acceptance and Use of Technology (UTAUT) model

The UTAUT model was formed by Venkatesh et al\(^{61}\), following a review of eight competing models that earlier research had employed to explain IS usage behaviour, including the theory of reasoned action, the technology acceptance model and the innovation diffusion theory. The model is represented in Figure 2.4.4, showing that it is designed as a tool for measuring the likelihood of success of information technology and to understand the main elements that affect user acceptance.

\(^{56}\) Goodhue & Thompson, ref. 6, p. 232.
\(^{57}\) Dishaw & Strong, ref. 52, p. 9.
\(^{58}\) Ibid., p. 10.
\(^{60}\) Dishaw & Strong, ref. 52, p. 12.
\(^{61}\) Venkatesh et al, ref. 1, p. 426.
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Venkatesh et al suggest that usage is affected by four elements, which are based on elements from previous models. The four elements include performance expectancy, effort expectancy, social influence and facilitating conditions\(^\text{63}\). The performance expectancy is the degree to which users believe that using the system will help them improve their performance. Effort expectancy is the degree of ease associated with using the technology. Social influence relates to the degree to which the users perceive that their important peers believe they should use the technology. It is suggested that social influence is an important factor in mandatory-use environments and in the early stages of potential adoption\(^\text{64}\). The element ‘facilitating conditions’ is defined as ‘the degree to which an individual believes that the organisational and technical infrastructure exist to support use of the technology’\(^\text{65}\). Figure 2.4.5 provides a list of factors that may be used in estimating the level of acceptance.

Two empirical tests of UTAUT suggest that gender, age, level of experience and voluntariness of use (see Fig. 2.4.4) affect the outcome of the four key constructs and therefore the level of usage. Performance expectancy directly affected the intention to use a technology and was greater amongst males and younger workers. Effort expectancy affected intention to use a technology and was greater amongst women, older workers and those with limited experience. Facilitating conditions had the greatest impact on usage amongst older workers and those with more experience. The effect of social influence on intention was greater for women, older workers, those with limited experience and those using a technology under mandatory conditions. The consideration of these factors indicates a key strength of the UUTUAT model, as other similar models do not look at the demographic profile of users.

UTAUT makes a significant contribution towards information technology research, as it synthesises several theories into a concise model consisting of only the major elements that affect

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\(^{62}\) Ibid., p. 447.

\(^{63}\) Ibid., p. 447.


\(^{65}\) Venkatesh et al., ref. 7, p. 453.
intended and actual technology usage. Since the elements that make up UTAUT are based on a vast range of previously tested studies, researchers may draw on a wealth of guidance to develop their own research instruments. The majority of empirical research that employs UTAUT uses a survey instrument, which may be easily adapted for longitudinal studies to identify adoption levels at different stages of use (see Table 2.4.2). UTAUT has been criticised for only focusing on individual perceptions of external circumstances that affect usage, when in reality many individual’s behaviours may affect usage, such as the project manager who selects the technology and the technical manager who makes applications available; managerial style can also affect usage but this is not considered. It has also been criticised for giving little attention to the context and the organisational culture in which the technology is used. However, the strengths of UTAUT in evaluating adoption appear to far outweigh these criticisms. Therefore when undertaking an evaluation of the mobile information system within the Leicestershire Constabulary, the UTAUT factors were taken into consideration and survey questions were developed from statements from Fig. 2.4.5. It was also important that the demographic profile of users were considered when evaluating the mobile information system within the Leicestershire Constabulary.
Figure 2.4.5: Potential mobile information system survey items from the UTAUT model

<table>
<thead>
<tr>
<th>Performance expectancy</th>
<th>Effort expectancy</th>
<th>Attitude toward using the technology</th>
<th>Social influence</th>
<th>Facilitating conditions</th>
<th>Self-efficacy</th>
<th>Anxiety</th>
<th>Behavioural intention to use the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>U6: I would find the system useful in my job</td>
<td>EOU3: My interaction with the system would be clear and understandable</td>
<td>AT1: Using the system is a bad/good idea</td>
<td>SN1: People who influence my behaviour think that I should use the system</td>
<td>PBC2: I have the resources necessary to use the system</td>
<td>I could complete a job or task using the system</td>
<td>ANX1: I feel apprehensive about using the system</td>
<td>BI1: I intend to use the system in the next (&lt;n&gt;) months</td>
</tr>
<tr>
<td>RAO: Using the system enables me to accomplish my job more effectively</td>
<td>EOU5: It would be easy for me to become skilled at using the system</td>
<td>AT2: The system makes work more interesting</td>
<td>SN2: People who are important to me think that I should use the system</td>
<td>PBC3: I have the knowledge necessary to use the system</td>
<td>SE1: If there was no one around to tell me what to do as I go</td>
<td>ANX2: It scares me to think that I could lose a lot of information using the system by hitting the wrong key</td>
<td>BI2: I predict I would use the system in the next (&lt;n&gt;) months</td>
</tr>
<tr>
<td>RAO5: Using the system increases my productivity</td>
<td>EOU6: I would find the system easy to use</td>
<td>AF2: Working with the system is fun</td>
<td>SN2: People who are important to me think that I should use the system</td>
<td>PBC5: The system is not compatible with other systems I use</td>
<td>SE4: If I could call someone for help if I got stuck</td>
<td>ANX3: I hesitate to use the system for fear of making mistakes I cannot correct</td>
<td>BI3: I plan to use the system in the next (&lt;n&gt;) months</td>
</tr>
<tr>
<td>OE7: If I use the system, I will increase my chances of getting a raise</td>
<td>EU4: Learning to operate the system is easy for me</td>
<td>Affect: I like working with the system</td>
<td>SF2: The senior management of this business has been helpful in the use of this system</td>
<td>FC3: A specific person (or group) is available for assistance with system difficulties</td>
<td>SE6: If I had a lot of time to complete the job for which the software was provided</td>
<td>ANX4: The system is somewhat intimidating to me</td>
<td></td>
</tr>
</tbody>
</table>

Whilst other user acceptance models only succeed in explaining a small percentage of user intentions to use particular information technologies (only 50 per cent) Venkatesh et al claim it is proven to be 70 per cent accurate at predicting user acceptance of information technology\(^\text{67}\). The model has been robustly tested in large organisations with users engaged in both voluntary and mandatory use of technology.

Research by El-Gayar & Moran applied UTAUT within an educational setting to evaluate student’s acceptance of a tablet personal computer (TPC)\(^\text{68}\). A survey was administered to 263 students who were using or considering purchasing a TPC; the survey contained questions related to the UTAUT

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\(^{66}\) Venkatesh et al, ref. 7, p. 460.

\(^{67}\) Ibid., p. 460.

\(^{68}\) El-Gayar & Moran, ref. 64.
elements. UTAUT was found to successfully predict the acceptance of TPCs, thereby allowing an explanation of the usage pattern of TPCs in an educational setting.

Table 2.4.2 summarises the empirical research that applies the UTAUT, as discussed above.

<table>
<thead>
<tr>
<th>Author</th>
<th>Context of study (including type of technology)</th>
<th>Participants</th>
<th>Newness of technology</th>
<th>Number of points of measurement</th>
<th>Cross-sectional or longitudinal analysis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>El-Gayar &amp; Moran&lt;sup&gt;69&lt;/sup&gt;</td>
<td>To explain the usage pattern of tablet computers in education</td>
<td>263 full-time first and second year students</td>
<td>Participants were new to the technology</td>
<td>One (a web-based survey)</td>
<td>Cross-sectional</td>
<td>Attitude towards using technology had the greatest effect towards acceptance; UTAUT factors found to successfully predict the acceptance of tablet computers.</td>
</tr>
<tr>
<td>Conspicuity Innovate&lt;sup&gt;70&lt;/sup&gt;</td>
<td>To investigate key factors that contribute to variations in MDT usage</td>
<td>Senior police officers and IT staff, frontline officers.</td>
<td>Participants had already had some use of the technology</td>
<td>One (interviews and observations)</td>
<td>Cross-sectional</td>
<td>Officers viewed MDTs positively but were hampered from using due to usability (poor effort expectancy) and poor communication pathways between tiers in the organisation (facilitating conditions).</td>
</tr>
</tbody>
</table>

2.4.6 Applied Technology Models in Policing

Despite widely documented research regarding technology acceptance, and claims that information technology is having one of the greatest influences on police practices<sup>71</sup>, it is claimed that similar research within a policing context appears to be lacking<sup>72 73</sup>. Colvin & Goh<sup>74</sup> developed a basic

<sup>69</sup> El-Gayar & Moran, ref. 64.
<sup>70</sup> Conspicuity Innovate, ref. 81.
<sup>71</sup> Manning, ref. 9, p. 362.
<sup>72</sup> Chan, ref. 10, p. 157.
Chapter Two: Critical Literature Review

A theoretical model to explain why police officers embraced or rejected mobile data terminals via a questionnaire and observations. They found that ease of use was the most important factor regarding take-up, with information quality and timeliness as the most important components due to the nature of police work. The research seemed to only take into consideration, however, the system factors affecting technology acceptance in the same way previous research did not address external variables. Similarly, research by Bouwman & van de Wijngaert found that the TAM is too general to predict intention to use mobile technologies by Dutch police officers. They found that the most important factors related to the context of the task and the relevance of the information, rather than perceived ease of use and perceived usefulness. However, these findings do not relate to wider organisational factors, and their research was based in a different context to UK policing (the Dutch police), and only used a questionnaire to investigate intention to use mobile technologies. Colvin & Goh recommend that future studies deal with ‘the relationship between biographical and personality variables and management practices and the TAM factors’. This has been addressed to some extent by Lin et al, where they assessed factors affecting the acceptance of a single interface technology known as COPLINK and related these findings to the TAM. The study identified factors such as the influence of an officer’s peers on their decision to adopt COPLINK. Although the study recognises the influence of external organisational factors within a policing context, the research does not evaluate the TAM but instead relates findings to the TAM. The study is also limited in that the findings are only applicable to one particular technology, which may not be true for the acceptance of mobile technology. In parallel, Straus et al find that end user involvement, management support and championing can strongly determine the usage of handheld BlackBerry devices by law enforcement units.

In the Sussex Constabulary, the UTAUT was applied as a framework for understanding the effect that participants’ experiences had on the variation in use of mobile data terminals (MDT). The UTAUT elements were applied as follows: performance expectancy was used to highlight what the MDT was and would like to be used for; effort expectancy brought to light the usability issues associated with the MDT; social influence emphasised who had a positive or negative impact on MDT usage and facilitating conditions stressed the issues related with training, support and general attitudes towards information technology. The research found that MDTs can help achieve gains in job performance using particular operational information systems but officers were hampered from doing so due to usability issues and organisational communication issues between tiers in the organisation, as represented in Figure 2.4.6.

74 Colvin & Goh, ref. 6, p. 90.
75 Ibid., p. 94.
77 Ibid., p. 194.
78 Colvin & Goh, ref. 6, p. 94.
79 Lin et al., ref. 73, p. 30.
The findings of this research provide evidence that the UTAUT may be beneficial in application to a currently under-researched context of policing and to verify whether key issues affecting usage of MDTs in the Sussex Constabulary are prevalent within the Leicestershire Constabulary. This may allow other organisations to prepare for and mitigate such issues when undertaking a similar project. The more important focus may be external factors that are currently not considered in the TAM and UTAUT, such as organisational culture and management style. Consequently, the UTUAT was considered for application within the Leicestershire Constabulary. However, since the TAM is more robust and more widely applied that the UTUAT, the TAM was the main theory selected for the research,

4.2 Prioritising factors within the UTAUT model

The UTAUT model is redrawn for MDT usage. The factors affecting MDT usage are prioritised 1, 2, 3, with 1 (highlighted in red) being the considered priority.

<table>
<thead>
<tr>
<th>Performance expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Implement new applications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effort expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduce lag in attempts</td>
</tr>
<tr>
<td>2. Fine tune the interface</td>
</tr>
<tr>
<td>3. Improve log off time out</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Develop protocols for MDT use so that supervisors (control room and frontline) have clarity about how to influence use.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitating conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Improve reliability</td>
</tr>
<tr>
<td>2. Develop MDT user group</td>
</tr>
<tr>
<td>3. Fix problems faster</td>
</tr>
<tr>
<td>4. Use Patrol to communicate with officers about MDTs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderating factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night / day</td>
</tr>
<tr>
<td>Urban / rural</td>
</tr>
<tr>
<td>Crewing</td>
</tr>
</tbody>
</table>

Increased usage intention
Improved behavioural intention

Figure 2.4.6: Summary of key issues affecting usage of MDTs in the Sussex Constabulary – empirical application of UTAUT research

Norman & Allen investigated the initial impacts of the introduction of mobile information technologies into a UK police force and suggested that there has been relative neglect in the literature on the potential opportunities and challenges posed by mobile information technologies. Similarly, Greene notes that evaluations in law enforcement organisations have focused almost exclusively on change outcomes, such as crime reduction, response time, while ignoring the process of change itself. This sentiment is to some extent addressed in related work by Agrawal et al., Nulden and Pica et al., but it

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83 Ibid., p. 46.
87 Nulden, U. Police patrol mobility: abstract of paper presented at the Case Western Workshop on Ubiquitous Computing, 24-26 October 2003. <http://weatherhead.case.edu/pervasive/participants_one.htm>, 01.02.05. [accessed 11.06.08].
appears relatively little is known about how mobilising a policing information environment impacts on working practice and processes. Vaast and Walsham comment that we can be confident there is an impact from the introduction of ICT into the workplace but there is little understanding of how this affects working practices. Edwards suggests that ‘police cannot keep away from technology to improve processes and provision to customers’. A common theme in the small amount of literature available is it is not the technologies alone that need to be analysed - Sorensen suggests ‘a need to take account of the actualities of human interaction’, in addition to the evaluation of information and knowledge processes. Agrawal et al have conducted research into the impact of mobile information technology in police work, but this work is limited in that it only studies the impact with regards to patrol cars; as usage increases throughout the force, it is likely to trigger further changes in working practices. Norman and Allen recommend further data are necessary on the nature, use and issues surrounding mobility, and suggest ‘further real-life studies of this nature would allow the issues identified in this study to be extended and further explored’. They also comment that such evaluations could lead to examination of the factors which affect the use of technology by police officers and the implications this has for managing user acceptance. Allen and Wilson explore these recommendations in their longitudinal empirical study into the use of mobile devices in the Surrey Constabulary using a grounded theory approach, demonstrating the complexity of social and organisational issues related to the mobilisation of information technology. However, the work only observed use of mobile devices in police stations and not in the field, so may lack valuable information regarding working practices.

2.4.7 Conclusions

The literature review has approached the concept of mobilising information and knowledge processes from three perspectives: information literacy, data quality and technology acceptance. The information literacy and data quality perspectives were used in this study inform the interface design of future police information systems that are used within a demanding mobile information environment. The technology acceptance perspective was applied to contribute towards a current gap in the literature regarding an understanding of the factors that affect adoption of mobile information technologies in a policing environment. In light of a growing trend towards mobile information and knowledge management and a governmental drive for police forces to implement such a concept, this is of particular importance and relevance. In doing so, both approaches can contribute towards optimising the impact of the

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90 Agrawal et al, ref. 86, p. 87.
91 Norman & Allen, ref. 84, p. 224.
92 Ibid., p. 224.
94 Ibid., p. 33.
mobilisation of the information and knowledge environment of the Leicestershire Constabulary. There has been little work conducted into these two areas in a policing context. However, the existing literature has helped in informing the methods and the design of the research, thus addressing the first objective of the research. Based on the findings of the literature review some final conclusions can be drawn regarding the present research on mobilising information and knowledge environments within the arena of policing. The current literature suggests a need to investigate the impact of mobile technologies on existing knowledge sharing practices, existing business processes, user acceptance and the implications of mobile technology for data quality and information literacy. These areas are discussed further in Chapter three.
Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

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Introduction

Aims

Objectives

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Literature Review: Knowledge Management: Background Context

Chapter 2.2
Literature Review: Knowledge Management: Structure

Chapter 2.3
Literature Review: Knowledge Management: Technologies

Chapter 2.4
Literature Review: Technology Acceptance Theories

Chapter 3
Research Methods

Chapter 4:
Developing an evaluation framework to select mobile technology

Chapter 5:
Adaptation of the technology acceptance model for policing

Chapter 6:
The impact of mobile technology on knowledge sharing in policing

Chapter 7:
Implications of mobile access to information systems for data quality and information literacy

Chapter 8:
The impact of mobile technology on business processes

Chapter 9:
Overall discussion

Chapter 10
Conclusions, Research Limitations and Recommendations

Future Research
Chapter Three: Methodology

Chapter Preface

The manner in which the research aims and objectives are achieved depends on the research philosophy to which the researcher subscribes. The research methodology consequently underpins and affects the choice of research methods. The purpose of this chapter is to discuss the research philosophy in relation to other philosophies and justify the choice of research methodology and research methods to collect sufficient data to fulfil the objectives of the research.

3.1 Definitions

3.1.1 Research methodology

Methodology is theory of how the research should proceed - ‘a way of thinking about social phenomena’. Similarly, Brewerton and Millward suggest that it is ‘a system of methods used in the study of a particular phenomenon’.

3.1.2 Research philosophy or paradigm

Crotty states the research philosophy is ‘the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria’. It is the underlying assumptions that determine the way in which data about a research area should be gathered, analysed and used. Justification of the underlying philosophy for the research is given in section 3.4.

3.1.3 Research approach

The research approach prescribes the way in which data are collected for the research project; an overall pragmatic perspective on the task, rather than just the choice of a particular research method. The research approach can either be constructive, nomothetic or idiographic. Further discussion of the chosen research approach is given in section 3.5.

3.1.4 Research methods

These are the techniques and procedures that are used for gathering and analysing the data. A full discussion and justification of the selected research methods can be found in section 3.6.

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3 Crotty, M. The foundations of social research: meaning and perspective in the research process, 1998, p. 3.
4 Walliman, N. Your research project, 2005, p. 188.
5 Cornford, T. Smithson, S. Project research in information systems, 2006, p. 65.
3.1.5 Research techniques or tools

The actual mechanisms that will be used to collect and record the data, such as interview frameworks and observation matrices.\(^7\)

3.2 Introduction

The conclusions from Chapter Two can be divided into two main categories of: 1. research opportunities, and 2. methodological issues, as provided below. These categories are discussed in more detail in the following sections.

3.2.1 Research Opportunities

The literature provides little evidence of research with regard to optimising and evaluating the impact of mobilisation within a policing context. Hence, the research focuses on providing further knowledge to seek to close the gap in the literature by investigating the following particular areas, which stem from the aim and objectives of the research:

- How can various mobile solutions be evaluated in an objective manner?
- What impact does mobilising information and knowledge processes have on knowledge sharing practices within police organisations?
- What factors affect the acceptance of technology amongst police officers and how does this change over time?
- How do these factors relate to existing theoretical models on user acceptance?
- What are the implications of mobilisation for information literacy, data quality and input, accuracy and retrieval?
- What impact does mobile technology have on existing policing processes?
- What lessons can be learnt from the mobilisation of a police information and knowledge environment by the Constabulary and other police forces in order to optimise the implementation of mobile technology and maximise benefits?
- How do these findings compare with those of other organisational contexts that are using mobile technology?

In order to fulfil the objectives of the research, a partly action research approach and partly ethnographic approach is adopted, using a multi-method data collection procedure. The ethnography part of the research was necessary to acquire an in-depth understanding of the organisational culture and processes. Once this understanding had been acquired, the action element of the research could proceed.

The remainder of this chapter discusses the justification for the overall research philosophy and approach adhered to, and the multiple data collection and data analysis activities used to collect sufficient questions to answer the aims and objectives of the research.

3.3 The Research Design

Figure 3.1.1 demonstrates the hierarchy and the research philosophy, research methodology, research method and research techniques, which comprise the design and framework of the research.

3.4 Research Philosophy

As previously discussed, a research philosophy is a worldview that informs the methodology and methods and guides the research efforts\(^8\)\(^9\)\(^10\). There are various philosophies within research and all are encompassed by what is known as epistemology: what is regarded as acceptable knowledge in a discipline\(^11\). The term epistemology is from the Greek episteme, ‘knowledge’ and logos, theory’, or the theory of knowledge. It is the area of philosophy that deals with knowledge and related concepts like justification and reality\(^12\) i.e. what is and is not true. Within the science discipline, there are two major research philosophies known as positivism and interpretivism\(^13\).

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\(^9\) Corbin & Strauss, ref. 1, p. 1.
\(^10\) Crotty, ref. 3, p. 18.
\(^13\) Bryman, ref. 10, p. 11.
3.4.1 Positivism

Positivism can be defined as ‘the branch of philosophy that emphasises the observable and factual over the theoretical or metaphysical’\(^\text{14}\). Bryman suggests that positivism is the epistemological position that ‘advocates the application of the methods of the natural sciences to the study of social reality’\(^\text{15}\). It entails arriving at knowledge through the gathering of facts that provide the basis for laws and suggests science must be conducted in an objective manner\(^\text{16}\), for example through scientific observation. Similarly, Cornford & Smithson explain that positivists believe all the knowledge obtained is based on the observation of phenomena in an objective and real world, which gives rise to facts that cannot be disputed\(^\text{17}\). This is because the facts are seen to have no embedded social values and will constantly remain to be true, as observations should be repeatable\(^\text{18}\). Galliers suggests that the issues arising from research within the Information Science domain, such as the apparent inconsistency of results and highly subjective nature of social science, do not accept the distinguishing features of positivism\(^\text{19}\). It is worth noting though, that this statement is not true for all contexts of research within the Information Science domain. Browne suggests that ‘there is a continuing use of positivistic methodologies to analyse the field of information policy’\(^\text{20}\) within Information Science, and that positivism ‘will continue to provide methodological orientations for aspects of the social sciences until the newer doctrines emerge in more finished form’\(^\text{21}\). However, the viewpoint of positivism seems to be inappropriate for the subjectiveness associated with social objects involved in this research. This calls for a new perspective that can be seen as the opposite of positivism, with a focus on culture, society and communication, known as interpretivism.

3.4.2 Interpretivism

Interpretivists (or anti-positivists) argue that the clear distinction between facts and value cannot be accepted. Instead, facts are seen as being affected by values, which cannot be separated and so the two are linked\(^\text{22}\). Cornford and Smithson suggest ‘all knowledge, including scientific knowledge, is socially constructed and therefore conditioned by the values of society that gives rise to them’\(^\text{23}\). Furthermore, Crotty proposes that the gathering of opinions, beliefs, feelings and assumptions gained in non-scientific ways contrasts sharply with the scientific gathering of facts through the positivist approach\(^\text{24}\).

The types of research problems investigated in the field of social sciences do not fall comfortably within the parameters of natural science, as they tend to involve unknown variables and theories, and

\(^{15}\) Bryman, ref. 11, p. 12.
\(^{16}\) Ibid., p. 12.
\(^{17}\) Cornford & Smithson, ref. 5, p. 59.
\(^{18}\) Ibid., p. 59.
\(^{22}\) Cornford & Smithson, ref. 5, p. 60.
\(^{23}\) Ibid., p. 60.
\(^{24}\) Crotty, ref. 3, p. 27.
can be highly value and meaning-laden\textsuperscript{25}. Thus, interpretivist research is more appropriate enabling the researcher to understand a socially constructed reality, rather than generating scientific facts\textsuperscript{26}; the assertion that human behaviour can be codified in laws is rejected\textsuperscript{27}. The reality drawn from the interactions and interpretations of people is always shifting, so long-term fixed conclusions from research cannot be drawn. Results and their tentative conclusions only point to a specific point in time.

More importantly, Cornford & Smithson note that interpretivism is normally focused in a specific context, for example a particular organisation or industry, meaning that the results are not applicable across other contexts\textsuperscript{28}. Interpretivists contend that the researcher is ‘inextricably bound into the human situation which he or she is studying’\textsuperscript{29} and society cannot be studied from a detached and objective viewpoint.

Table 3.4.1 provides an explanation of the distinguishing features between the objectivist/ positivist approach and the interpretivist philosophies. This was useful in determining the philosophy of the research.

<table>
<thead>
<tr>
<th>Table 3.4.1: The alternative bases for interpreting social reality\textsuperscript{30}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Philosophical basis</strong></td>
</tr>
<tr>
<td>Realism: the world exists and is knowable as it really is</td>
</tr>
<tr>
<td>Organisations are real entities with a life of their own</td>
</tr>
<tr>
<td><strong>The role of social science</strong></td>
</tr>
<tr>
<td>Discovering the universal laws of society and human conduct within it</td>
</tr>
<tr>
<td><strong>Basic units of social reality</strong></td>
</tr>
<tr>
<td><strong>Theory</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{25} Walliman, ref. 4, p. 202.
\textsuperscript{26} Cornford & Smithson, ref. 5, p. 60.
\textsuperscript{27} Walliman, ref. 4, p. 205.
\textsuperscript{28} Ibid., p. 205.
\textsuperscript{29} Walliman, ref. 4, p. 205.
approach would be more suitable. The rationale for this is that the aim of the research requires concepts and findings to emerge from field data regarding information literacy, knowledge sharing, business processes and user acceptance. Mobile technology was not previously implemented into the Leicestershire Constabulary meaning that conclusions cannot be drawn from previous data and so the researcher must become immersed in the implementation and evaluation process in order to collect data and draw conclusions. The Leicestershire Constabulary may be viewed as a social environment rather than a laboratory environment, with many changing factors, which may affect the research findings (see Table 3.4.1). For example, since humans make their own conscious decisions about what knowledge they choose to share and what factors influence their choice of technology, pursuing the aim of the research under the positivist approach would not produce results generalisable outside similar types of organisations. Furthermore, policing organisations exist in a dynamic environment where the context of information available within systems and existing as tacit knowledge is constantly changing. This suggests that the results collected regarding the research objectives will not be consistent to those collected at another point in time, thus rejecting positivism. The research seeks to provide understanding of the impact of mobilising information and knowledge process and does not seek to form hypotheses or draw conclusions from a sample population. Positivism focuses more on generating quantitative experimental data rather than generating underlying attitudes and qualitative data. As previously stated, the interpretivist approach focuses on specific organisational contexts that are not widely applicable to other industries. Since the research focus is on the Leicestershire Constabulary, the interpretivist approach is more relevant than positivism.

Denscombe suggests understanding of values and opinion is usually arrived at through the use of qualitative methods. However, as suggested in section 3.2.2 the researcher is bound to the research and must interpret the findings. Therefore it is important that this is done by imposing as little bias as possible into the interpretation and reporting the findings as they appear. It may be possible to achieve this by recording any preconceptions or knowledge about the findings prior to the data collection stage of the research. These preconceptions can be then compared to the interpreted findings to assess whether existing knowledge has influenced any outcomes. However, this may not guarantee that bias is eliminated completely, as some previous knowledge may be applied to the findings subconsciously.
3.5 Research Approach

As discussed in section 3.1, a research approach prescribes the way in which data are collected for the research project. There are various options to collect the data thus the most appropriate approach must be selected to fulfil the research objectives. There remains an element of choice about which approach to use, and this largely depends on the type of data to be obtained and practical considerations related to time and resources\(^{32}\).

This section summarises the various approaches available and is followed by a justification of the choice of approach.

3.5.1 Research approaches used in previous research

The literature review has identified a small number of relevant research studies that relate to the aim of this research. The majority of these studies appear to adopt a case study approach involving multi-method including interviews, observations and survey instruments (see Table 3.5.1).

\(^{32}\) Denscombe, M. The good research guide for small-scale social research projects, 2003, p. 131.
Table 3.5.1: Summary of approaches employed in the literature

<table>
<thead>
<tr>
<th>Author</th>
<th>Details of study</th>
<th>Approach used</th>
<th>Data analysis used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norman &amp; Allen&lt;sup&gt;33&lt;/sup&gt;.</td>
<td>Investigation into the initial impacts of the introduction of mobile information and communications technology into a UK police force&lt;sup&gt;34&lt;/sup&gt;.</td>
<td>Interpretivist case study approach: 14 semi-structured interviews with criminal investigation dept., scene of crimes officers, project manager and senior management; observations in call-handling centre and in criminal investigation department and on-site with scene of crimes officers&lt;sup&gt;35&lt;/sup&gt;.</td>
<td>Atlas software used to develop and organise transcribed interview data into categories&lt;sup&gt;36&lt;/sup&gt;.</td>
</tr>
<tr>
<td>Agrawal et al&lt;sup&gt;37&lt;/sup&gt;.</td>
<td>Exploration of how mobile information technologies have improved critical factors that affect the work environment of officers within a US police department&lt;sup&gt;38&lt;/sup&gt;.</td>
<td>Positivist survey instrument used with a five point Likert scale. The instrument was piloted on 30 officers to verify survey items and then completed by 153 police officers&lt;sup&gt;39&lt;/sup&gt;.</td>
<td>Quantitative data analysis.</td>
</tr>
<tr>
<td>Colvin &amp; Goh&lt;sup&gt;40&lt;/sup&gt;</td>
<td>Exploration of why patrol officers embraced or rejected computer technology i.e. mobile data terminals, in order to validate the TAM in a policing context&lt;sup&gt;41&lt;/sup&gt;.</td>
<td>Survey instrument along with observation data to determine factors affecting user acceptance and amount of time-savings associated with introduction of laptop computers in patrol cars. Sample involved 430 patrol officers within a large west coast US city&lt;sup&gt;42&lt;/sup&gt;.</td>
<td>Quantitative data analysis&lt;sup&gt;43&lt;/sup&gt;.</td>
</tr>
<tr>
<td>Hughes &amp; Jackson&lt;sup&gt;44&lt;/sup&gt;</td>
<td>Exploration into how knowledge management initiatives have been implemented over the past ten years in the West Australia Police Service&lt;sup&gt;45&lt;/sup&gt;.</td>
<td>Reflective interpretivist case study, as one of the authors had worked in a police force for 22 years, along with internal interviews with 4 managers, 4 crime analysts and 8 operational officers and an analysis of documents&lt;sup&gt;46&lt;/sup&gt;.</td>
<td>Qualitative data analysis.</td>
</tr>
<tr>
<td>Northrop&lt;sup&gt;47&lt;/sup&gt;</td>
<td>Addresses factors affecting the extent of computer use by police&lt;sup&gt;48&lt;/sup&gt;.</td>
<td>Positivist survey instrument; data drawn from the URBIS project, a multi-year study of computerization in U.S. local governments, of which 940 police officers and 820 detectives were sampled&lt;sup&gt;49&lt;/sup&gt;.</td>
<td>Quantitative data analysis.</td>
</tr>
<tr>
<td>Consipicuity Innovate&lt;sup&gt;50&lt;/sup&gt;</td>
<td>Investigation of key factors that contributes to variations in MDT usage.</td>
<td>Interpretivist interviews and observations with senior police officers, IT staff and frontline officers.</td>
<td>Qualitative and quantitative data analysis.</td>
</tr>
</tbody>
</table>

3.5.2 Selection of Research Approach

In order to collect the data, consideration should be given to the philosophy of the research and the context in which the data is collected. Iivari\textsuperscript{51} offers three general approaches to aid the prescription of a research approach:

1. **Constructive research approaches** such as conceptual development and technical development. Constructive approaches are associated with developing frameworks, refining concepts or pursuing technical developments. A framework is not necessary to collect the data for the research so constructive research methodologies are rejected.

2. **Nomothetic research approaches**, such as formal-mathematical analysis, field and laboratory experiments and field studies and surveys. This broad type of research approach involves exploring empirical data in order to test hypotheses of a general character. The impetus is to collect data and undertake analysis in such a manner as to provide general insight, for example conducting an experiment as to stimulate a range of conditions found in multiple locations throughout the world. Crotty\textsuperscript{52} suggests that the nomothetic approach is looking for consistencies, regularities or ‘the law’ (‘nomos’). This approach is rejected, as it suggests a positivist viewpoint and the research is based in one organisational setting rather than multiple locations.

3. **Idiographic research approach**, for example case studies and action research. This broad type of research approach involves the exploration of particular cases or events and providing the richest picture of what emerges. The aim is to understand events and phenomena in their own particular context. Idiographic research places emphasis on the analysis of qualitative and subjective accounts based on participation or close involvement with everyday events\textsuperscript{53}. Crotty implies that idiography is associated with human affairs and an individual case (‘idios’)\textsuperscript{54}. This can be paralleled with Interpretivism. As the unit of analysis for the research is a single organisation, the Leicestershire Constabulary, rather than multiple comparative units of analysis, idiography is the most suitable approach to collect the data.

Table 3.5.2 presents a list of approaches available identified by Cornford & Smithson\textsuperscript{55}, indicating which research philosophy they belong to.

\textsuperscript{52} Crotty, ref. 3, p. 67.
\textsuperscript{53} Cornford & Smithson, ref. 5, p. 67.
\textsuperscript{54} Crotty, ref. 3, p. 67.
\textsuperscript{55} Cornford & Smithson, ref. 5, p. 68.
### Table 3.5.2: Research Approaches

<table>
<thead>
<tr>
<th>Philosophy</th>
<th>Broad method/approach</th>
<th>Specific Approach</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivist</td>
<td>Constructive</td>
<td>Frameworks</td>
<td>A prescribed sequence of events that can be applied when undertaking a particular piece of research e.g. evaluation of systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theorem proof</td>
<td>Use of formulae and procedures that can be applied to represent a problem.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prototyping</td>
<td>A typical instance of a solution is produced and can be tested before producing the final working version.</td>
</tr>
<tr>
<td>Nomothetic</td>
<td>Laboratory experiments</td>
<td></td>
<td>The researcher manipulates some variables and observes the results. However, the laboratory setting and identified relationships may not be applicable to real-world contexts.</td>
</tr>
<tr>
<td></td>
<td>Field experiments</td>
<td></td>
<td>Experiments conducted in real organisations, thereby increasing the reality of results. However, few organisations are willing to undergo experiments and it can be difficult to control variables.</td>
</tr>
<tr>
<td></td>
<td>Surveys</td>
<td></td>
<td>Obtain views and practices at a single point of time and draw conclusions from the sample to the whole population using quantitative analysis techniques.</td>
</tr>
<tr>
<td></td>
<td>Case studies</td>
<td></td>
<td>Phenomena are studied in its real-life context without interfering with the phenomena.</td>
</tr>
<tr>
<td></td>
<td>Forecasting</td>
<td></td>
<td>Uses quantitative techniques such as regression analysis to provide insights into future events where variables may change, such as predicting the level of sales.</td>
</tr>
<tr>
<td>Interpretivist</td>
<td>Idiographic</td>
<td>Action research</td>
<td>Where the researcher participates with the subjects in the problem situation, rather than taking the role of observer. The problem usually results in change. Data is collected during the participation to provide practical value to an organisation and the researcher uses the data relate to theoretical knowledge.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Case studies</td>
<td>An in-depth exploration of one situation, for example to address the implementation of a new accounting system in a particular organisation. Yin defines the purpose of the method is to ‘cope with the technically distinctive situation in which there will be many more variables of interest than data points’.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethnography</td>
<td>Where the researcher is immersed in an organisation and interprets the viewpoints of members of that setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures research</td>
<td>See forecasting.</td>
</tr>
</tbody>
</table>

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56 Ibid., p. 70.
58 Cornford & Smithson, ref. 5, p. 73.
59 Ibid., p. 71.
61 Bryman, ref. 11, p. 291.
Chosen approaches: Action research & Ethnography

The research adopts a combination of action research and ethnography. As explained in section 3.2.1, as a researcher new to the organisation, the ethnography part of the research was necessary to understand the workings of the organisation. Had the research been undertaken by an employee within the Constabulary, the ethnographic elements of the research in Table 3.5.2 may have been less crucial.

Table 3.5.3 provides explanation for the approach used for each element of the research. The following section discusses the two approaches and their relevance to the research.
Table 3.5.3: Selected research approaches for this study

<table>
<thead>
<tr>
<th>Objective no.</th>
<th>Research Objective</th>
<th>Philosophy</th>
<th>Broad method/approach</th>
<th>Specific Approach</th>
<th>Brief justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Understand organisational context of policing and specifically the Leicestershire Constabulary</td>
<td>Interpretivist Idiographic</td>
<td>Ethnography</td>
<td>Necessary to be immersed in the organisation and interpret observations within the organisation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Investigate the impact of mobile technology on existing information and knowledge sharing practices within the Constabulary</td>
<td>Interpretivist</td>
<td></td>
<td>Ethnography</td>
<td>Data collected via an ethnographic approach to understand how data is measured and how officers search and input information.</td>
</tr>
<tr>
<td>7</td>
<td>Investigate the implications of mobile access to information systems for data quality and information literacy</td>
<td></td>
<td></td>
<td></td>
<td>Partly ethnographic approach to collect the necessary data, as participants were interviewed and observed in order to understand the key factors.</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate police acceptance of mobile technology</td>
<td>Action research</td>
<td></td>
<td></td>
<td>Partly action research approach, as the findings were applied practically to enhance user acceptance. This also resulted in a change to existing scientific knowledge by adapting previous user acceptance theoretical models.</td>
</tr>
<tr>
<td>3</td>
<td>Develop an evaluation framework to enable police forces to select the solution that best matches their information and knowledge needs and user requirements</td>
<td></td>
<td></td>
<td></td>
<td>Necessary to participate in the decision-making exercise of selecting a mobile solution via application of the framework.</td>
</tr>
<tr>
<td>8</td>
<td>Determine the impact that the implementation of mobile technology has had on business processes within the Constabulary</td>
<td></td>
<td></td>
<td></td>
<td>A series of lessons learned and guidelines were produced from this element of research, which other police forces can practically apply during the implementation process.</td>
</tr>
<tr>
<td>6</td>
<td>Investigate the impact of mobile technology on existing information and knowledge sharing practices within the Constabulary</td>
<td></td>
<td></td>
<td></td>
<td>This element of research will also help build the theories with regard to the impact of mobile knowledge management, which is a relatively new area of research within the context of policing.</td>
</tr>
</tbody>
</table>
Justification for selection of action research

Shani & Pasmore provide a definition of action research as:

‘an emergent inquiry process in which applied behavioural science knowledge is integrated with existing organisational knowledge and applied to solve real world problems. It is simultaneously concerned with bringing about change in organisations...and adding to scientific knowledge. Finally it is an evolving process that is undertaken in a spirit of collaboration and co-inquiry’.

Action research ‘rests on the belief and experience that all people accumulate, organise and use complex knowledge in everyday life’. Both definitions draw attention to the relevance of action research for the organisational problem of implementing mobile technology into the Leicestershire Constabulary, whereby scientific knowledge from the fields of knowledge management, technology acceptance and information retrieval can be applied to optimise the impact of mobile technology on organisational processes and practices. The action research approach is believed to originate from the work of Kurt Lewin, who envisaged a process whereby research would be conducted with the aim of achieving a certain goal. Lewin set the stage for solving real-life problems and shifted the role of the researcher from being a distant observer to involvement in direct problem-solving.

The process of conducting action research can be conducted as shown in Figure 3.5.1:

![Figure 3.5.1: The process of conducting action research (adapted from Greenwood & Levin)](image)

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64 Ibid., p. 5.
65 Ibid., p. 18.
66 Ibid., p. 4.
There are specific conditions for conducting action research. Greenwood & Levin suggest that action research is composed of three elements, and if any of the three is absent then the process is not action research:

1. Research: action research practitioners advocate the value of knowledge and that action research is one of the most powerful ways to generate new knowledge.
2. Participation: action research involves social researchers who work with members of an organisation to establish the research agenda, generate the knowledge necessary to transform the situation and put the results to work. Action research is therefore a participatory process in which everyone involved shares responsibility for the research.
3. Action: action research aims to alter the initial situation of the organisation: the research and participation bring about change.

The action research approach is the most appropriate for the research, as it helped to develop the existing body of knowledge regarding user acceptance technology, with the specific focus of mobile devices in policing which to date appears to have little understanding available. Participation was applicable to the research, since a pilot study and period of further evaluation of mobile technology was strongly favoured by senior management within the Constabulary, and thus the researcher collaborated with the management to set the research agenda. The latter point is what makes some elements of the research applicable to action research over other relevant methodologies such as case studies and ethnography.

**Justification for selection of ethnography**

Not all elements of the research study met the requirements above. In other cases, ethnography was most relevant. Some elements of the research required collecting data within the Constabulary and interpreting viewpoints of members of the Constabulary, but did not lead to any direct change in the state of the organisation; hence the use of ethnography as a research approach, as defined in Table 3.5.3.

**3.5.3. Mixed Methods**

In addition to whether the research is concerned with the discovery of general laws (nomothetic) or the exploration of an individual case (idiographic), one of the most common distinctions of research approaches is between quantitative and qualitative methods. A key strength of adopting the action research approach is that it allows the researcher to use a variety of sources, a variety of research data and a variety of research methods, sometimes termed triangulation. This means that the researcher can gain a deeper understanding of ‘subtleties and intricacies of complex social situations’ in a way that

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67 Ibid., p. 19.
68 Denscombe, ref. 32, p. 31.
69 Brewerton & Millward, ref. 2, p. 53.
70 Yin, ref. 60, p. 98.
71 Denscombe, ref. 32, p. 38.
is denied to the survey approach. This may be termed a multi-method approach to research, where quantitative and qualitative data is collected. According to Denscombe, differing methods can complement one another, as they produce different kinds of data on the same topic, allowing the researcher to see things from different perspectives than if data is drawn from just one method\textsuperscript{72}. It is important for the researcher to consider which approach to choose (qualitative, quantitative or mixed methods), so that these translate into suitable data collection and analysis strategies. This approach is underpinned by the philosophical traditions; Bryman characterises the differences between quantitative and qualitative research approaches, as shown in Table 3.5.4.

<table>
<thead>
<tr>
<th>Table 3.5.4: Distinctions between quantitative and qualitative research strategies\textsuperscript{73}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative</strong></td>
</tr>
<tr>
<td>Theory</td>
</tr>
<tr>
<td>Epistemological orientation</td>
</tr>
<tr>
<td>Ontological orientation</td>
</tr>
</tbody>
</table>

There is an ongoing debate about the distinctions between quantitative and qualitative data. Quantitative research methods were originally developed in the natural sciences to study natural occurrences, and qualitative research was developed in the social sciences to enable researchers to study social and cultural occurrences\textsuperscript{74}. From this, it may be argued that for the purpose of the research a qualitative approach should be adopted. However, Howe argues that ‘quantitative and qualitative methods are inextricably intertwined’\textsuperscript{75}. Miles and Huberman suggest this ongoing debate is ‘unproductive’\textsuperscript{76}, providing reason to combine the two types of data. Moreover, a multi-method approach to data collection allows findings to be questioned or corroborated by one another; if quantitative survey or observation data suggest one explanation on a topic, this might be corroborated or discarded on the basis of findings from gaining a deeper understanding through use of a qualitative method\textsuperscript{77}. In other words, by doing so it ensures the validation and correctness of findings of the research. Therefore, despite the research being based on a largely qualitative approach, a quantitative aspect in the form of a questionnaire was considered suitable to further satisfy the objectives. Since previous research has combined qualitative and quantitative methods (see table 3.5.1) this was considered appropriate. This research adopts a combination of methods that have been applied in previous research (e.g. interviews, surveys and observation). The research seeks to add further to the existing body of knowledge by also applying methods that appear to have been scarcely applied to similar studies within this research.

\textsuperscript{72} Ibid., p. 132.
\textsuperscript{73} Bryman, ref. 11, p. 20.
\textsuperscript{74} Myers, M. D. Qualitative research in information systems. MIS Quarterly, 1997, 21(2), 241.
\textsuperscript{75} Howe, K. R. Against the quantitative-qualitative incompatibility thesis or dogmas die hard. <http://dirwww.colorado.edu/education/faculty/kennethhowe/Docs/Howe_Against_the_Quant_Qual_Incompatibility_Thesis.pdf>, 1988, [accessed 30.10.08].
\textsuperscript{76} Miles, M. B. & Huberman, M. Qualitative data analysis: an expanded sourcebook, 1994, p. xx.
\textsuperscript{77} Ibid., p. 133.
context. These include focus groups and observational ‘work shadowing’ in order to identify more in-depth qualitative data and provide a greater understanding of the truth. The justification for using each method is given in section 3.6.1.

Table 3.5.4 shows that there are two main types of theory: deductive and inductive. Bryman explains that a deductive theory involves collecting data to answer questions posed by theoretical considerations, whereas an inductive theory involves deriving a theory from the collection and analysis of data\(^78\). An inductive theory approach to the research was taken over a deductive approach because of lack of control over variables, such as the level of computer experience held by officers, information systems accessed and types of incidents attended during observations. Employing an inductive theory strategy allowed an exploratory approach to the research where different aspects of the impact of technology can be investigated\(^79\). An inductive theory approach also conforms to the interpretivist philosophy and the largely qualitative data (see Table 3.5.4).

### 3.6. Research Methods

Table 3.6.1 maps the research methods to objective in order to demonstrate how each objective will be fulfilled. A justification for using each particular method is subsequently given.

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\(^78\) Bryman, ref. 11, p. 4.

\(^79\) Ibid., p. 10.
Table 3.6.1: How the objectives of the research will be achieved - a multi-method approach

<table>
<thead>
<tr>
<th>Objective</th>
<th>Research methods to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To conduct a critical literature review</td>
<td>Literature review to identify what is already known in connection with the research area and any unanswered research questions in order to ensure the work is original. Conducting a literature review will also enable identification of different theoretical and methodological approaches to the research along with any possible theoretical frameworks by which to underpin findings.</td>
</tr>
<tr>
<td>2. To understand the organisational context of policing and specifically of the Leicestershire Constabulary</td>
<td>Observation to gain an understanding of operational business processes and the organisational context Document analysis to study how information is currently gathered and processed e.g. crime recording forms Focus groups to identify the current organisational processes that are used to share information and knowledge and to consider the impact of these organisational processes on the effectiveness and efficiency of the Constabulary Informal open interviews to identify interesting stories related to information and knowledge sharing within the organisation and cultural and management issues that impact on knowledge sharing</td>
</tr>
<tr>
<td>3. To produce an evaluation framework to enable police forces to select the solution that best matches their information and knowledge needs and user requirements</td>
<td>Focus groups with operational officers to identify user requirements for a mobile information system</td>
</tr>
<tr>
<td>4. Evaluate police acceptance of mobile technology</td>
<td>Focus groups, observation and questionnaires to investigate the factors affecting usage and user acceptance</td>
</tr>
<tr>
<td>5 Test the adapted user acceptance model</td>
<td>Semi-structured interviews to identify implementation issues and factors affecting user acceptance with other police forces</td>
</tr>
</tbody>
</table>
| 6. Investigate the impact of mobile technology on existing policing practices within the Constabulary and their knowledge sharing | Focus groups with operational officers to explore the impact of mobile information technologies on work practice, to identify the level of officer usage, and to examine the benefits, opportunities and risks posed, and the impact on knowledge sharing. Observation and work-shadowing exercises were carried out during operational police shifts to evaluate the usage of each MDT device in context in order to indicate the impact of mobile information and how well mobile devices support officer activity, as well as to identify the benefits that participants gained from use of the MDTs Questionnaires were administered to operational officers to develop a profile for each officer of their characteristics and attitudes towards mobile devices and knowledge sharing. Semi-structured interviews to analyse the impact of officer use of MDTs on a selection of stakeholders who are not directly involved in
frontline duties. Therefore, interviews were conducted with staff including section Sergeants, Inspectors and staff from the Control Unit. Interviews were also conducted with other organisations that are recognised for their mobilisation abilities in order to identify best practice beyond the police service.

**Informal open interviews** to identify interesting stories about the use of mobile technology, events that are widely discussed amongst officers with regard to the use of mobile technology and the impact of mobilisation on knowledge sharing.

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3.6.1 Justification for using methods

This section provides a brief justification for the choice of methods used for the study. At the beginning of subsequent Chapters, a more detailed explanation of the deployment of each method is provided.

Focus groups

Focus groups allow a number of domain experts to be gathered together to form opinions about the necessary requirements to make a project such as a mobile information system a success. They usually consist of a small number of people who are brought together by a facilitator to explore attitudes and perceptions, feelings and ideas about a topic. The key advantage of focus groups is that they promote participation, communication and allow the use of a team where each member has a different background of expertise. This may be of benefit when gathering user attitudes and user requirements towards mobile technology, as various individuals from differing operational and technological backgrounds can be brought together to gather a range of data. This may boost creativity and thus provide a more comprehensive discussion than if individuals were interviewed alone; in a group situation ‘many people are prompted to suggest ideas which might not occur to them on their own’. Appendix 2a of this report details the focus group questions that were used to identify user requirements for a mobile information system. Appendix 2c details the focus group questions used during the pilot evaluation study of mobile information technologies within the Leicestershire Constabulary. These data were used to cover the objectives related to understanding the user acceptance factors and the impact on knowledge sharing.

A further series of focus groups was held with officers at a later stage after the initial introduction of mobile technology in order to investigate the impact of mobile technology on inputting and searching for information and on knowledge sharing, as shown in Table 3.6.1. Appendix 2h of this report details the questions that were used during this series of focus groups.

Interviews

A semi-structured interview has a predetermined set of issues to be explored but allows flexibility in terms of the order in which the issues are explored, whereas a structured interview must follow a predetermined order. More importantly, face-to-face semi-structured interviews ‘allow the interviewee to develop ideas and speak more widely on the issues than in a questionnaire’, as interesting responses can be followed up and underlying motives can be investigated more deeply, along with indications from non-verbal cues. However, interviews can produce a non-standardised set of data that can be difficult to analyse because responses are not pre-coded. Qualitative analysis software packages may assist in

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82 Gorman & Clayton, ref. 80, p.143.
83 Denscombe, ref. 32, p. 167.
85 Denscombe, ref. 32, p. 190.
overcoming this problem (outlined in section 3.6.4). Since interviews have open-ended responses and the data are specific to a unique context it may be difficult to achieve reliable information. For this reason, the data were corroborated using other methods. Appendix 2d details the questions that were used in the stakeholder interviews of pilot evaluation study of mobile information technologies within the Leicestershire Constabulary. Appendix 2i contains the questions that were used for the telephone interviews with organisations recognised for their mobilisation abilities and appendix 2j details the questions used to interview senior police officers. Semi-structured interviews were also conducted to cover objectives related to data quality, factors affecting user acceptance within other police forces and impact on business processes (see appendices 2k, Section 5.4.1 and Section 8.1.2 respectively). Due to the open-ended nature of these objectives, it was felt that interviews would allow an in-depth exploration of the issues associated.

**Questionnaires**

Questionnaires appeared commonly within the research methods literature with several definitions. One comprehensive definition is given by Hutton, who states that a questionnaire is ‘the method of collecting information by asking a set of pre-formulated questions in a predetermined sequence in a structured questionnaire to a sample of individuals’. Similarly, Cornford & Smithson suggest that questionnaires enable the researcher to obtain data about practices, situations or views at one point in time. Questionnaires are a popular technique that is normally used to discover people’s attitudes and enable the researcher to identify and describe the variability in phenomena as well as to examine and explain relationships between variables. Robson suggests they can be used to ‘provide a scientific ring of confidence when experiments are not feasible or ethically defensible’. It is argued that a well-designed questionnaire can enhance the researcher’s understanding of the social issue being investigated, and since experiments were not practical for the research (see subsequent section ‘experiments’) and a large amount of qualitative data was being collected, a questionnaire was felt to be suitable. However, it is disputed that they are not an ideal method to answer every research objective, as the data provides snapshots of points in time rather than a focus on underlying processes and changes and relies on breadth rather than depth for validity (hence the need for supplementing qualitative data).

For the research, three questionnaires were administered. The first questionnaire (refer to Appendix 2b) aimed to identify initial usage, attitudes and perceptions towards mobile technology during a two-week pilot of mobile technology that involved police officers operating in the City Centre area. This questionnaire was administered in the pilot study. Having identified the perception and general attitude of mobile technology, a second questionnaire was designed (see Appendix 2f). This sought to establish the perceived level of information literacy amongst police officers and recognise the implications of mobile technology for information literacy skills of police officers. The third questionnaire was designed to

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87 Cornford & Smithson, ref. 5. p. 70.
89 Robson, ref. 84, p. 230.
understand the impact of mobile technology on a wider scale than use of the interviews would have practically allowed (see Section 8.1.2 for details).

With this technique, it is possible to collect data from many people quickly and at relatively low cost. Whereas interviews and focus groups are usually aimed at a relatively small scale of participants, questionnaires allow a wider sample coverage therefore potentially offering more representative data. The sample coverage of the questionnaires is given in the subsequent paragraphs sections (see also section 3.6.3).

A key advantage of questionnaires is that standardised answers remove the scope for variation through face-to-face contact that is offered in focus groups and interviews. This also reduces the likelihood of contaminating responses in the wording of the questions or the manner in which the question is asked, which may help to overcome inconsistencies and bias posed in interviews thus potentially corroborating interview and focus group data. This can also help to achieve a high level of reliability. Therefore, the majority of questions were closed questions. This helps to keep the respondent focused on the important issues and eases comparison. As Dencombe suggests, ‘the value of data is likely to be greatest where respondents provide answers that fit into a range of options offered by the researcher, allowing for speedy analysis and collation of data’. For this reason, multiple-choice answers were the most common closed question type, because they were better suited to ask respondents their level of agreement about an issue. Such answers included the use of a Likert scale, such as how the level of job satisfaction from using mobile technology, or a ‘Yes/No’ option. However, in order to achieve a level of reliability and avoid internal validity issues that can sometimes be a disadvantage of questionnaires, it is important that pre-coded answers contained no bias towards the views of the researchers rather than the respondents’ views, and that they also did not frustrate respondents and deter them from answering. Therefore questionnaires were piloted before administering to the full sample. The questions were also adapted from previous studies in order maintain reliability, and further detail of these questions is given in the subsequent section.

It is argued that it can be difficult to establish a high degree of rapport with respondents in a short space of time, which can prevent respondents from providing truthful responses. To help overcome this issue, care was taken to ensure both questionnaires were clearly structured with the purpose of the survey clearly explained. For example, questions in the first questionnaire (Appendix 2b) were ordered from general to particular, and began with demographic questions (e.g. gender, age, job position, rank, years of policing experience held, perceived level of computer competence) to ease the respondent into the questionnaire. The questions then focused on the attitudes towards mobile technology (e.g. impact on job satisfaction, productivity and ease of use), the usage of mobile technology (e.g. when the technology was used – for all or some of the shift, applications used, situations that technology was most useful, availability of information and level of radio usage), and the general acceptance of mobile technology (e.g. whether would adopt mobile technology for conducting daily tasks, whether would mind if the organisation took away mobile technology and whether the mobile technology should be rolled out.

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91 Ibid., p. 234.
92 Walliman, ref. 4, p. 237.
93 Denscombe, ref. 32, p. 161.
94 Ibid., p. 159.
95 Ibid., p. 159.
96 Robson, ref. 84, p. 231.
across the Force). These questions were based on previous evaluation studies that employed surveys within other policing organisations, including those conducted by Agrawal et al\(^97\), Colvin & Goh\(^98\) and Conspicuity Innovate\(^99\) in order to ensure a level of validity. The questionnaire was issued during focus groups conducted before and after the two-week trial of mobile technology to allow comparison of how expectations compared with reality. A total of 40 responses were gained for this particular questionnaire.

Questions in the second questionnaire (Appendix 2f) were also ordered from general to particular, with questions being split into three sections. The first section aimed to identify the general experience of police officers with searching for information, including personal use of search systems as well as at work (e.g. how often search for information using a computer, search systems used, how often search results are accurate, how many keywords are used and whether advanced search features are utilised). The second section of questions focused more particularly on the workplace experience of police officers with searching for work-related information, and how mobile technology has impacted on the searching experience, along with the level of training provided. This section also included questions on sources of information that officers frequently access and their level of agreement with statements on knowledge sharing within the Leicestershire Constabulary. The third section included demographic related questions, such as gender, rank, years of policing experience held, whether the respondent is currently using mobile technology and the type of mobile technology they are currently using (e.g. mobile data terminal or Blackberry). Demographic related questions were included at the end of the questionnaire to retain the respondent’s focus on answering the questions related to information literacy, and to avoid the respondent becoming disgruntled with answering simple questions. This is an important consideration, as at the time the Constabulary had administered a number of internal surveys to its police officers and there was a general feeling of ‘survey overload’. Walliman suggests that to minimise annoyance amongst respondents, consideration should be given to the time when the questionnaire is issued, for example it would be annoying for respondents within a retail organisation to complete a questionnaire before the busy Christmas period\(^100\). For this reason, care was taken to ensure that the questionnaire was issued at a time when few other questionnaires were in circulation within the Constabulary, in order to avoid the previously discussed issue regarding rapport with respondents. In order to ensure reliability and avoid internal validity issues, the questions were adapted from a number of related academic studies that were identified in the literature. The details of the sources of questions can be found in appendix 2f (at the end of the survey questions). For the third questionnaire, further details on the design can be found in Section 8.1.2.

Questionnaires can be distributed in a variety of forms, such as via post, email or face-to-face. The first two questionnaires were distributed to officers in paper form during focus groups and during shift briefings. This allowed a better response rate than distributing electronically, as the officers present could complete the questionnaire there and then, however this may have reduced the potential sample size. For the second questionnaire related to information literacy, paper based administration generated a total of 48 responses. It was felt a wider sample was required, so the survey was administered in electronic form via email to officers who had not already completed the paper-form questionnaire. To

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\(^{97}\) Agrawal, ref. 37.  
\(^{98}\) Colvin & Goh, ref. 40.  
\(^{99}\) Conspicuity Innovate Ltd, ref. 50.  
\(^{100}\) Walliman, ref. 4, p. 237.
achieve this, officers from different shifts that were not involved in the focus groups were contacted. The email was sent from the Superintendent to add more authority to the questionnaire and to potentially increase the response rate. This gained an additional 71 responses, providing a total of 119 responses for this particular questionnaire. The third questionnaire was completed face-to-face with respondents and responses were input directly into an electronic format. Questionnaires were conducted face-to-face to avoid frustrating potential participants with an additional questionnaire to complete electronically. A total of 76 responses were gained for this particular questionnaire. Further details of the sampling method is discussed in section 3.6.3.

One of the key disadvantages of questionnaires is the element of ‘social desirability response bias’ i.e. respondents may wish to be seen in a good light, thus affecting the level of truth within findings. This was recognised within the research, for example within questions where respondents were asked to rate their search strategy. Obtaining more objective data, such as through participant observation may have helped to overcome this issue. However, in practice it was impractical to observe police officers searching for information within an operational or classroom environment (see sections on ‘observation’ and ‘experiments’). Despite this, respondents were informed that all responses would be anonymous, which is argued to encourage frankness when sensitive areas are involved.

Since standardised answers are gained from most questionnaires, data analysis is relatively straightforward compared to qualitative data analysis. The data from the first questionnaire was input into an electronic survey tool to allow automatic exporting of results to an Excel file for further analysis. The data from the questionnaire administered during the later evaluation was input using optical mark recognition software, as this allowed quicker input of results than manual input, which can then be exported to data analysis software packages. Further discussion of how the data from the three questionnaires were analysed is given in section 3.7 and Table 3.6.2 within this Chapter.

**Observation**

Observation allows the researcher to investigate the actions and behaviour of people within a natural context, and provide useful insights. This can be used to complement interview, focus group and questionnaire data and may have less bias. For the research, a combination of participant and non-participant observation was used. To understand the organisational context participant observation was used; information was gathered in an unstructured process and observations were written up as soon as they had been made. To evaluate the usage of each MDT device in context, non-participant observation was used, which allowed the researcher to be guided by a set of checklists (see appendix 2e for observation data collection sheet). In doing so, a holistic explanation incorporating relationships

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101 Robson, ref. 84, p. 231.
102 Ibid., p. 234.
103 Walliman, ref. 4, p. 236.
104 Robson, ref. 84, p. 310.
105 Ibid., p. 310.
106 Brewerton & Millward, ref. 2, p. 96.
107 Ibid., p. 96.
between various factors affecting the level of officer acceptance can be gained. Details of the sampling and sample sizes for the observational research can be found in Table 3.6.2.

For objective 1.1.7, another form of observation was tested on officers, known as ‘expert verbal reasoning’ or ‘protocol analysis’ (see Appendix 2g). A method was needed to identify how officers search for information and the impact of mobile technology on information literacy. Whilst this information could be gained from a questionnaire, it was felt that this information would be largely subjective and would not provide data collected in real situations. Officers could be directly observed but it was felt that some officers might feel uncomfortable being ‘watched’, which may bias the results of the research.

Protocol analysis is a knowledge-capture technique that consists of asking experts to solve a particular problem and verbalise what goes through their heads. The resulting verbal protocols are then analysed. Awad and Ghaziri suggest that the method ‘provides a wealth of information on cognitive processes and for building knowledge management systems’. The use of scenarios over asking questions about a problem-solving task can offer ‘an explicit concrete vision of how some human activity could be supported by technology’. Research by Owen et al. has shown that protocol analysis granted a valuable insight into how subjects sought to discover information within a dynamic environment, and how they navigated and discounted sources of information. Similarly, Chen applied the method as part of a framework to investigate students’ problem-solving processes while using computers and found that it provided valuable empirical data. Furthermore, a study by Fich that evaluated the usability of a commercial website strongly suggests that directly observing users over experimental evaluation or subjective assessment is the most systematic and valid. Fich suggests the method eliminates the problem of people forgetting their justification of actions after they have completed a task. The method only requires a small sample size, due to the richness of data collected. It can also be argued that the method means that the subjects feel like they are the expert by asking them to verbally explain their reasoning to the researcher, rather than observing through experimental design, which could make subjects feel uncomfortable.

However, in practice the method proved not suitable. A large number of officers who are using mobile technology in the vehicles are single crewed, meaning it is difficult to input and search for information whilst driving and performing operational duties. Therefore, the use of the method was trialled but only a small amount of data could be collected. The method was later rejected for the research.

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108 Denscombe, ref. 32, p. 209.
110 Ibid., p. 166.
111 Ibid., p. 165.
115 Ibid., p. 153.
Document Analysis

In order to investigate how information is currently collected and to identify data and information sources that are input onto the Crime and Intelligence System, document analysis was used. This is a research method that may be applied in order to make replicable and valid references from data to their context\(^{116}\), in this case the analysis of paper and electronic crime recording mechanisms to investigate the processes and use associated with crime and intelligence data. Compared to interviewing or questionnaires, the method is unobtrusive and therefore may provide a more holistic set of data\(^{117}\). However, it is important to note that some documents will have been written for purposes other than research, so it may be difficult to allow for biases and distortions this introduces\(^{118}\); hence the use of a multi-methods approach to overcome this problem. It is also important to note that some information held within paper and electronic sources may be confidential and subject to data protection legislation, therefore the researcher needed to approach this method with care.

Experiments

Laboratory experiments permit the researcher to observe results between small numbers of variables that are studied thoroughly via a controlled laboratory situation using quantitative analytical techniques with a view to generalising findings applicable to real-life situations. However, it is important to note that the extent to which identified relationships are applicable to a wide range of real world scenarios is limited, due to an idealised laboratory environment and isolation from variables that are found in the real-world, which could impact on relationships\(^{119}\). In order to assess the effectiveness of knowledge structuring techniques, the creation of scenarios or experiments where officers are asked to search for a specific piece of information was considered. Using quantitative data, such as task completion times of scenarios, the effectiveness of knowledge structuring techniques could be assessed by comparing completion times of taxonomy use against non-taxonomy use. However, it was felt that within the research context this method would be impractical for a number of reasons. Officers would have to be taken off duty in order to conduct the experiments, thus creating abstraction costs. Furthermore, officers would need to be observed and timed and since police officers are viewed as well-respected professionals it was felt that timing officers to complete a task would cause some resistance and was therefore deemed inappropriate. This gap in the literature may therefore be recommended for exploration by research outside the remit of the thesis.

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\(^{116}\) Krippendorf, K. Content analysis: an introduction to its methodology, 1980, p. 21.  
\(^{117}\) Robson, ref. 84, p. 358.  
\(^{118}\) Ibid., p. 358.  
\(^{119}\) Cornford & Smithson, ref. 5, p. 70.
Informal open interviews (adapted from the storytelling method)

In order to identify the impact that mobilising information and knowledge processes has on existing knowledge sharing and organisational working practices in policing organisations and the factors affecting the use of mobile technology amongst police officers, the method known as storytelling was adopted. However, in reality it appeared that the use of the method appeared to be more of an informal open interview rather than the collection of stories. Since the use of informal open interviews stemmed from the storytelling approach, detail and use of the storytelling method is provided in the following paragraphs.

The approach of directly retelling events to others may be termed ‘anecdote enhancement’, and includes storytelling in organisations\textsuperscript{120}. Gabriel suggests that ‘stories collected in organisations are highly charged narratives, not merely recounting events, but interpreting them, enhancing them and infusing them with meaning’\textsuperscript{121}. Likewise, Denning states ‘storytelling gets inside of the minds of the individuals who collectively make up the organisation and affects how they think, wonder, worry, agonise… and in the process create and recreate their own organisation’\textsuperscript{122}.

Despite the method being often widely viewed as being void of significance or reason and short-lived, Seely-Brown, who was the chief scientist at Xerox; Prusak, who worked as a researcher in IBM; Groh who creates educational films for her own firm Groh Productions; and Denning, who was director of knowledge management at World Bank, all concur that storytelling is ‘an extraordinarily valuable lens for understanding and managing organisations in the 21\textsuperscript{st} century’\textsuperscript{123}. They found that storytelling had surprising importance and persuasiveness in their respective settings, where narrative could play a key role in organisations in the public and private sector. They suggest that storytelling ‘has a hand in practically everything that happens of any significance for human affairs’\textsuperscript{124}. Seely-Brown argues that today’s knowledge economy requires the need to learn continuously and see and do things differently in order to achieve success; storytelling supports this need by enriching the sharing of knowledge and applying knowledge within stories to a new range of settings\textsuperscript{125}. He continues to suggest that ‘even scientists must admit that knowledge cannot be captured via a formula or equation; it calls for new intellectual constructs and the challenge of background assumptions enriched by events, objects and communities of practice that provide us with different perspectives through which to view the world’\textsuperscript{126}. With this in mind, storytelling may offer a different perspective to identify the impact of mobilisation on knowledge and organisational policing practices.

However, for the last couple of thousand years, storytelling has received disapproval from several members of the academic and research community. The source of such disapproval may stem back to the work of Plato, who was a major influence on the foundations of Western philosophy. In his

\textsuperscript{121} Gabriel, Y. Storytelling in organisations, 2000, p. 31.
\textsuperscript{122} Denning, S. The springboard: how storytelling ignites action in knowledge-era organisations, 2000, p. xiv.
\textsuperscript{123} Seely-Brown, J., et al. Storytelling in organisations: why storytelling is transforming 21\textsuperscript{st} century organisations and management, 2005, p. ix.
\textsuperscript{124} Ibid., p. x.
\textsuperscript{126} Ibid.
masterpiece, The Republic, he strongly argues that storytelling (and poetry) be banned from use in the literate society, despite Plato himself being recognised as one of the greatest storytellers of all time, for example in Symposium where he uses stories to develop a philosophical dialogue on the nature of love\textsuperscript{127}. His argument worked well in the context of ancient Athens when there was little emphasis on quantitative analysis. In spite of this, Seely-Brown disputes that ‘the modern world has gone too far in the opposite direction, with an exclusive focus on analysis and a dismissal of narrative… there has been an unfortunate tendency for Plato’s followers to adopt what Plato argued in The Republic, rather than what he himself practiced in the Symposium\textsuperscript{128}. Plato’s student, Aristotle, ‘helped implement much of the intellectual agenda of The Republic by placing a huge emphasis on the classification of knowledge and creating a model for science that left storytelling in a peripheral role of illustrating abstract propositions\textsuperscript{129}. In parallel, the work of Descartes meant that many followers felt they had to adopt a mathematic, scientific method, ‘free of mind and spirit’\textsuperscript{130}. As a result of this, scientists found they were achieving successful results through experimental methods and felt this was the sole method to discovering the truth. Consequently a view emerged that only knowledge generated by science and represented using analytic equations is genuine knowledge, thus rejecting the storytelling method in academia. However, at present storytelling is increasing in popularity. A Smithsonian Symposium in 2001 provided an opportunity for people from various organisations using storytelling to share their experiences, and it was oversubscribed and now has international attendance\textsuperscript{131}. The importance of organisational storytelling is also starting to be recognised in the management literature, with articles appearing in Booz & Company’s Strategy and Business, the Harvard Business Review and the Wall Street Journal\textsuperscript{132}. Narrative is increasingly accepted as a powerful tool for understanding organisations\textsuperscript{133} and may provide more informative data. As Snowden suggests, ‘stories in organisations reveal patterns of culture, behaviour and understanding in a different and frequently more effective way than interviews and questionnaire based approaches... the stories told in an organisation, around the water cooler, in project reviews, indeed in all aspects of organisational life, reveal the ideation patterns of that organisation’. The strength of stories is that they do not present information or facts about events, but they ‘enrich and infuse facts with meaning’\textsuperscript{134}, which can offer a path towards providing a more truthful representation of an individual or collective situation. Seely-Brown et al support this statement by arguing that ‘stories can communicate deep, holistic truths, while abstract language and abstract discussions tend to slice off fragments\textsuperscript{135}; it is much easier to understand another person talking about a topic than it is to read any documentation and a lot of learning about an organisation occurs in the interaction between people\textsuperscript{136}. Telling stories allows the subject to communicate events more clearly than being put on the spot through questions in interviews and questionnaires, because we know more than we can tell. By telling a story with feeling, subjects are able to communicate more than they explicitly know\textsuperscript{137}. Thus

\textsuperscript{127} Seely-Brown, ref. 123, p. 172.
\textsuperscript{128} \textit{Ibid.}, p. 172.
\textsuperscript{129} \textit{Ibid.}, p. 172.
\textsuperscript{130} \textit{Ibid.}, p. 172.
\textsuperscript{131} Seely-Brown, ref. 123, p. x.
\textsuperscript{132} \textit{Ibid.}, p. xi.
\textsuperscript{133} \textit{Ibid.}, p. 177.
\textsuperscript{134} Gabriel, ref.121, p. 135.
\textsuperscript{135} Seely-Brown, ref. 123, p. 168.
\textsuperscript{136} \textit{Ibid.}, p. 21.
\textsuperscript{137} \textit{Ibid.}, p. 168.
there is a notion of informality present in storytelling, and it is strongly felt that participants are likely to be more honest and open about their experiences than in a formal, scheduled setting that is using up their time.

With regards to this research, storytelling may provide a better understanding and truths of experiences with mobile information and knowledge sharing. To promote the informality, it was intended to collect storytelling data whilst officers were completing administrative duties or on breaks to minimise the abstraction to their operational duties. In practice the data collection method lent itself more to informal open interviews, which retained the informality of the storytelling method but were conducted as more of an interview approach than collecting stories as and when they were told.

The fact that stories do not present information or facts about events may also be seen as a weakness in the method, and Gabriel recommends that any author using storytelling must accept ambiguities in data and resist the temptation of setting the record straight, but at the same time not lose sight of the relation between stories and facts: ‘facts are not dissolved by stories but recreated through them’. Gabriel also advises that the attitude of the researcher may affect the quality of stories and if a researcher shows any judgement or criticism then they are unlikely to elicit stories. For this reason an unbiased approach was taken to the exercise, and the researcher ensured that she showed a display of interest, empathy and pleasure in information that officers shared. Another key danger of the method, which Gabriel warns of, is ‘the selective use of organisational narratives to amplify or reinforce the researcher’s preconceived ideas or assumptions’ and ‘researchers pursuing a particular line of enquiry may focus on stories that support their ideas and disregard the importance of others’. This argument is echoed by Snowden, who contends that practitioners may select and emphasise the most interesting facts, which may not correspond with the experiences of other people in the organisation. Thus all data from the informal open interviewing exercise were analysed and the researcher considered data that may undermine the analysis and stand in the way of interpretation, as this could lead to new avenues for findings.

Gabriel recommends two approaches to collecting storytelling data: the first is to ask appropriate questions and explain the purpose of the research and the second is to collect stories as and when they occur, which is often used in a broader ethnographic approach. For the purposes of this research, the first approach was taken. The key benefit of this approach over a more ethnographic approach is that it generates larger amounts of field material, thus several different accounts of the same story may be compared in a relatively economical manner. In addition, the information generated can be more easily transcribed at the researcher’s leisure. Gabriel implies that such an approach is favoured by many of the systematic researchers into stories. Conversely, stories are not encountered in their natural state so it is important to take into account the risk of the research imposing their interpretation onto stories, as previously discussed. Nevertheless, some stories may be common in an organisation and thus easily retold. With this background in mind, it was important that officers had a clear understanding of what the

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138 Gabriel, ref. 121, p. 136.
139 Ibid., p. 137.
140 Ibid., p. 151.
141 Snowden, ref. 120.
142 Gabriel, ref. 121, p. 138.
143 Ibid., p. 137.
144 Ibid., p. 137.
researcher was seeking. Therefore, the purpose of the research was explained to officers, and the researcher advised that the findings would be used to produce a series of recommendations for mobile technology. Research by Gabriel found that people rarely had a problem appreciation why stories were being used and favoured the method over questionnaires. Officers were reassured that all their stories would be treated anonymously, and were told the session was informal and thus were invited to be as open and honest as possible. The questions (Appendix 2) were designed to be as open ended as possible and to serve as a trigger to elicit stories. There is a theoretical grounding for questions, as they are based on those that have been extensively used in research by Gabriel. Stories were recorded onto paper rather than using a tape recorder, as this was felt to be less distracting and more informal for officers.

3.6.2 Triangulation

As table 3.6.1 shows, a variety of methods were used for each objective. The main advantage of using multiple methods for a particular line of enquiry is triangulation. Denzin broadly employs the term to refer to an approach that uses ‘multiple sources of data and methodologies’. Bryman suggests that researchers conducting ethnographic studies and action research based studies ‘often check out their observations with interview questions to determine whether they might have misunderstood what they had seen’. In other words, it provides a means of testing the source of information against other sources. Robson states that ‘both correspondencies and discrepancies are of value: if two sources give the same information then they may cross-validate one another, if there is a discrepancy, its investigation may help to explain the phenomenon of interest’. Similarly, Yin claims ‘the purpose of triangulation is to collect information from multiple sources but aimed at corroborating some facts or phenomenon.’ The research involved data triangulation (from multiple methods) and methodological triangulation, as quantitative research (e.g. questionnaires) is used to corroborate mostly qualitative research.

3.6.3 Sample selection

Sampling bounds the collection of data and defines whom to investigate within the practicalities of time and resources. It is important that participants for focus groups, interviews, questionnaires, observation and laboratory experiments are selected to ensure that findings consist of the most valuable data to fulfil the research objectives. For objectives 3 to 9, employees within the Leicestershire Constabulary were sampled, including operational officers, project managers and a selection of stakeholders who are not directly involved in frontline duties: section Sergeants, Inspectors and staff from the Control Unit and Crime Input Bureau. The selection of the Leicestershire Constabulary for the research may be based on convenience sampling, which is built on selections which suit the researcher.
and which are ‘first to hand’; the Leicestershire Constabulary is geographically near to the researcher and the University already has established a good working relationship with senior management. Although the sampling technique can be recognised as hard to equate with good research\(^\text{152}\), it is believed that the organisational context of the Leicestershire Constabulary is one that fully meets the needs of the research. The Constabulary is taking an innovative approach to mobile technology. It is the first Force in the country to introduce mobile data terminals into police vehicles\(^\text{153}\) and the MDTs enable officers responding to incidents to have full mobile access to internal and external systems via the same interface available to them from their workplace desktop computer. Therefore, this approach is likely to see a greater impact on policing and knowledge sharing than approaches taken by other Forces, with mobile access to only email and calendar facilities.

The selection of candidates for focus groups, interviews, questionnaires, observation and informal open interviews (see Table 3.6.2) was selected using a purposive sampling technique. The technique is often used in case studies and where participant observation is involved\(^\text{154}\), and entails selecting participants with a particular purpose in mind, which reflects relevance to research objectives\(^\text{155}\). The technique allows the researcher to concentrate on people which there are good grounds for believing will be critical for the research; instead of using a cross-sectional sample, the researcher can concentrate on instances that will produce a wide variety of results to illuminate the research objectives at hand. In this sense, the technique may be informative in a way that conventional probability sampling cannot\(^\text{156}\); the techniques can be shown to be extremely effective in predicting outcomes\(^\text{157}\).

With regards to the philosophy and methodology of the research, interpretivism and idiography focus on exploring particular cases or events (see sections 3.4.3 and 3.5.2). The two do not lend themselves to generalising results widely; however they can illuminate the general situation by focusing on a specific instance. Therefore concentrating the research sample on a particular organisation and the most relevant candidates through convenience and purposive sampling suited the overall design of the research. Although the ideal sample size of 206 participants was not reached to provide a 95 per cent confidence level\(^\text{158,159}\) to the results, the actual sample size of 119 was deemed sufficient to provide an insight into the research objectives. Further data could have been collected to provide greater confidence to the results, but this was impractical and is recognised as a limitation.

The majority of respondents used for the information literacy questionnaire were also those who participated in the focus groups. The participants within the focus groups contained officers with a variety of computer competencies, and the overall findings from the focus groups appeared to reach a level of saturation. Therefore it was felt that extending the sample size further would not add additional value to the research findings.

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\(^{152}\) Denscombe, ref. 32, p. 17.
\(^{153}\) BBC News. *Technology has police on the beat.* <http://news.bbc.co.uk/1/hi/england/leicestershire/7804847.stm>, 30.12.08, [accessed 06.01.08].
\(^{154}\) Robson, ref. 84, p. 265.
\(^{155}\) Denscombe, ref. 32, p. 15.
\(^{156}\) Ibid., p. 15.
\(^{157}\) Brewerton & Millward, ref. 2, p. 117.
\(^{158}\) N.B. Using the total population of 900 mobile technology users within the Leicestershire Constabulary, a sample size calculator with a 95 per cent confidence level and a confidence interval of 6 generates a sample size of 206.
\(^{159}\) Robson, ref. 84, p. 264.
### Table 3.6.2: Research conducted, sample, how data was analysed, and appendix location

<table>
<thead>
<tr>
<th>Research</th>
<th>Date of research</th>
<th>Sample size</th>
<th>Response Rate</th>
<th>Analysis technique</th>
<th>Appendix location of data collection instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus group to identify user requirements for development of an evaluation framework</td>
<td>Oct 07</td>
<td>Nine operational officers who have already experienced mobile technology</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>2a</td>
</tr>
<tr>
<td>Multi-method evaluation study into pilot implementation of mobile information technologies with regard to user acceptance and knowledge sharing</td>
<td>Apr to June 08</td>
<td>Questionnaire completed by 30 officers during the focus groups</td>
<td>100 per cent</td>
<td>Quantitative</td>
<td>2b, 2c</td>
</tr>
<tr>
<td>Eight semi-structured focus groups with 30 officers using mobile technology, before and after the trial period</td>
<td></td>
<td>Semi-structured Interviews with 12 call management centre staff</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>2c, 2d</td>
</tr>
<tr>
<td>Observational work-shadowing with 18 out of the 30 officers ; mobile technology use observed on 38 incidents throughout course of 20 shifts</td>
<td></td>
<td>Observational work-shadowing with 18 out of the 30 officers ; mobile technology use observed on 38 incidents throughout course of 20 shifts</td>
<td>60 per cent</td>
<td>Quantitative &amp; qualitative</td>
<td>2e</td>
</tr>
<tr>
<td>Informal open interviews to identify experiences with mobile technology and knowledge sharing</td>
<td>Oct 08</td>
<td>Informal open interviewing exercise (see Fig 3.6.1) with 27 operational officers using mobile technology</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>2l</td>
</tr>
<tr>
<td>Activity</td>
<td>Participants</td>
<td>Data Collection</td>
<td>Data Analysis</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<td>-------</td>
<td></td>
</tr>
<tr>
<td>Questionnaire with mobile technology users to investigate the impact of mobile technology on knowledge sharing and to determine different search strategies used by officers, to establish the perceived level of information literacy.</td>
<td>119 operational officers using mobile technology</td>
<td>71 responses gained out of 474 officers electronically (15 per cent)</td>
<td>Use of SPSS and Excel</td>
<td>Quantitative</td>
<td>2f</td>
</tr>
<tr>
<td>Focus group to identify the impact of mobile technology on perceived information literacy skills of officers and on knowledge sharing.</td>
<td>50 operational officers using mobile technology.</td>
<td>100 per cent</td>
<td>Use Atlas to code data into themes.</td>
<td>Qualitative</td>
<td>2h</td>
</tr>
<tr>
<td>Interviews with organisations that are using mobile technology, to identify best practice beyond the police.</td>
<td>4 interviewees; each from Yorkshire Water, RAC, British Gas and BT. Selected as they are using similar technology to the Constabulary and have been using for several years on a wide scale, so can learn a lot from their experiences.</td>
<td>100 per cent</td>
<td>Use of Atlas.ti to code qualitative data and identify themes from interviews. Data was also manually summarised.</td>
<td>Qualitative</td>
<td>2i</td>
</tr>
<tr>
<td>Interviews with senior officers to identify information literacy skills.</td>
<td>Six Chief Inspectors involved with supervising the operational use of mobile technology</td>
<td>100 per cent</td>
<td>Use of Atlas.ti to code qualitative data and identify themes from interviews.</td>
<td>Qualitative</td>
<td>2j</td>
</tr>
<tr>
<td>Face to face semi-structured interviews to identify measures used to monitor data quality within the Constabulary and to understand reasons for the perceived level of data quality and attitudes towards data quality.</td>
<td>Operational officers, IT staff and employees within the Constabulary responsible for monitoring data quality</td>
<td>100 per cent</td>
<td>Manual</td>
<td>Qualitative</td>
<td>2k</td>
</tr>
<tr>
<td>Focus groups with officers to examine the ease of inputting information into information systems.</td>
<td>15 x focus groups with 78 operational police officers</td>
<td>100 per cent</td>
<td>Manual – use of post-it notes to categorise.</td>
<td>Qualitative</td>
<td>See Section 7.2.2</td>
</tr>
<tr>
<td>Activity</td>
<td>Participants</td>
<td>Percentage</td>
<td>Methodology</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
<td>---------------</td>
<td>-----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Interviews with project managers of other police forces to test the adapted user acceptance model</td>
<td>5 police forces: Cheshire, Essex, Wiltshire, Lancashire, Humberside Project managers of mobile technology within each police force</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>Use of Atlas.ti to code qualitative data and identify themes from interviews.</td>
<td>See Section 5.4.1</td>
</tr>
<tr>
<td>Action research workshop facilitated by the NPIA to test the adapted user acceptance model</td>
<td>Mobile technology Project managers from 43 UK police forces</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>Use of Atlas.ti to code qualitative data and identify themes from interviews.</td>
<td>See Section 8.1.2</td>
</tr>
<tr>
<td>Interviews with senior police officers to identify impact of mobile technology on business processes</td>
<td>3 Inspectors supervising use of MDTs in their local policing unit; 3 Chief Inspectors responsible for strategic development of mobile technology; 3 Superintendents responsible for strategic development of mobile technology</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>Use of Atlas.ti to code qualitative data and identify themes from interviews.</td>
<td>See Section 8.1.2</td>
</tr>
<tr>
<td>Semi-structured face-to-face interviews with stakeholders involved at each end of core policing process</td>
<td>11 Command and control room personnel; 8 Crime input bureau personnel; 12 Operational police officers using MDTs</td>
<td>100 per cent</td>
<td>Qualitative</td>
<td>Use of SPSS and Excel</td>
<td>See Section 8.1.2</td>
</tr>
<tr>
<td>Face-to-face questionnaire to identify impact of mobile technology on business processes</td>
<td>74 participants</td>
<td>100 per cent</td>
<td>Quantitative</td>
<td>Use of SPSS and Excel</td>
<td>See Section 8.1.2</td>
</tr>
</tbody>
</table>
3.7. Data analysis

Qualitative and quantitative data were generated from the research, the majority being qualitative, as evident in Table 3.6.2. Regardless of the type of data, the analysis process can be broken down into three types of activities: data reduction, data display and conclusions drawing or verification. Miles & Huberman\textsuperscript{160} and Bryman\textsuperscript{161} advocate that these three stages are integrated with the data collection activities, following the sequence steadily during the collection of data and then increasing the level of reduction, display and conclusions until a final summary of the findings is produced (see Figure 3.7.1).

Figure 3.7.1: The process of data analysis (adapted from Miles & Huberman)\textsuperscript{162}

Data reduction

Data reduction refers to the process of selecting, sorting, focusing and narrowing the collected data that appears in the final version of reports, in order to allow final conclusions to be drawn\textsuperscript{163}. Techniques that are available to achieve this for qualitative data include coding, identifying themes, clustering similar data and producing summaries and memos of data. The main form of data reduction for the qualitative data of the research was coding. Coding is the mechanism to place data into general categories, represent data, provide themes for data and find out why certain data commonly occurs\textsuperscript{164}. Coding can be conducted by coding data line-by-line, comparing and grouping codes, developing descriptive themes or analytical themes\textsuperscript{165}. For the informal open interviews and semi-structured interview data, the data was reduced by applying codes to each relevant line of information using qualitative analysis software (see section below for details). The codes were based on themes that emerged from the data, such as knowledge management, knowledge sharing, information overload, usability and so forth. This can allow identification of relationships between codes and thus theories to be built from codes. Qualitative data were also reduced through selection, summarising and paraphrasing. In the evaluation study, respondents were asked to write their main perceived benefits and risks onto separate post-it notes and then place each post-it note under a specific category (e.g. usability,

\textsuperscript{160} Miles, M. B. & Huberman, M. Qualitative data analysis: an expanded sourcebook, 1994, p. 32.
\textsuperscript{161} Bryman, ref. 11, p. 322.
\textsuperscript{162} Miles & Huberman, ref. 160, p. 10.
\textsuperscript{163} Ibid., p. 50.
\textsuperscript{164} Bryman, ref. 11, p. 398.
\textsuperscript{165} Thomas, J. & Harden, A. Methods for the thematic synthesis of qualitative research in systematic reviews. \textit{BMC Medical Research Methodology}, 2008, 8(45). Available at: <http://www.biomedcentral.com/1471-2288/8/45>, [accessed 31.10.08].
knowledge sharing, technical, security). This therefore allowed the data to be coded there and then. Interviews were recorded and manually summarised and paraphrased.

To reduce the quantitative data collected, statistical analysis was used. Statistical procedures including descriptive statistics such as percentages and inferential statistics such as chi-squares and dependent t-tests were used. These were applied largely to the evaluation study and information literacy questionnaires. Although the research is not aiming for wider generalisation, the use of inferential statistics allowed the data to be tested for any statistical significance.

### Data display

Miles and Huberman suggest that data display is ‘an organised, compressed assembly of information that permits conclusion drawing and action’\(^{166}\). Whilst for qualitative data, displays of extended text can be used; they do not permit efficient conclusion drawing. Better displays of qualitative information can include matrices, graphs, charts and networks, which allow information to be more accessible and compact. These techniques to display data were employed in the research and are evident within the results chapter. Data for each theme were placed into a thematic grid, (see Appendix 3a-c of this report) which enabled effective analysis of the data by easily seeing where common findings occurred within each theme.

### Conclusion drawing/ verification

It is suggested by Miles and Huberman that ‘as the researcher is conducting the process of data analysis, they are already beginning to draw their own conclusions with regard to what overall picture the data is producing, such as regularities, patterns, explanations, possible configurations, causal flows and propositions’\(^{167}\). By comparing the outcome of this process to the results of the process from another research method, the research may be verified. This may relate to the process of triangulation (see section 3.6.2). The outcome of conclusion drawing is evident in the results chapter.

### Tools used for data analysis

The findings generated from each research method were analysed separately using different tools and techniques. The quantitative data from the evaluation study and information literacy questionnaires and observational work shadowing were analysed using Microsoft Excel. Further quantitative analysis was undertaken using a quantitative data analysis package known as Statistical Package for the Social Sciences (SPSS), which allows data to be analysed more fully than in Excel.

There are several qualitative software packages available, such as Atlas.ti and Nvivo. Both have relative advantages and disadvantages, but due to practicality reasons Atlas.ti was selected. Atlas can be used for the analysis of graphical, audio and video data but for this research it was only used for the analysis of text within both the informal open and semi-structured interviews. Atlas helps identify themes

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\(^{166}\) Miles & Huberman, ref. 160, p. 11.

\(^{167}\) Ibid., p. 11.
and patterns in data, thus allowing conclusion drawing and verification. The transcripts of interviews and stories were entered into a hermeneutic unit and codes were assigned to sections in the text document transcript, as discussed in the ‘data reduction’ part of section 3.6.4. The use of Atlas allowed data to be electronically coded and related quotes to each code to be easily retrieved. Since there were several data sets collected within the interviewing exercise, the use of Atlas was worthwhile.

3.8. Summary

The literature review has helped to inform the research objectives and the selection of methods regarding the impact of mobilising information and knowledge processes within policing. From this, the research was designed using an interpretivist philosophy with an idiographic and action research mixed methods approach. The research methods employed for the research include focus groups, interviews, questionnaires, observation, document analysis and informal open interviews. To verify and validate the results of each method, the results were triangulated. The sample for the research has been selected using convenience sampling to decide on the Leicestershire Constabulary, and purposive sampling to choose individual participants. An analysis of the data along with an integrated discussion of the results collected is presented in Chapters four to nine.

Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

Chapter 1
Introduction

Aims

Objectives

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Literature Review: Knowledge Management: Background Context

Chapter 2.2
Literature Review: Knowledge Management: Structure

Chapter 2.3
Literature Review: Knowledge Management: Technologies

Chapter 2.4
Literature Review: Technology Acceptance Theories

Chapter 3
Research Methods

Chapter 4:
Developing an evaluation framework to select mobile technology

Chapter 5:
Adaptation of the technology acceptance model for policing

Chapter 6:
The impact of mobile technology on knowledge sharing in policing

Chapter 7:
Implications of mobile access to information systems for data quality and information literacy

Chapter 8:
The impact of mobile technology on business processes

Chapter 9:
Overall discussion

Chapter 10:
Conclusions, Research Limitations and Recommendations

Future Research
Chapter Four: Developing an evaluation framework to select mobile technology

Chapter Preface

In order to manage the change process from paper to mobile information management, a framework for evaluating user requirements and features of various solutions within the market in an unbiased manner was required. This Chapter develops an evaluation framework to ensure that the Constabulary selected the mobile solution that best met their requirements, and thus spent public monies from the Government wisely, rather than basing decisions on managerial hunches.

The framework was developed through an empirical study within the Leicestershire Constabulary. The study involved collecting qualitative data regarding user requirements via a focus group with operational officers who had experience of using a mobile information management solution (MIMS) in the past. Firstly, as part of the framework, a stakeholder analysis technique was used to identify, evaluate and address the issue of competing user requirements. Secondly, a feature analysis technique was employed to evaluate various MIMS solutions in an unbiased manner. Finally, the framework was verified through interviews and observation, both internally within the Constabulary and externally with experts from three UK other police Forces.

Findings suggest the framework was well-received internally by senior management, as it presents information in a graphical format and ensures that business requirements drive the final IT decision. External experts within other police Forces also verified the framework, stating that it can provide a more robust, structured approach to decision-making. The research produced a positive outcome in that the framework led to the successful implementation of a mobile data terminal solution with full access to systems used in the station, thus allowing ‘anytime anyplace’ crime recording; the Constabulary was the first in the UK to do so. Compared to the features used in other UK police Forces, the Constabulary appears to have considered the main requirements of a mobile information solution. This indicates that the chosen mobile data terminal solution is the most appropriate and effective.

The Chapter contributes to the domain of evaluating information management solutions and user requirements by creating an evaluation framework that can provide an effective decision-making process which can be used by police forces and other similar organisations looking to adopt, design and evaluate a usable mobile information system (MIMS). Analysing the user requirements and evaluating these against software functionality within the mobile technology marketplace meets Objective three of the research. This Chapter is part of a paper that was presented at the European Conference of Information Management and Evaluation in September 2009.

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4.1. Background

4.1.1. The need for an evaluation framework

The move from paper-based systems to mobile computing represents a radical change to policing, as it breaks historically embedded norms. This challenge, along with the drivers and importance of mobilising information management systems, means it is imperative that the correct solution is chosen, from the many on offer via software suppliers. As qualified in section 1.2, an evaluation framework was developed to achieve this.

4.1.2. Evaluation techniques

It is a common view that a large part of all information technology projects are cancelled, over budget or late\(^2\). Frisk\(^3\) implies one reason for the failure of such projects is that evaluation has been poor. Evaluation can be defined as ‘the act of measuring or exploring some property of a system, the result of which informs decision-making concerning that system in a specific context’\(^4\). Andersen and Jensen\(^5\) suggest that ‘evaluations help managers to refine an IT implementation based on the understanding of its performance’. It has been suggested that evaluation has centred on technical aspects and economic evaluation methods, such as return on investment, which lack consideration of stakeholders and the context of the information technology system\(^6,7\). Stockdale & Standing\(^8\) contend that despite the plethora of evaluation methods available, there are few examples of frameworks from which to build an integrated evaluation strategy.

In other cases, IT investments can be evaluated holistically through an interpretative approach, which uses the stakeholders’ perceived value of an information system\(^9\). Several authors have developed different interpretative evaluation frameworks, for example a context, content and process framework (CCP)\(^10\), which excludes financial measures, and a five-stage benefit management model\(^11\). Frisk\(^12\) applied the CCP framework (see Figure 4.1.1) within the Swedish Fire and Rescue Service and found that CCP could provide a deeper understanding of the effect of technology investment from different stakeholders, rather than simply discovering poor performance from an income statement via the economic approach. The two methods focus on stakeholders but do not effectively balance stakeholder needs, unlike the stakeholder analysis method. Further explanation and justification of the stakeholder method is given in Section 4.2.2.

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\(^6\) Ammenwerth, ref. 4, p. 1292.
\(^9\) Frisk, ref. 3, p. 179.
\(^10\) Stockdale & Standing, ref. 9, p. 1096.
\(^12\) Frisk, ref. 3, p. 180.
Within the literature, appropriate methods are available to evaluate an information system. For example, DESMET selection criteria can be applied to ensure selection of a reliable and unbiased evaluation method. DESMET forms the theoretical basis for developing the framework, and is discussed further in Section 4.2.3.

4.1.3. The research domain

Table 4.1.1 shows the research domain. Employees within the Leicestershire Constabulary were sampled, including operational officers, project managers and a selection of stakeholders who are not directly involved in frontline duties. Experts from other UK police Forces were sampled to verify the framework in a wider policing context. All participants were selected using a purposive sampling technique, which allows the researcher to pinpoint people where it is believed that they will be critical for the study (as detailed in Chapter three).
4.2. Developing the Evaluation Framework

Table 4.1.1 shows the methods used in each phase of the evaluation framework. This section details the outcome of applying each phase of the evaluation framework within the research domain.

4.2.1. User requirements of mobile technologies

In order to identify competing user requirements a focus group was held with a total of nine operational police officers (see Table 4.1.1). The focus group aimed to explore current experiences with MIMS and specifically officers recorded positive and negative aspects relating to performance, reliability, usability, interface, security and data quality (see Appendix 2a for full details). Ideas were recorded in silence on post-it notes, allowing each expert to contribute equally. These were then grouped accordingly.

The focus group identified that duplication of effort and time wasted are key issues for officers using the current paper-based system, as the forms were designed for scanning rather than direct input of information. Officers agreed that a MIMS would enhance the gathering and recording of information as details can be input directly onto the crime information management system rather than at the end of a
Chapter Four: Developing an evaluation framework to select mobile technology

This speeds up the business process and removes inaccuracies in double keying, thus allowing for better information management in terms of more complete, reliable and accurate information. Officers suggested that an ideal MIMS should allow faster data input, such as prompts and drop-downs, as the system would be used in tense situations. Such an interface would also contribute towards improving the level of data quality, as information is captured ‘as it happens’ and ‘incidents can be updated straight away’. Recording information via a MIMS was felt to be more legible than hand written information. Officers suggested a standard keyboard with which to enter information; a touch screen keyboard was viewed problematic. The screen size and keyboard type must be large enough to display and input information.

In the focus group officers expressed concern over performance and speed of access to information. There was consensus that a good network speed and an integrated interface to retrieve/input information were essential to avoid system failures and to provide a richer picture of a situation. Officers also suggested a single log on would reduce the number of passwords required.

With regards to security, participants expressed the requirement to balance the need to prevent officers from repeatedly having to enter RSA codes when the ignition is turned on and off, but also to make the data secure. The units themselves must be protected from theft and the data must be secured by a way of blanking the screen from ‘prying eyes’. In light of recent losses of government-held personal information\(^\text{15}\) this is an important issue. An electronic audit trail was felt to be useful in providing data security. Concern was also raised over communication with the public: diverting attention to data entry rather than focusing on the victim.

4.2.2. Evaluating competing requirements: Stakeholder Analysis

Justification for using the stakeholder analysis technique

Stakeholder analysis comprises of two stages: identification of project stakeholders via brainstorming (as outlined by Pouloudi & Whitly\(^\text{16}\)) and evaluation of the importance of these stakeholders\(^\text{17}\). The evaluation stage involves categorising stakeholders into four main groups (see Figure 4.2.1). The value of this over a simple list of stakeholders is that it assists the project manager in maintaining relationships with the correct people and to plan for mitigation of the influence of certain stakeholders that may be detrimental to the project, and therefore ensure the key business needs are met. The x-axis shows the extent to which a stakeholder could gain from a project and the y-axis shows the ability of a stakeholder to affect the success of a project\(^\text{18}\) (see Figure 4.2.1).


The implementation of MIMS attracted interest from various stakeholders within and outside the organisation, who expressed specific needs about the project. These needs were competing with one another and it proved difficult to fulfil everyone’s wishes; it was therefore important to ensure that stakeholders were managed and the most significant stakeholder needs were met. It was important that the key business requirements drove the IT decisions.

The method presents information in a format that aids effective decision-making, unlike other similar methods such as those described by Mason & Mitroff and Mitroff & Linstone. Interpretive approaches such as the CCP and benefit management models do not fully satisfy the need to balance differing stakeholder perspectives, and additional methods such as those offered by Mason & Mitroff and Mitroff & Linstone present information in a numerical form, which requires technical background knowledge of the tool in order to interpret the information. Phillips states that a stakeholder analysis tool allows better representation of information for decision-making as it shows who has influence on decision-making and who benefits from the project outcomes, which provide more effective axes for decision-making than other approaches available.

Olander suggests that stakeholder analysis has proved to be valid in successfully managing several construction projects. Within the information systems (IS) arena, Rolls Royce has previously applied the analysis method in supporting its strategic IT decision-making. The method has shown to be useful in understanding IS project failure of e-commerce solutions, where inability to recognise external suppliers as key project stakeholders led to underestimation of an influential role in a project. Despite previous research illustrating the value of the stakeholder analysis in evaluating and optimising a potential MIMS, it does not appear to have been documented within a MIMS policing context.

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25 Mason & Mitroff, ref. 23, p. 42.
26 Mitroff & Linstone, ref. 24, p. 64.
28 Olander, ref. 19, p. 281.
29 de Chazal, ref. 18.
30 Pan, ref. 17, p. 174.
Findings from the application of the stakeholder analysis technique

Figure 4.2.2 shows the stakeholder analysis for the research. It is evident that the key players for the project are largely the operational officers, as their actions and level of user acceptance will affect the project’s ability to meet its objectives and the devices will affect the way they do their job. It is therefore important to develop good rapport with officers and prioritise their needs, as identified via the focus group (section 4.2.1), as opposed to the needs of senior management. As a result, a bottom-up approach to implementation was recommended. The other important group of stakeholders are those that should be kept informed, as these are a source of risk to the project. For example, trade unions may see the mobile devices as a source of job cuts thus creating a negative influence on the project. An awareness of this allows the MIMS project manager to place emphasis on nurturing relations with this group.

<table>
<thead>
<tr>
<th>High importance/low influence</th>
<th>High importance/high influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alwasey (radio) manager</td>
<td>Operational officers</td>
</tr>
<tr>
<td>Information portal designer</td>
<td>MIMS project manager</td>
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<tr>
<td>Crime Input Bureau</td>
<td>Process reengineer</td>
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<td></td>
<td>IT analyst</td>
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<tr>
<td></td>
<td>MIMS developer for Anmed</td>
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<td></td>
<td>Response department</td>
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<tr>
<td></td>
<td>MIMS developer for ANPR department</td>
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<tr>
<td></td>
<td>Court Officers</td>
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<tr>
<td></td>
<td>MIMS suppliers</td>
</tr>
<tr>
<td>Low importance/low influence</td>
<td>Low importance/high influence</td>
</tr>
<tr>
<td>Operational sergeants</td>
<td>Training department</td>
</tr>
<tr>
<td>Inspectors outside the project</td>
<td>Corporate development department</td>
</tr>
<tr>
<td>Road transport department</td>
<td>Governmental bodies (e.g. Home Office)</td>
</tr>
<tr>
<td>Procurement department</td>
<td>National Policing Improvement Agency</td>
</tr>
<tr>
<td></td>
<td>Corporate communications department</td>
</tr>
<tr>
<td></td>
<td>Trade unions</td>
</tr>
</tbody>
</table>

Figure 4.2.2: Stakeholder analysis for the MIMS project within the Leicestershire Constabulary

4.2.3. Evaluating user requirements against solutions: Feature Analysis

Justification for using the feature analysis technique

Following the identification of the most important stakeholder needs (see two previous sections), the second phase of the framework is to evaluate these needs against various MIMS within the marketplace. To do this a Feature Analysis method was adapted. Feature analysis forms part of the DESMET methodology, which offers quantitative (surveys, experiments) and qualitative (feature analysis, benchmarking) evaluation methods, depending on what is being evaluated. Quantitative methods require a measurable value that is expected to change (e.g. benefits), whereas qualitative methods are suitable where intangible benefits or few past performance indicators exist (e.g. MIMS)\(^{31}\). DESMET provides a set

---

of criteria for selecting an appropriate evaluation method (Table 4.2.1). Since MIMS solutions are being evaluated and compared the latter three options were rejected and feature analysis was used, thus eliminating the need for prerequisites (e.g. measurement).

Table 4.2.1: DESMET selection criteria

<table>
<thead>
<tr>
<th>What is evaluated</th>
<th>Evaluation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Comparing tools and solutions</td>
<td>Feature analysis Benchmarking</td>
</tr>
<tr>
<td>2. Comparing solutions that automate tasks against manual tasks</td>
<td>Observation</td>
</tr>
<tr>
<td>3. Generic methods</td>
<td>Case study</td>
</tr>
<tr>
<td></td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
</tr>
<tr>
<td>4. Specific methods</td>
<td>Case study</td>
</tr>
<tr>
<td></td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
</tr>
<tr>
<td></td>
<td>Feature analysis</td>
</tr>
</tbody>
</table>

Feature analysis was used firstly because it is based on identifying the requirements that users have for a solution and mapping those requirements against the features of a number of alternative solutions. This aims to avoid the system with simply the most features being selected. Suppliers within the marketplace supply vast amounts of information concerning the technical and non-technical specification of MIMS. Feature analysis was selected secondly as it averts the need for senior management to read through this information or statistics during the decision-making exercise, as the output of the feature analysis results can be presented in a single table or bar chart. Senior Chief Officers have to understand large quantities of data in order to make necessary decisions and the graphical breakdown may reduce the level of information overload. Where high profile public money is being spent, senior management critically need to select the most appropriate MIMS and thus solutions must be evaluated in the most effective and objective manner. It is believed that feature analysis meets this need via its advantages, which carry more weight than other evaluation methods (see section 2.4).

For the research, feature analysis was adapted according to a sequence of seven steps prescribed by Kitchenham:

1. Select candidate solutions to evaluate
2. Identify the user requirements
3. Prioritise features with respect to the user requirements by using a scoring system
4. Agree on a scoring system that can be applied to all the features
5. Carry out the evaluation to score the solutions against the criteria
6. Analyse and interpret the results
7. Present conclusions on the evaluation to decision-makers.
Findings from the application of the feature analysis technique

The evaluator created a list of requirements identified via a focus group against features of various MIMS through reviewing sales literature and meeting with suppliers to look at prototypes. This method is used when screening a large number of tools. Case study and experimental approaches may also be used when there are fewer tools to trial\textsuperscript{35}. A ‘weighting scale’ was used as the scoring system for each specific requirement; the higher the weighting the more essential the requirement. This led to a list of ‘must have’ and ‘nice to have’ features for MIMS. Weightings were added to the MIMS requirements on a 0 – 100 scale:

- 10-30: Useful
- 40-70: Important
- 80-100: Essential

Having a classification below “useful” is not considered to be informative, as identified requirements are, by definition, useful\textsuperscript{36}.

The weightings for each requirement were determined from discussion in the focus group and based on the requirements that would provide greatest potential business efficiency savings. The features are categorised into a number of areas including software functionality, user-friendliness, information management effectiveness, ergonomics, security and cost.

The available features in each solution were compared to the list to generate a total score for each solution; the greater the score the better the solution met the requirements. If a solution did not have the specific requirement it was scored 0. This information can be disseminated via tabular form or graphical form.

A ‘wish list’ of features for MIMS was produced as a result of the focus group findings, so these requirements were weighted to provide a prioritised user specification against which features of software solutions could be evaluated (as detailed in section 4.1.3). The bar chart in Figure 4.2.3 shows the overall scores for the various software solutions, which is based on calculations that were determined by following the guidelines in Table 4.2.1. It is possible to see at a glance which solutions are suitable for the Leicestershire Constabulary; between these two solutions – Solution six and Solution eight. The final decision was based on the cost of implementation and the reputation of the supplier. Solution six scored highly in the feature analysis, but due to its reliance on a communications network exclusive to the emergency services it was more expensive than Solution eight, which relies on a commercial network. The chosen mobile data terminal solution (Solution eight) provides full access to systems accessed in the station and the ability to record crimes live from the scene\textsuperscript{37}, and has a docking station in the car but can be taken into properties\textsuperscript{38}. Solution six, (‘Airwave’) is an in-car instrument, whereas Solution 10

\textsuperscript{35} Ibid., p. 124.
\textsuperscript{37} BBC News. Technology has police on the beat. <http://news.bbc.co.uk/1/hi/england/leicestershire/7804847.stm>, 30.12.08, [accessed 06.01.08].
\textsuperscript{38} BBC News. Officers take laptops on the beat. <http://news.bbc.co.uk/1/hi/england/leicestershire/7547040.stm>, 07.08.08, [accessed 12.09.08].
('Beat') is a handheld ‘portable digital assistant’ device. For this reason, Solution six was the second choice rather than Solution 10.

![MIMS Feature Analysis: High level view](image)

**Figure 4.2.3:** MIMS feature analysis results – graphical format

### 4.2.4. Verifying the Evaluation Framework

**Interview and observation with senior management within the Constabulary**

The evaluation framework was tested in order to ensure that it met the needs of management within the Constabulary. To do this, interviews were conducted with five participants comprising of one Assistant Chief Constable, one Chief Superintendent, one Superintendent, one Chief Inspector and one Inspector. Interviews also explored the preferred representation of results amongst participants from the feature analysis phase of the framework. Observation was also conducted to evaluate management reaction to the framework as a decision-making tool.

The results of the interviews suggest that the experience of using the feature analysis phase of the framework was well received by management at the Leicestershire Constabulary. The framework has greater simplicity and visual representation of information for decision-making than statistics. The comparison of user requirements against software capabilities provided a useful analysis, as it was clear to see where the advantages and disadvantages lay with each system. Senior management favoured the feature analysis framework because it reduced the need to read through a mass of information about each MIMS solution to arrive at a final decision; instead the feature analysis integrated all the necessary information into a single table and chart. Findings from the interviews and observation suggested that management prefer the graphical representation rather than the tabular format. This is because the graphical representation eliminates the need to read through the numbers in the table and thus improves the efficiency of decision-making. Senior management also felt that the feature analysis tool provided sound evidence to explain the reasoning for selecting a particular MIMS solution rather
than basing decisions on a hunch. This was beneficial when the Constabulary sought funding for the chosen MIMS from government bodies, such as the Police Authority.

In addition to the feature analysis phase, the focus group and stakeholder analysis phases of the framework were particularly favoured by the project manager and the IT analyst of the MIMS. The project manager commented that the stakeholder analysis phase was invaluable in minimising competing approaches and balancing different needs. Both the project manager and the IT analyst concurred that the focus group allowed them to identify additional requirements that could have been omitted if management alone had produced the user requirements. Doing so may prove to be beneficial in the long term in maximising user acceptance and ensuring that public money is spent wisely.

Overall, the findings suggest that the evaluation framework was well received by management; this is mirrored by findings in Rolls Royce and evaluating geographic profiling solutions, where the graphical output of feature analysis enabled senior managers to make strategic decisions quickly and effectively, as opposed to presenting management with statistics. This suggests that the evaluation framework may prove to be effective in other organisations.

**Verification beyond the Constabulary: ‘expert’ opinion**

The evaluation framework thus far had been verified internally with senior officers and project managers within the Leicestershire Constabulary. The features or requirements used in the feature analysis to select a mobile information management solution were relevant to the Leicestershire Constabulary. To ensure the validity of the framework in a wider policing context, it is important to identify requirements from additional police forces. In addition to ensuring implementation of the most appropriate mobile solution, the applicability of the framework to other policing contexts was also investigated.

To do this, experts on mobile technologies within three other UK police Forces were sampled. Following an invitation from the National Policing Improvement Agency (NPIA) to present the framework at a symposium to other UK police Forces, contact was made with a NPIA delegate to encourage project managers from 13 Forces to participate in this element of research. Consequently, experts within the Derbyshire, Northamptonshire and Warwickshire Constabularies were sampled based on convenience purposive sampling. The experts were project managers of mobile technology projects. These were specifically sampled because they have been involved in the selection and implementation process and thus have a good understanding of the key features of a mobile solution. Face-to-face semi structured interviews were conducted with the project managers to gain ‘expert opinion’ on the key features in the selection process of a mobile solution. An expert is someone with knowledge and practical engagement with the issues under investigation. In this sense, a project manager overseeing the implementation of a mobile solution seemed most appropriate. Due to the depth of expertise, it was felt unnecessary to gather large amounts of data. The interviews served as a two-way process and an interactive exercise to explain and gain feedback on the framework. During the interviews, the outputs of the phases of the

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39 de Chazal, ref. 18.
framework were explained to the expert. The experts were then asked which features are important in their technology selection process. They were then asked if they would use the framework for their selection process if they were to do the project again.

Expert opinion verified the majority of the features that were covered in the feature analysis within the Leicestershire Constabulary. A small number of new features also arose from the expert opinion. The features arising from the expert opinions are shown within Table 4.2.2. As evident in the Table, most features arising that were also used in the selection process in Leicestershire were those with a high weighting. This may suggest that the feature analysis incorporates the most important features. However, a common feature from the expert opinion was connectivity, which carried a relatively low weighting in the evaluation exercise in Leicestershire. Experts in Derbyshire and Warwickshire suggested that geographical areas of the Force were largely rural, with limited or no third generation connectivity. Although the Panasonic Toughbook solution appeared attractive to the experts, it relies on a third generation connection to perform efficiently. Compared with Derbyshire, for example, which covers vast areas of the Peak District, Leicestershire is less rural.

The most common features from the experts were access to a camera to capture evidence and a short log on procedure. These two features were not apparent in the feature analysis in Leicestershire. Experts discussed the importance of a simple and short procedure to log onto the device in order to minimise user frustrations. A password is required to log onto the Panasonic Toughbook device, and an additional password is necessary to access the virtual desktop environment. Lack of consideration to this apparently essential feature may prove to be a barrier to user acceptance, and is explored further within Chapter Five. Experts felt that access to a camera facility was a useful feature, and not critical to usage of the technology. Therefore lack of consideration of this feature may appear to be less of an issue. Overall, the results from the verification with the experts indicate that the Leicestershire Constabulary have selected the most appropriate solution, but may wish to give consideration to the procedure to log onto the Toughbooks.
Table 4.2.2: Expert opinion results: verification of features

<table>
<thead>
<tr>
<th>Requirement functionality category</th>
<th>Specific feature</th>
<th>Weighting of feature within Leics</th>
<th>Feature applied in the feature analysis within Leics</th>
<th>Sources of expert opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational features</td>
<td>Software functionality</td>
<td>Access to operational systems</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to email</td>
<td>80</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to electronic forms</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to camera facility</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td>Management of information features</td>
<td>Information management effectiveness</td>
<td>Access to management information (e.g. usage statistics)</td>
<td>90</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good connectivity</td>
<td>30</td>
<td>Y</td>
</tr>
<tr>
<td>Ergonomics &amp; Security Features</td>
<td>User-friendliness</td>
<td>Graphical user interface</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Link to remote keyboard</td>
<td>60</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Ergonomics</td>
<td>Officer safety</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short log on procedure</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Portability of device</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Security</td>
<td>Device security</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data security</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td>Economic features</td>
<td>Cost</td>
<td>Device cost</td>
<td>100</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical support costs</td>
<td>90</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical support availability</td>
<td>-</td>
<td>N</td>
</tr>
</tbody>
</table>

Key: DB = Derbyshire Constabulary
NH = Northamptonshire Constabulary
WR = Warwickshire Constabulary

In addition to verification of the features, the overall framework as a tool to decision-making was well-received by all three experts participating in the research. Experts commonly agreed that the framework can provide several benefits, including user engagement to identify requirements, consideration of a wider range of features, and a robust, structured approach to decision-making. One expert suggested that the framework may complement initial stages industry-recognised project management methodologies, such as project mandate reporting of the PRINCE II methodology. All three experts stated that they would use the framework if they were to conduct the selection process again, as it would provide a guide when entering the ‘unknown’ alongside time pressures imposed by the Government. However, some experts also suggested that it was difficult to clearly define requirements until practical issues were encountered, and was more of a incremental process. It was also indicated that a disadvantage of the framework was little consideration of the sustainability of the technology in the longer term.
4.3 Summary

From this research, an evaluation framework has been developed to enable evaluation of mobile information systems. The evaluation framework consists of:

- a focus group to identify user requirements,
- stakeholder analysis to ensure the most important and influential stakeholder requirements are met in order to minimise resistance to change and evaluate competing needs,
- feature analysis to evaluate potential MIMS solutions against user requirements in an unbiased manner,
- interviews and observation to verify the findings of the framework, both internally and externally.

The framework builds on existing frameworks in the literature, which stress the importance of considering stakeholder needs, but do not suggest how such needs can be managed.

The use of a stakeholder analysis and feature analysis proved popular with senior management, as it allowed more effective dissemination of the pros and cons of each solution, rather than using statistics or long reports. This also ensured that business requirements were driving the final IT decision, rather than senior management who may not necessarily have a full understanding of operational needs of officers. Little work has been documented of the use of such a framework within a policing environment, where senior officers are faced with large quantities of data to make decisions regarding numerous potential initiatives. By presenting information in a graphical format this initiative went from being a potential to an agreed proposal. The results from the interviews and observation suggest that development of an evaluation framework can add to effective decision-making within the field of evaluating information management systems for any organisation, as requirements can be customised to suit the organisation. The framework was used to implement a mobile data terminal solution successfully with full access to systems accessed in the station, thus allowing ‘anytime anyplace’ crime recording; the Constabulary is the first in the UK to do so\textsuperscript{42} \textsuperscript{43}.

The Chapter contributes to the arena of evaluating information management solutions and user requirements by creating an evaluation framework that can be adapted by police forces and other organisations looking to adopt, design and evaluate a usable mobile information system (MIMS). The use of an effective evaluation framework such as the one suggested in this Chapter can minimise the chances of IT failure, by ensuring selection of the appropriate system from the outset. This Chapter has addressed the third objective of the research.

Although the initiative was given the go-ahead from senior management, acceptance from an operational level was crucial. The subsequent Chapter of this thesis evaluates the factors affecting acceptance of the selected mobile data terminal solution.

\textsuperscript{42} BBC News, ref. 38.
\textsuperscript{43} Enderby Eye. Police mobile data to deliver 30 per cent more time on the streets. &lt;http://www.enderbyeye.co.uk/news/news08_130.html&gt;, 10.08.08, [accessed 12.09.08].
Chapter Five: Adaptation of the technology acceptance model for mobile technology in policing

Chapter Preface

Having selected the most appropriate mobile technology solution via a feature analysis, it is important to examine the factors affecting officer acceptance so that issues arising from introducing mobile technology into a hierarchical organisation, such as a police force, can be minimised. There appears to be little understanding of the key factors, yet this is critical to the success of the initiative. A qualitative, partially ethnographic design was followed to allow an in-depth exploration of this issue.

The study was based on a mixed-methods longitudinal evaluation study of the implementation of mobile technology within a UK police force over a nine-month period during 2008. A basic theoretical model, the Technology Acceptance Model (TAM), was then applied retrospectively to determine its suitability within a mobile policing context, and to a lesser extent the Unified Theory of Acceptance and Use of Technology (UTAUT) model. This contributed to the existing body of knowledge on technology acceptance by examining whether existing user acceptance theories are valid within a policing context. Four main categories of officer acceptance factors were identified: officer performance, security/reliability/usability, management style and cognitive acceptance. The TAM alone was not applicable to the officer acceptance factors identified in the study, because the TAM does not take into consideration the external factors within the implementation and social contexts. Consequently, an adapted, holistic TAM (H-TAM) was developed, which incorporated these factors into the existing TAM elements. The generalisability of the H-TAM for mobile technology means it could be applied by other police forces, regardless of the type of mobile device implemented, to address the barriers to acceptance.

The findings within the Leicestershire Constabulary were then validated against findings within other police forces to determine a holistic TAM. The validation phase of this research was based on interviews conducted with five UK police forces, along with a national workshop with the majority of UK police forces. The revised H-TAM from the verification provides practical recommendations to allow police forces to minimise resistance from users. The Chapter presents the results from the triangulation and analysis of the longitudinal data and discusses the findings in relation to other police forces and the existing literature. This Chapter fulfils objectives four and five of the thesis.
Chapter Five: Adaptation of the technology acceptance model for mobile technology in policing

5.1 Background

5.1.1 The importance of investigating user acceptance of mobile technology and validating the holistic TAM (H-TAM)

Despite the apparent benefits of mobile technology, there are also potential barriers that may affect the success of such high profile investment. Manning\(^1\) notes that the introduction of mobile data terminals in a US police force caused disruption to existing business processes and patterns of communication amongst officers. For example, officers were able to perform administrative duties and access information whilst on duty, which caused a reduction in the level of time available to interact with other officers back in the station\(^2\). It is suggested that this element was a factor in limiting the acceptance of the new technology.

Consequently, significant investment from the UK Government into the implementation of mobile devices means it is important to identify the factors affecting user acceptance of mobile technology within a UK police force, the Leicestershire Constabulary. The literature review has shown this is a little-researched area and more studies are needed to understand user acceptance of technology within a policing context. This Chapter reports such factors affecting the acceptance of a mobile data terminal (MDT) solution, which enables officers responding to incidents to have full mobile access to internal and external systems via the same interface available to them from their workplace desktop computer. Therefore, the technology may potentially have a greater impact on organisational practices than approaches taken by other Forces, with mobile access to only email and calendar facilities. This may have wider implications for technology acceptance than smaller scale approaches.

This Chapter investigates the main factors that influence the usage of mobile technology amongst police officers (Section 5.2). Theoretical recommendations are produced to increase the validity of theoretical models within a policing context. Practical recommendations are also produced to allow police forces and similar organisations that have mobilised information processes to maximise the acceptance and usage of such technology, thus exploiting the greatest business benefit. Due to Governmental drivers to implement mobile technology within a limited timeframe, there was significant pressure for the evaluation research to go ahead. This meant that the applicability of two theoretical user acceptance models had to be tested retrospectively in relation to the identified factors, rather than appropriately using theoretical models as an underlying basis for the research.

Glomseth & Gottschalk\(^3\) argue that there seems to be no such thing as one single police culture, and it is affected by the organisation, structure and tasks. This is viewed as occupational culture, which involves accepted practices, rules and principles of conduct that are applied to a variety of situations. For example, their research found that the key factors of the occupational culture of the counter-terrorism unit within a Norwegian police force was deadlines, whereas police officers in the criminal investigation unit felt sufficient time was important in their job\(^4\). Similarly, Christensen & Crank\(^5\) found cultural differences

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2 Ibid., p. 362.
4 Ibid., p. 11.
between police officers in urban and non urban areas e.g. non urban police officers were less concerned with action, risk, excitement and crime fighting, while Reuss-Ianni\textsuperscript{6} made a distinction between street cops and management cops. Such occupational cultural differences may imply that different factors need to be considered in order to maximise the acceptance of new technologies, by ensuring that the technology provides benefits in accomplishing the needs and demands of particular officers. It is important to test the adapted model to ensure that it fits to a variety of contexts and accommodates variations in culture.

Consequently, Section 5.4 of this Chapter tests the findings regarding user acceptance within other UK police forces to ensure that the barriers to user acceptance can be addressed by any police force implementing or about to implement mobile technology.

5.1.2 The research domain

The objective of the study was to investigate the factors affecting officer acceptance of the MDTs and to apply the two theoretical models retrospectively to see which best fits within a mobile policing context. Ideally, the TAM and the UTAUT would have been used as a basis for the research model, but practical constraints of time arising from significant Governmental pressures made this a non-feasible option. The Constabulary were under pressure to gather data quickly that demonstrated the potential of MDTs in order to acquire funding from external bodies. Thus the data were collected within a two-week pilot study and the TAM and the UTAUT were applied following the collection of data.

A qualitative, partially ethnographic design was followed to allow an in-depth exploration of the factors affecting user acceptance. Although related research has adopted a quantitative, statistical approach\textsuperscript{7} it was felt in order to meet the aim of the research more depth was necessary to understand potential barriers to usage of mobile devices.

Following a two-week pilot study, subsequent data for this research were based on a longitudinal evaluation study of the implementation of MDTs in response vehicles. This was conducted over a nine-month period, from March to December 2008. The initial pilot study involved data being collected prior, during and after the pilot, and subsequent evaluation followed the wider rollout of MDTs (Table 5.1.1). Participants within the Constabulary were selected for focus groups, interviews, observational ‘work-shadowing’ and questionnaires, as follows:

- The focus groups (detailed in Appendix 2c) provided a forum for open discussion, where the aim was to extract qualitative information and reach consensus regarding officers’ experiences and perception of the impact of mobile technology prior to and after the trial. Data collected in the focus groups covered the impact on work practice, the situations and processes that the officers used MDTs, how they enhanced or hindered their work practices, and the main perceived risks and benefits of mobile technology.

\textsuperscript{6} Reuss-Ianni, E. Two cultures of policing: street cops and management cops, 1993, p. 6.
\textsuperscript{7} Colvin, C. A. & Goh, A. Validation of the technology acceptance model for police. \textit{Journal of Criminal Justice}, 2005, 33, 94.
- Semi-structured interviews (Appendix 2d) were conducted in three groups with a total of 12 staff from the Call Management Centre to investigate the impact of the pilot project on their own work practices, in terms of benefits and challenges arising.
- Observation (‘work-shadowing’) (Appendix 2e) was conducted during the two-week pilot period by a team of nine observers in order to evaluate the use of each MDT device in context. The work shadow exercise was conducted during a range of early, late, day and night shifts in order to explore the usage of mobile technology in a variety of situations. A total of 38 incidents were shadowed throughout the course of around 20 shifts. Observation allowed the researcher to investigate the actions and behaviour of people within natural circumstances, and collect data that could be used to complement focus group and survey findings.
- A questionnaire was employed to obtain quantitative information regarding the usage and perceptions of MDTs (detailed in Appendix 2b).

Selection criteria for participation in the pilot project included apparent enthusiasm to engage with MDTs on the part of the officers concerned. For the wider evaluation study participants were selected on the basis of purposive sampling in terms of whether they had received training for the MDT and their availability for questioning. It is recognised that this sampling technique may have biased some of the findings, as less enthusiastic, proficient users may have been excluded from the pilot. However, it was important to the success of the implementation project to involve more proficient users. It is important to recognise that this was important for the ‘action’ but less than ideal for the ‘research’, and that results from the pilot may not be fully representative of full implementation.

The findings regarding officer acceptance of mobile technology were then verified to ensure their applicability within a wider policing context. This was achieved through semi-structured interviews with project managers of mobile technology within five UK police forces: Cheshire, Essex, Humberside, Lancashire and Wiltshire. The author also participated in an action research workshop run by facilitators from the NPIA branch of the UK Home Office, where representatives from all UK police forces involved in the implementation of mobile technology were present. The workshop aimed to identify on a national level the factors preventing full usage of mobile devices. Representatives from each Force recorded factors on post-it notes and the findings were presented in an overall report.
Table 5.1.1: The Research Domain

<table>
<thead>
<tr>
<th>Stage of study</th>
<th>Phase of longitudinal research</th>
<th>Time period</th>
<th>Method</th>
<th>Response rate</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Identification of factors affecting user acceptance</td>
<td>Pilot study</td>
<td>Pre-pilot: March 2008</td>
<td>Focus groups</td>
<td>30 participants</td>
<td>Operational officers participating in the pilot project</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Questionnaire</td>
<td>100 per cent response rate; 30 respondents</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two-week pilot study: April 2008</td>
<td>Observational 'work-shadowing'</td>
<td>60 per cent response rate; 18 out of 30 participants</td>
<td>Operational officers participating in the pilot project</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Focus groups</td>
<td>30 participants</td>
<td>Stakeholders not directly involved in frontline duties – call management centre personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Questionnaire</td>
<td>As pre-pilot questionnaire</td>
<td>Stakeholders not directly involved in frontline duties – call management centre personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-pilot: May 2008</td>
<td>Interviews</td>
<td>12 participants</td>
<td>Stakeholders not directly involved in frontline duties – call management centre personnel</td>
</tr>
<tr>
<td></td>
<td>Wider evaluation</td>
<td>October to December 2008</td>
<td>Focus groups</td>
<td>48 participants</td>
<td>Stakeholders not directly involved in frontline duties – call management centre personnel</td>
</tr>
<tr>
<td>ii. Verification of officer acceptance and the H-TAM</td>
<td>Not applicable</td>
<td>September 2009</td>
<td>Interviews</td>
<td>5 police forces: Cheshire, Essex, Wiltshire, Lancashire, Humberside</td>
<td>Project managers of mobile technology within each police force</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Action research workshop facilitated by the NPIA of the UK Home Office</td>
<td>All UK police forces</td>
<td>Representative s from all UK police forces involved in mobile technology projects</td>
</tr>
</tbody>
</table>

Demographics of the Sample

During the pilot study data were collected from 30 operational officers. The sample consisted of 94 per cent males and six per cent females. A significant number of officers (47 per cent) ranged from 18 to 44 years old. A major proportion of officers held between six to ten years of policing experience (59 per cent). Most officers (53 per cent) rated their computer competence as ‘proficient’ i.e. they use a computer all the time and know most of its features.
5.2 Results and Discussion: The applicability of findings to the TAM and UTAUT

TAM applicability

The user acceptance categories and factors identified (as shown in Table 5.2.1) from the longitudinal study were mapped to the existing TAM to assess how well each factor fits with the elements of the TAM. An interpretive approach was taken to analysing the data from the various methods. This was achieved via the creation of a thematic grid. Themes that consistently emerged from the data within the thematic grid over the longitudinal time period were considered to be important user acceptance factors. The analysis produced 17 different themes, which were then grouped manually into four overarching categories: performance, security/ reliability/ usability, management style and cognitive factors.

Based on this mapping, it is apparent that the TAM is appropriate for some intrinsic performance factors. ‘Perceived usefulness’ (PU) is suitable for functionality of MDTs, officer efficiency, inputting and accessing information. ‘Perceived ease of use’ (PEOU) supports usability of MDTs. PEOU also maps to the reliability/ security/ usability of the MDT and the level of officer safety as a result of MDT usage.
Table 5.2.1: Technology acceptance categorises and factors identified from the research and mapped against the user acceptance factors of the TAM

<table>
<thead>
<tr>
<th>Overarching theme</th>
<th>MDT officer acceptance factors</th>
<th>TAM element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational performance factors</td>
<td>Officer performance</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Functionality</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Data quality</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Inputting information</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Accessing information</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Sharing information</td>
<td>N</td>
</tr>
<tr>
<td>Security/reliability/usability factors</td>
<td>Reliability</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Security</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Interface design</td>
<td>-</td>
</tr>
<tr>
<td>Management style factors</td>
<td>Training &amp; organisational support</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Officer level of IT skills</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Level of officer involvement</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Level of information about MDTs</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Officer safety</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Health &amp; safety</td>
<td>N</td>
</tr>
<tr>
<td>Cognitive factors</td>
<td>Officer perception of MDTs</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Influence of peers</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Public perception</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Culture</td>
<td>N</td>
</tr>
</tbody>
</table>

Key: Y = factor supported in the TAM element
N = factor not supported in the TAM element
- = factor not relevant to the TAM element

However, the performance factors of data quality and sharing information are not supported by the TAM. In parallel, Colvin & Goh\(^8\) found that additional factors to those in the TAM i.e. information quality and timeliness were the most important components of user acceptance due to the nature of police work. Furthermore, the wider organisational issues of officer involvement and information about MDTs, health and safety, officer/public perception, influence of peers and organisational culture are not considered within the existing TAM. The results from the longitudinal study show that these factors could also play an influential part on the user acceptance of MDTs, especially in terms of the implementation style and social aspects. This is particularly true of the influence of peers due to the close bond formed with colleagues.

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\(^8\) Colvin & Goh, ref. 7, p. 94.
Money & Turner\textsuperscript{9} and Huang \textit{et al}\textsuperscript{10} argue that external variables must be considered when applying TAM in another context, and thus further research into the factors affecting usage of technologies is needed. For example, managerial style can affect usage but this is not considered in the model. The TAM has also been criticised for giving little attention to the context and the organisational culture in which the technology is used. Chan\textsuperscript{11} notes that the traditional and rigid structure of policing can sometimes present difficulties to implement change. Allen \textit{et al}\textsuperscript{12} concur with the notion of change, suggesting that mobile technology is being introduced into police forces as a tool, ignoring the impact of the tool on work practices and wider organisational issues. Collerette \textit{et al}\textsuperscript{13} highlight the need to incorporate social dimensions into managing adoption of a new police information system. Similarly, Lu \textit{et al}'s\textsuperscript{14} review of handheld computer adoption in healthcare found that the adoption rate for physicians in the USA and Canada is 40 per cent and wider organisational and institutional adoption is relatively slow, because a lack of organisational support and training and usability issues contributes towards a lack of motivation to use the devices. In other words, the level of adoption may depend on the organisational culture and employee attitude towards change. Cognitive factors are a key consideration and are supported by Kim \textit{et al}. In addition, Legris \textit{et al}\textsuperscript{15} reviewed TAM empirical research and found a high level of inconsistencies, suggesting that the postulation of TAM that external variables intervene indirectly by influencing PEOU and PU are not sufficient to predict IT adoption. Consequently, they recommend that TAM is integrated into a broader model that includes organisational and social factors in order to improve TAM’s predictive capacity\textsuperscript{16}. It is acknowledged by Orlikowski and Hofman\textsuperscript{17} that the effectiveness of a change process relies on the interdependence between the technology, the organisational context and the management style used to manage the change. This suggests that it is important to study the external factors because they are the ultimate drivers of usage yet they have received little attention in the literature. Moreover, Burton-Jones & Hubona\textsuperscript{18} challenge the assumption that TAM fully mediates external variables through user beliefs and found that including the direct effect of external variables can improve predictions of technology usage by up to 250 per cent.

**UTAUT applicability**

It is evident from an analysis of the MDT factors against the UTAUT elements of performance expectancy (impact on performance), effort expectancy (ease of use), social influence (influence of

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\textsuperscript{9} Money, W. & Turner, A. Application of the technology acceptance model to a knowledge management system. In: Proc. 37\textsuperscript{th} Annual Hawaii International Conference on System Science: Hawaii: January 05-January 08, 2004.


\textsuperscript{11} Chan, J. B. L. The technological game: how information technology is transforming police practice. *Criminology and Criminal Justice*, 2001, 1(2), 156.


peers) and facilitating conditions (level of organisational support) that the UTAUT supports the identified factors from the research. These include reliability, performance, officer safety, officer perception of MDTs, functionality and usability. It also appears to support factors that the TAM did not, including training & organisational support and influence of peers. However, it still does not support the factors of public perception of MDTs, data quality, security, health & safety, inputting information, accessing information, sharing information, level of officer involvement, and organisational culture. Therefore, the UTAUT could be considered more applicable to a mobilised policing context than the TAM, but further factors must be considered. The following section reviews the four categories and the factors identified by this research, and discusses their role within a holistic technology acceptance model.

Factors affecting user acceptance of mobile technology

The factors for each category were further analysed by producing a cognitive map (Figure 5.1.1). Cognitive maps have the advantage over lists or tables, as they can show graphically how each factor influences the others, and whether an increase in one factor leads to an increase or decrease in the other. The following section explains the themes within each category.

Figure 5.1.1: Cognitive map of factors affecting user acceptance of mobile technology

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5.2.1 Operational performance factors

Some of the factors within the overarching category of operational performance support the elements of the TAM. The factors relating to inputting and accessing information positively influenced PU of MDTs. With regard to inputting information, focus group and work-shadow participants reacted enthusiastically to the time savings afforded by the ability to create and update crime reports directly. Before MDTs, officers returned to the local police station to input information, and limited availability meant they often queued until a desktop computer became available. MDTs also bypassed the three-day delay for information to become available electronically via the paper-based crime-recording process. However, the lack of an electronic signature facility for authorising statements from victims negatively influenced PU.

Conversely, the TAM does not appear to account for the apparent improved accuracy of information as a result of MDTs, and the negative impact on knowledge sharing. Focus group participants stated that more accurate information could be obtained via MDTs than the radio. During the work-shadow exercise it was observed that officers were able to input information into information systems via MDTs without delay, thereby eliminating loss of information caused by recording information after a busy shift. This in turn improved the level of real-time intelligence available to officers for decision-making. Furthermore, pre-pilot participants expected that the level of face-to-face contact and opportunities to share local knowledge with other officers whilst on patrol would reduce. Participants felt that this may reduce the ability to identify links between pieces of information and thus reduce officer performance. In reality, this concern was met and may have reduced the level of user acceptance, but these factors do not fit with PU or PEOU, and thus must be integrated into a more holistic TAM.

5.2.2 Security/ reliability/ usability factors

Reliability factors negatively affected PEOU, and included poor battery life, network coverage and connection speed throughout both phases of the research. Consequently, radio usage increased and MDT usage decreased over the period of the project. Security factors also had a negative impact on PEOU. Officers placed greater demand on the CMC for information due to the low level of privacy from rear-seat passengers in the patrol car, and the inability for the MDT dock to tilt towards the driver. Likewise, the results of a similar study concur that coverage, connection and security issues must be addressed if technology has any chance of being used.

The software interface of the MDT positively influenced PEOU, as it is the same as the desktop interface used by officers in the police station, thereby reducing the level of cognitive effort required. The majority of participants from both phases of the research agreed this made MDTs usable. However, PEOU was reduced by the poor visibility of the external keyboard and effort required to log onto an MDT. Consideration of the logging on procedure in the selection process (Chapter Four) may have helped to minimise impact on PEOU.

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5.2.3 Management style factors

Management style emerged as an important determinant on officer acceptance, but its underpinning factors (except officer safety, training/ organisational support and IT skills of users) are not intrinsically related to PU or PEOU of MDTs. However, to promote officer acceptance the influence of decisions taken by management must be considered within a holistic TAM.

The impact of MDTs on officer safety emerged as a key factor within both phases of the study. Pre-pilot participants perceived that officer safety would improve, thereby positively influencing PU. It was felt that MDTs could be used to obtain a more in-depth risk assessment of those involved in an incident than could be had via the radio. Correspondingly, the work-shadow exercise observed instances of participants accessing history and warning markers via the MDT, making officers better informed. However, some pre-pilot participants suggested that management decisions, such as the expectation for officers to make few returns to the station, an increase in single-crewed vehicles and changes to shift start times might reduce opportunities for sharing warning markers face-to-face and have a negative impact on officer safety, thus reducing PU of MDTs. For this reason, ‘officer safety’ is a ‘management style’ factor. This issue was validated during post-trial and phase two focus groups, especially since management have introduced a location-monitoring device on MDTs to audit the number of return trips. Similarly, Norman & Allen\textsuperscript{21} report an overall concern amongst officers of a ‘road warrior’ lifestyle on the level of knowledge sharing.

The level of training and organisational support boosted PEOU of MDTs. Most pre-pilot focus groups participants concurred that the training provided for the pilot had been adequate, as the MDT has the same systems and interface used in the police station. The level of IT skills supported this: 78 per cent of pre-pilot questionnaire respondents described they had proficient IT ability to make competent use of MDTs. Therefore PEOU in relation to training may be lower for less technology literate officers.

Although officers participated in the pilot and were invited to give feedback, management had already made decisions regarding the functionality and type of device. Regardless of officer feedback, management seemed satisfied that they had made the correct decision and were unlikely to change the technology having already made a significant investment in the MDTs. For example, it was reported throughout the longitudinal study that the position of the MDT vehicle dock could cause health and safety issues, such as poor posture and eyestrain. These factors suggest that a lack of user involvement in the decision-making process had a negative impact on officer acceptance, but are not intrinsically related PU or PEOU of MDTs. Related research also highlights a need to consider more extensive factors including user involvement and communication of information throughout the development of a new police information system in order to allow successful change\textsuperscript{22, 23, 24}. In light of this, an apparent lack of information about the mobile project appeared to have a negative impact on PEOU. For example, there were instances where focus group participants were unclear about why they were attending the focus groups. The session was simply scheduled into their work roster by their supervisor without little

\textsuperscript{21} Ibid., p. 225.
\textsuperscript{22} Collerette et al, ref. 13, p. 163.
\textsuperscript{23} Norman & Allen, ref. 20, p. 224.
explanation about the purpose of the session. This may also reflect the command-driven nature of policing organisations.

5.2.4 Cognitive factors

Factors including officer and public perception of MDTs, organisational culture and influence of peers emerged from the data. These factors were grouped together under the category of cognitive factors, which relates to intangible factors that indirectly influence officer acceptance of MDTs.

The general consensus from phase two focus groups was that despite some of the reliability issues, MDTs are considered ‘a good bit of kit’ and better than having no information at all. From the post-pilot questionnaire, 88 per cent of respondents stated their colleagues were positive towards MDTs and all respondents agreed that the devices should be rolled-out across the Force. Furthermore, during the work-shadow exercise the majority of participants reported that MDTs had increased their job satisfaction during the course of a shift. This was mirrored in the post-trial focus groups, as officers suggested that the enhancements to overall efficiency and effectiveness led to feelings of empowerment. However, during the stakeholder interviews, CMC personnel expressed concerns over possible job redundancies, as MDTs have the potential to reduce the role of the control unit. Despite this, the main users of MDTs have a positive perception of MDTs. Agrawal et al.\textsuperscript{25} found that job satisfaction increased as a result of MDTs, since operational duties became more interesting and challenging.

Since strong bonds between fellow police officers are apparent in law enforcement, in the early stages of implementation problems are likely to be quickly echoed to peers and create a negative climate\textsuperscript{26, 27}. Lin et al.\textsuperscript{28} argue that individual officers often team up for task planning, execution and contingency management. Due to this, the pilot participants acted as ‘super-users’, which appeared to boost PU amongst more change-resistant officers. Additionally, focus group participants from both phases of the study were concerned that management decisions related to the use of MDTs (section 5.2.3) might damage existing shift culture, due to reduced opportunities to share intelligence face-to-face (for example during meal breaks). Furthermore, participants from each phase of the longitudinal research were concerned about the short timescale that they were expected to adjust to the change of staying out of the station and being more self-sufficient. It was suggested in the wider evaluation that the nature of the police service means it can be difficult to adapt to a culture change, and since there has been a ten-year culture of returning to the station officers perceived it would take longer than a few months to adjust and accept this new way of working. This may reflect the hierarchical command nature of policing, where superiors make changes and expect officers to adjust accordingly. Organisational culture is therefore an important factor that must be considered within a holistic TAM.

\textsuperscript{26} Collerette et al. ref. 13, p. 164.
\textsuperscript{27} Manning, P. K. The technology of policing: crime mapping, information technology and the rationality of crime control, 2008, p. 47.
5.3 Practical Implications

In this study, the main barriers to achieving officer acceptance are low awareness of the benefits that MDTs offer; reduced functionality; usability, security and reliability issues; increased isolation; minimal opportunities for familiarisation with MDTs in non-operational settings and minimal level of officer involvement in the decision-making process. In order to overcome these barriers, the following recommendations have been made which may be of benefit to other police organisations using or about to implement mobile technology:

1. To increase PU usefulness of mobile technology, organisations could consider:
   a. Selling the benefits of the technology to the user, perhaps through demonstrations and clear communication;
   b. Providing critical additional functionality, such as the provision of an electronic signature function for witness statements, along with wireless and illuminated keyboards, and a more flexible screen solution that allows for pivoting towards the driver.

2. PEOU might be increased if organisations seek to:
   a. Overcome the reliability issues that are affecting the level of usage, including battery life, network coverage and speed;
   b. From a wider implementation context, provide opportunities to allow officers to familiarise themselves with the MDT in non-operational settings;

3. More importantly, external factors that do not feature in the TAM must be addressed, such as organisational culture and management style:
   a. Maintain widespread, ongoing and effective communication of information concerning the project across all levels of an organisation;
   b. Involvement of officers in the design process to identify main requirements of MDTs from an early stage, through the use of user workshops;
   c. Ensure continued opportunities for face-to-face interaction between officers, so that reductions in time spent in stations does not lead to a loss of team spirit and morale, or a reduction in formal and informal exchange of knowledge and intelligence. This might be achieved through the continued use of face-to-face briefings and informal meetings, such as refreshment breaks, and regular use of double-crewing;
   d. Leverage the strong influence of peers on officer acceptance via project champions to promote the benefits of mobile technology via frequent word of mouth from the more proficient officers to the less proficient, more resistant users.

Based on the findings of this study, an adapted holistic model of acceptance of mobile technology has been developed (Figure 5.3.1). By incorporating external variables such as management style and cognitive factors, an implementation strategy that is more closely aligned with the expectation
Chapter Five: Adaptation of the technology acceptance model for mobile technology in policing

of police officers may be developed. This can be applied by police forces to address barriers in order to increase officer acceptance of such MDTs and handheld devices. However; to ensure its validity it is important to validate the existing TAM with other UK police forces. This was investigated and is discussed in Section 5.4.

![Figure 5.3.1: A Holistic Officer Acceptance Model of Mobile Technology (H-TAM) (adapted from Lin et al29, 30)](image)

5.4 Verification of the H-TAM

5.4.1 Research Domain

As discussed in Section 5.1.2, semi-structured interviews were conducted with representatives from five police forces to verify the H-TAM shown in Figure 5.3.1 and identify the wider applicability of factors identified within the Leicestershire Constabulary. The police forces were sampled on the basis of purposive sampling, as it was important to capture a range of mobile devices (MDT or handheld) and expertise (length of time the technology had been in use). The interviews were conducted with project...
managers (PMs) of mobile technology. Although there may be potential bias with interviewing those who have a vested interest in the mobile technology project, it is believed that project managers have the best understanding of the key implementation issues that need to be addressed. The characteristics of the sample are shown in Figure 5.4.1. Alongside this, data collated at a workshop facilitated by the NPIA was also applied to the H-TAM.

During each semi-structured interview, the model (Figure 5.3.1) was presented to mobile data project managers of each force. In order to avoid capturing the previously discussed bias from project managers, it was important to phrase the interview questions in a way that would not focus on one specific aspect of officer acceptance, such as the reliability of the signal strength of a particular device. Therefore, participants were asked about the extent to which the model encapsulates the experience of mobile technology in their force, whether there was anything that they would change in the model when

Figure 5.4.1: The sample, within the UK, during the verification phase of the H-TAM
rolling out mobile technology in their force, and if so, what they would change. Each interview was transcribed with consent of the respondent (copies of the transcripts are available upon request).

5.4.2 Results and discussion: the applicability of the holistic TAM

The transcripts of the semi-structured interviews and NPIA workshop were analysed by using the qualitative analysis package, Atlas.ti in order to identify the common themes and factors emerging from the data. This set of data was coded using Atlas.ti to identify the frequency of factors within the H-TAM, and any new themes emerging from the additional data beyond the Leicestershire Constabulary were coded as a new user acceptance factor. As discussed in Section 3.7, the use of thematic grids was also used. Quantitative analysis was conducted on the data set in order to identify the most common factors throughout different police forces. Atlas.ti was used to export to Microsoft Excel the frequencies of factors within each interview and NPIA workshop, and total frequencies of each factor emerging from the transcript documents (see Table 5.4.1). This technique is commonly referred to as content analysis, which enables quantitative analysis of communication messages. Miles & Huberman argue that because words usually have multiple meanings, in some cases it is more appropriate to use numbers to reduce ambiguity. In terms of answering the research question, this makes it clearer to verify the H-TAM by reducing the interview transcripts and identifying common patterns. In order to avoid loss of richness of data, Bryman & Hardy recommend keeping any words and numerical data together in the analysis.

Based on the results of the content analysis (Table 5.4.1), it is evident that within a wider policing context the most influential overall officer acceptance factors are:

- Level of information provided about mobile technology (13.06 per cent of all documents);
- Level of training (10.81 per cent of all documents);
- Level of officer involvement in decision-making (10.36 per cent of all documents);
- Reliability (8.11 per cent of all documents);
- Peer influence (8.11 per cent of all documents);
- Officer efficiency (6.76 per cent of all documents);
- Functionality of the device (5.86 per cent of all documents).

A large percentage of these factors are external factors, which supports the notion that wider implementation issues, not intrinsic to the mobile device, must be considered to increase PEOU and PU; these are not currently considered within Davis’ TAM. Similarly, the least frequent factors within the content analysis are mostly internal factors, including data quality (less than one per cent of all documents), inputting information via a mobile device (less than one per cent of all documents), security of the device (1.80 per cent of all documents), and health and safety (0.90 per cent of all documents). More importantly, the most frequent overall theme was management style (40.5 per cent of all documents).

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32 Miles, M. B. & Huberman, M. Qualitative data analysis: an expanded sourcebook, 1994, p. 56.
33 Bryman & Hardy, ref. 31, p. 562.
documents), compared with officer performance factors (26.62 per cent of all documents), cognitive factors (21.62 per cent of all documents), and security/reliability/usability factors (14.86 per cent of all documents). The magnitude of management style factors during the implementation process may be less surprising within a rigid, hierarchical chain command organisational structure. However, these results also suggest that intrinsic PU resulting from the officer efficiency factors is also an important influence on officer acceptance and must also be considered. Although the use of percentages does not provide an in-depth picture, it is useful to identify the common factors within a wider policing context.
Table 5.4.1: Content analysis of factors from the H-TAM within other UK police forces
(N.B. figures refer to occurrence of factors within the interview transcripts)

<table>
<thead>
<tr>
<th></th>
<th>Handheld devices</th>
<th>HH &amp; broadband</th>
<th>MDT</th>
<th>All devices</th>
<th>Overall totals/percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yorkshire</td>
<td>Essex Police</td>
<td>Cheshire Police (interview)</td>
<td>Cheshire Police (NPIA presentation)</td>
<td>Wiltshire Police (interview)</td>
</tr>
<tr>
<td>Accessing information</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inputting information</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Data quality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Officer efficiency</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sharing information &amp; knowledge</td>
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<td>1</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Functionality</td>
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<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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<td></td>
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</tr>
<tr>
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<td>2</td>
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<td>0</td>
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<tr>
<td>Interface design</td>
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<td>2</td>
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<td>0</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Officer level of IT skills</td>
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<td>3</td>
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<tr>
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<td>Level of information about mobile technology</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Officer perception of mobile technology</td>
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<td>3</td>
<td>5</td>
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<td>Public perception of mobile technology</td>
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<tr>
<td>Total</td>
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<td></td>
</tr>
<tr>
<td>TOTALS:</td>
<td>34</td>
<td>53</td>
<td>64</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Officer performance factors</td>
<td>Security/reliability/usability factors</td>
<td>Management style factors</td>
<td>Cognitive factors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Operational performance factors

As discussed in the previous Section, the two widely agreed factors regarding operational performance amongst the research sample were the functionality of mobile devices and the impact of mobile technology on officer efficiency. The main issues of the ‘officer efficiency’ factor related to direct access to information for purposes of identification and updates, resulting in a greater number of arrests and thus an increase in the PU of mobile technology.

In addition to identification, it was suggested by PM 2 from the Cheshire Police that the ability afforded by mobile technology for officers to save time when updating details had a positive impact on PU:

*What typically happens is if an officer attends a missing persons incident, they will be dispatched to the address of the parents/ care home etc and take a photograph of the missing child, then drive all the way back to the station, scan the photo and attach it to the document, which will then be available to all officers to download. Instead, an officer can take a photograph on the PDA and ping it out to all officers* (PM 2, Cheshire Police).

However, there was a less positive aspect in that PMs 3 and 5 suggested mobile technology could act as a means of monitoring what police officers are doing and remove an element of trust. This might reduce PU of mobile technology.

With regard to the functionality of mobile devices, the key points related to a shortage of functionality on the devices. These included a poor input interface, lack of access to additional systems or the available functionality within systems, and the removal of the telephony feature from the handheld devices. The poor interface to input information is highlighted by a comment from PM 5 within the Yorkshire Police Collaboration:

*Yeah, these are our devices [shows PDA]; it doesn’t actually come with a flip-out keyboard…it’s still top-pocket technology in terms of policing but you wouldn’t slip it in your back pocket and take it down the pub in your jeans…but if this did come with a slip-out keyboard then the same people who are complaining about the on-screen keyboard would be complaining about the bulkiness of the device.* (PM 5, Yorkshire Police Collaboration).

As found in the study in the Leicestershire Constabulary, it appeared that a common issue negatively affecting PU of mobile devices throughout UK police forces was the lack of access to systems. Despite this, some project managers commented that PU can be increased by acting on user feedback, such as increasing the functionality.

With regards to the H-TAM, these two factors strongly support the findings within the Leicestershire Constabulary and their impact on officer performance and thus PU should be considered a key focus within the implementation process.
Security/reliability/usability factors

The content analysis showed that overall the main factor negatively affecting PEOU of mobile technology across all police forces studied was reliability. In particular, the main issues related to connectivity, speed and battery life of the device.

As apparent within the Leicestershire Constabulary, the connectivity of mobile devices was a key factor affecting PEOU amongst PMs 4, 6, 9 and the NPIA workshop participants. Project managers 3 and 7, and participants from the NPIA, supported the importance of a good battery life on PEOU. In addition to this, it was found that the time required to log on, as common within the Leicestershire Constabulary, was a major issue affecting PEOU.

These issues, as discussed in Section 5.2, are already incorporated into the H-TAM and therefore can be seen to verify the model within a wider policing context.

Management style factors

From the content analysis, management style factors emerged as the most frequently cited theme and therefore strongly validate the H-TAM, in terms of consideration of the implementation context. Within this theme, the content analysis found that the most common factors were the level of training, the level of officer involvement, and the level of information about mobile technology.

The negative impact of the low level of training provided during the implementation process on PU was widely mentioned within the interviews, and therefore strongly validated this factor of the H-TAM. The notion that the lack of real-life scenarios within training programmes and the short duration of training courses may affect PU was confirmed in the interviews. It was found that one police force had addressed this by providing a full training package that takes a hands-on approach and makes use of scenarios and real-life exercises, as demonstrated by the following quote:

"The approach to rollout is quite important. We started off by giving a full training programme with individuals. We took the devices to the officers and then trained them how to use the device and the mobile applications over a two-week period. Secondly, we used a computer-based programme to teach officers how to navigate around a device. Supervisors would allocate two hours within their shift for their officers to do the computer-based training and officers use the PDA during their work time by accessing email and other applications to familiarise themselves with the device. Following the computer-based training, we called the officers back in to a one-day workshop, which was scenario-based. We're not teaching them how to be police officers; we’re teaching them how the mobile device will help them in certain circumstances to be able to do work in a more effective way, and in the place where an officer needs to do the task. (PM 7, Wiltshire Police)"

Alongside the importance of training, project managers 3, 7 and NPIA workshop participants supported the key factor of officer involvement in the decision-making process. This was apparent by stressing the need to promote PU by constantly gaining and acting upon officer feedback: - This is illustrated in the following remarks:
We normally have a chat with our officers. I mean for our officers, we have a feedback email and a user group and we do encourage the officers to write to us. We’re really trying to do some stuff now that’s engaging the officers again. In the user group, we had a mixture of roles, ranks, divisions, units…everyone really. With the user feedback we always try to action it. We go back to the officers and say ‘you asked us to do this…you told us it was a problem…we’ve done something’. (PM 3, Essex Police).

The most frequently occurring factor from the content analysis was the level of information provided to users about mobile technology. Project managers 1, 2, 3, 5, 7, 8 and NPIA workshop participants strongly emphasised the importance of ensuring that users, not just operational officers but key stakeholders such as control room personnel, are kept informed about the core purpose of introducing the technology, and suggested that not doing so may have a negative effect on PU of mobile devices:

[PM 1] I mean, underpinning all this [the model] is WHY?

[PM2] Well that’s in the ‘level of information about MDTs’ factor isn’t it, it’s not just telling the officers how to use the technology but why they are using it.

[PM 1] Yeah but it’s underpinning the whole thing, because at the end of the day if you haven’t got a bloody good reason why you’re doing it then all these factors disappear - you don’t need a device. I think user acceptance is about getting people brought into that idea.

(PM 1 & 2, Cheshire Police)

Related studies, including the findings within the Leicestershire Constabulary and by Collerette et al\textsuperscript{34} also demonstrate the importance of the communication of information throughout the development of a new information system in order to allow successful change.

Cognitive factors

As evident in Table 5.4.1, during the verification phase of the research the influence of peers was also a common factor within the cognitive theme. This factor proved to be particularly influential on PU of MDTs within the Leicestershire Constabulary, whereby more proficient users acted as ‘super users’ to the less proficient, more change-resistant officers (Section 5.2.4). As demonstrated by the quote below, similar findings were also reported within other UK police forces, suggesting that making use of project champions may be one of the most significant means to increase PU amongst users. Due to close bonds that are apparent within law enforcement, as a result of officers working in teams to solve problems, the influence of peers is an important consideration and therefore a key factor within the H-TAM.

\textsuperscript{34} Collerette et al, ref. 13, p. 164.
Having done the workshop, remaining officers have support through divisional champions who will assist the other officers with any difficulties. We also have a small team in the project team who are operational police officers to provide credibility. These assist with the rollout and do the workshop training, and talk to the users in terms of how the device is used operationally along with their experiences with the devices.

(PM 7, Wiltshire Police).

New officer acceptance factors: management style

New factors emerged from the verification phase of the research, which did not appear as officer acceptance factors within the Leicestershire Constabulary. These factors included the need for local leadership and supervision, senior management buy-in to encourage usage of the devices, and the amount of time to implement mobile technology. These factors are extrinsic to properties of the technology and therefore are not accounted for by the TAM or the UTAUT.

It was highlighted throughout the verification phase that in order to increase usage amongst operational officers, it is vital that local supervisors, i.e. the sergeants of the officers, encourage their officers to use their device and raise questions when an officer spends a significant period of time inside their police station. This finding may relate to the hierarchical, command-nature of policing.

[PM1] Local factors need to be considered within the TAM model. For example, we didn’t get the supervision on board. Even now, local supervision still haven’t got a clue why we are telling officers to use the devices. We are looking to address this now. Officers need their supervisors to kick them out and question why they’re in there..

[PM2] Years ago, the sergeant was kicking officers out of the station and asking them why they were back in the station…officers had to ask permission to go back to the station…whereas now IT has dragged them all in and given them a valid reason for coming back in and now officers are set in that way aren’t they?

[PM1] Yes…now we have a non-confrontational culture in the police…very ‘soft’…sergeants have two years service…they’ve not been told how to supervise in a rigorous way…that’s all fallen away…the supervisor wants to be best mates with their team…and they’re going to start kicking officers out of their station?!…I don’t think so! (PM 1 & PM 2, Cheshire Police).

It was also highlighted that usage could be promoted via publication of usage figures, in order to promote healthy competition between local policing units. Project managers 1, 2, 3 and 6 and NPIA participants suggested that supervisors of policing units with low usage levels might feel encouraged to increase their usage in order to appear better than their rivals. Since the culture of policing has an element of inter-departmental camaraderie this may be successful.
In addition to local supervision encouraging usage, it was highlighted from the experience of other police forces that there needs to be buy-in from senior management in order to promote usage from the top-down. Although this was less of an issue within the Leicestershire Constabulary, because senior management were already keen to implement MDTs prior to the development of the Governmental initiative, it may be an important factor for other police forces. Senior management of later adopting police forces, who are implementing mobile technology because of the drive from the Government, may be less enthusiastic. The main comments raised by three of the five police Forces included the need for buy-in from Chief Constables, and enforcement of usage from the highest level of the organisation. Again, due to the hierarchical, command-nature of policing this is a key factor in promoting officer acceptance. However, in less authoritarian organisations this factor might not be effective, and may have a negative effect on user acceptance, which is why the H-TAM in this study remains specific to only policing organisations. This newly emerging factor from the interviews is exemplified in the following comment:

We had a total bastard take over our force two years ago...he’s come in and absolutely kicked arse...turned up at local police stations and said to officers ‘what are you doing in here, get out!’ He’s been an absolute Godsend! So the new chief has had this effect and the officers are really up for it...they’re streamlined, they know about visibility...so when a PDA is introduced officers are like ‘oh yeah, let’s have one of those, I can get out of the station more’. For Forces that don’t have that culture, usage will reach a peak and for it to increase any further there needs to be some serious intervention by applying some of the management style factors within your TAM model along with additional things like strong supervision.

(PM 1, Cheshire Police).

The final new factor emerging from this phase of the study was the short time period to implement mobile technology. Although within the Leicestershire Constabulary this factor had been addressed to some extent, it was more related with the time needed to allow the culture of the organisation to adjust to the change in working practices, rather than specific time to implement the mobile devices as a project. An important, widely raised point in the interviews was that due to significant pressure from the Government to implement mobile devices by the end of 2008, the timeframe to implement the project was too short. This may have had a negative impact on PU of mobile devices. Therefore, as evident in the following remarks, this needed to be incorporated as a new factor in the H-TAM:
We had a situation where we started out with something that was a small-scale pilot and the funding and big money came along, so we had to change the infrastructure - we’d set out a plan for the programme and then the government targets came along so we had to change the deadlines quite drastically...for example, because of some of the technical difficulties, we’d gotten into the realms of training before we even had the technology to deliver - because IT had told us that they could deliver the technology within these timescales, and we were given the green light - and we ended up in really quite a messy and difficult situation.

(PM 5, Yorkshire Police Collaboration).

I think what we should’ve done as well is we should’ve done everything much more slowly. For example, training a team, letting the ideas bed in, learnt some lessons, and adjust the training accordingly...having a feedback cycle - but we had none of that. It was already set in stone...we just blasted out the technology to 1200 users...probably 800 of them were totally unequipped to use the devices. (PM 1, Cheshire Police).

New officer acceptance factors: local context factors

Many of the forces have taken a different implementation approach to the Leicestershire Constabulary, by tailoring the device functionality to the individual roles and individual tasks. Although the Leicestershire Police have addressed this to some extent by providing MDTs to patrol cars and handheld BlackBerries to foot patrol personnel, this is more related to tailoring of the hardware device than the software functionality. Access to all available information systems in the police station on a MDT was found to increase PU in Leicestershire. However, it was suggested by the entire sample that providing all applications available on a desktop computer in a police station on a MDT had a negative effect on PU. PMs suggested that this was because users may feel overwhelmed with the number of systems on a mobile device, some of which are irrelevant to their job, and so might not use their mobile device:

It is important to ensure that the application suits the mobile environment. So you don’t necessarily want the same volume of information...you just want the nuggets...the crystallisation of the information to make a decision... I think that everyone is searching for that killer application in terms of functionality that will make all officers want to use mobile devices. But I don’t think it exists...well not for all roles. You’ve gotta find the killer application for each role. For the MDTs in Leicestershire, it’s a mirror of what’s on the desktop, so officers have got most of the functionality, but then is that necessarily a good thing because different roles will use different functionalities and it’s not tailored to specific roles.

(PM 5 & PM 6, Yorkshire Police Collaboration).
In order to increase PU, it was found that all police forces within the sample have taken account of the individual roles in policing and tailored the software functionality and training to each role according to the systems used most frequently. For example, a road traffic officer is more likely to need access to online road traffic collision forms than a foot patrol officer:

*I think the key is, until you put something specific on that device that that person thinks ‘wow…I can’t believe they’ve provided me with this, it’s really what I need’, that’s when they’re going to pick it up and use it because it’s of an immediate direct benefit to them…for example we’re putting fixed penalty notices on the PDA…we’re not really sure what the officer time saving is going to be, but our back office are really keen for it because of staff redeployment and reducing the level of time for them to complete tasks…some functionality is specific to certain roles, such as fixed penalty notices, which are obviously going to be of most benefit to the road policing unit…At the same time the devices have stop and search forms available, which are more beneficial to the neighbourhood policing roles…so it’s about trying to get a balance on there to get something on the device for all of them.* (PM 5, Yorkshire Police Collaboration).

In addition to tailoring the functionality of the device to individual roles, Essex Police and Wiltshire Police have considered when it is and when it is not appropriate or practical to use a handheld mobile device for specific tasks. For example, it is less practical to input lengthy statements and reports using a handheld device, and this might reduce PU of mobile technology. Instead, an officer might choose to return to their local police station to complete this task. In order to increase PU and to manage the cultural change associated with encouraging officers to stay out of their police station, Essex and Wiltshire Police have created a remote access to policing information systems in public spaces, such as libraries and local schools. The remote access can also be used at home to allow more flexible working if overtime is necessary for administration, without defeating the object of increasing visibility. Within Essex Police, consideration of how the mobile technology fits to the individual task has prevented a negative impact on PU and increased visibility, and also possibly deterring public disorders: -
We have implemented desktop PCs into our local hospital, Broomfield, so if you have
dead time waiting at the hospital, you can make use of that time…an officer can be sitting
there and working in a public place and be visible at the same time… rather than
wandering around a hospital with a cup of coffee, officers can start prepping a few bits of
documentation…and save time at the end of their shift. We are looking to put desktop PCs
into schools and courts etc…if an officer is passing a library they might nip in there to do a
long task rather than going back to the station. We had an incident the other day in the
library, and if an officer had been sat there working then the incident might not have
happened. It’s really simple to set up as well, and it adds to the existing mobile data
technology…you have a whole raft of doing mobile working, not just a PDA… the options
are working in harmony to keep officers out of the station depending on the task they need
to do. It’s about working out that variety and the best way to deliver the technology for the
task. (PM 3, Essex Police).

Further consideration of how the technology fits with individual tasks and the working
environment in which police officers must complete these tasks might also help to increase PU. This
notion is supported in previous research by Bouwman & van de Wijngaert, who find that the context of
specific tasks plays a role in the trade-off between PEOU and PU. For example, one project manager
commented how the working environment of policing is more hostile than those of commercial
organisations using mobile devices. This might mean it is more appropriate for a police officer to
complete lengthy tasks in a local public library or school, rather than at a home of a victim:

Organisations are very very different to police forces. A British Gas engineer is going to a
house where people want him to be in the house, where he’s there to help the people,
they will make him a cup of tea and provide him with a table and chair to sit down and use
his laptop. So it’s a different environment. (PM 1, Cheshire Police).

This approach might work well in other police forces that are aiming towards increasing visibility
by encouraging police officers to stay out of the station, but are receiving resistance to the cultural
change entailed with this. The research study within the Leicestershire Police suggests that this is a
familiar situation and so this approach could be a potential solution. Consequently, PU of mobile devices
may increase, as they can be used in more useful situations, whilst for lengthier tasks a desktop
computer in the community can be used without compromising on visibility. However, it will be important
that in the long-term this approach does not impact negatively on knowledge sharing. The research
findings within this Chapter show that this might have a significant effect on PU and officer acceptance,
and therefore is investigated in depth within the following Chapter.

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5.5 Practical Implications

Applicability of the holistic TAM within a wider policing context

During this phase of the research, an H-TAM has been developed to enable application of lessons about how to maximise officer acceptance of mobile technology. The H-TAM has been tested within other police forces and findings demonstrate that the model can be applied by other police forces about to or currently implementing mobile technology. Overall, despite exclusion of some newly emerging factors, the research showed that the H-TAM was applicable within other police forces, illustrated by comments such as:

*For me, I recognise everything that is on the model. I mean PM6 is more of your research person for how the model might sit, but for me I can give you a practical perspective as to how the model fits within our experience. I’d say it’s pretty much there. I think all the factors from our experience are in the model and I think the links are clear as well.* (PM 5, Yorkshire Police Collaboration).

*I actually think that your model sums up all the conversations that we have been having over the past three weeks around implementing the 3G MDTs into our force and I would like to use it during the implementation process, please could you send us a copy? It seems that there is no one single factor that is lowering the usage of MDTs and your model has covered the majority of factors nicely.* (PM 8, Lancashire Police).

*No I mean looking at that it looks very good. Our experience is that these things on the diagram are very fluid things.* (PM 1, Cheshire Police).

*So although we have a different device (PDA), all these factors are still common throughout, especially socialisation, cultural and management and communication factors.* (PM 7, Wiltshire Police).

Based on the results of the verification, the most applicable factors influencing PU are as follows:

- Impact of mobile technology on officer efficiency
- Functionality of mobile devices
- Peer influence
- Level of training
- Level of officer involvement
- Level of information about mobile technology
The most applicable factors influencing PEOU are reliability of the device and the level of training. However, the verification phases of the research showed that to make the TAM fully holistic, it requires some additional factors. Factors previously unidentified by the Leicestershire factors, that need to be considered during the implementation process from the verification phase of the research, were as follows:

- Fit of technology to individual roles
- Fit of technology to individual tasks
- Local supervision
- Time to implement project
- Senior management buy-in

Although the majority of police forces suggest that all these factors have a major effect on PU, the results of the content analysis show that the most influential factors are the fit of technology to individual roles and tasks, and the influence of local supervision to enforce usage.

The findings of these results have been integrated into the existing H-TAM (see Figure 5.5.1). The most influential factors are enlarged and identified by a thick black border, whilst less important factors remain as they were in the original H-TAM. This enables police forces to see at a glance which individual factors to focus on. The newly emerging factors of local supervision, senior management buy-in and time to implement the project have been incorporated into the existing management style factors, whilst the factors of fit of the technology to the role and task have been placed into a category labelled ‘local context’. These two factors have been placed into a new category since there can be variation in roles and tasks in place in each police force. The new H-TAM is a high-level model that can be applied by any UK police force, regardless of device being implemented.
5.6 Summary

This Chapter has investigated the main factors that influence the usage of MDTs. In light of a growing trend towards mobile information and knowledge management and a governmental drive for police forces to implement such a technology and realise significant benefits, this is of particular importance and relevance.

The evidence from this longitudinal study identifies four main categories that explain whether police officers embrace or reject MDTs. The four categories are labelled as performance, security/reliability/usability, management style and cognitive factors. In the technological context, performance factors included officer efficiency, data quality, inputting, accessing and sharing information and functionality of MDTs. Factors underpinning the security/reliability/usability category were battery life, network coverage, connectivity and level of privacy from rear-seat passengers in the police vehicle. Within the wider implementation context, the level of training, technical support, officer involvement and information for MDTs were the main factors underlining the management style category. From a social context, officer and public perception of MDTs, peer influence and organisational culture influenced the level of cognitive acceptance.

The factors described above were integrated and applied to existing theoretical models, such as the Technology Acceptance Model and the Unified Theory of Acceptance of Use of Technology Model. It
was found that the TAM alone was not applicable to the MDT user acceptance factors identified in the study, because the TAM does not take into consideration the external factors within the implementation and social contexts. Consequently, the H-TAM was produced to incorporate these factors into the existing TAM elements. The H-TAM is a high-level view of the key factors that should be addressed in order to overcome barriers to user acceptance of mobile technologies. However, it was found that the UTAUT was more readily applicable to the findings than the TAM, but lacked consideration of some external factors such as public perception of MDTs, level of officer involvement and organisational culture. Therefore, the UTAUT could be considered more applicable to a mobilised policing context than the TAM, but further factors must be considered.

Overcoming the barriers to user acceptance is critical to realise the benefits of mobile technology. This Chapter argues for the need to sell the benefits of the technology to the user, involve officers in the design process to identify main requirements of mobile technology from an early stage and to maintain widespread, ongoing and effective communication of information concerning the project across all levels of an organisation. Since the use of mobile technology encourages users to spend less time in the station it is important that associated possible risks of isolation are managed. Therefore it is recommended that mechanisms to ensure continued opportunities for face-to-face interaction and knowledge sharing between officers be implemented. It also argues that police forces must consider the use of super-users to enable the benefits of mobile technology to be promoted via word of mouth from the more proficient officers to the less proficient, resistant technophobes.

The generalisability of the adapted model for mobile technology means it could be applied by other police forces, regardless of the type of mobile device implemented (e.g. MDT or handheld device). The applicability of the model to other police contexts warranted further research, for example through testing its reliability within other police forces. The findings of this phase of research showed that the model is largely applicable within a variety of other UK police forces, with a range of device types and numbers, and rural and urban locations. The most common factors within other police forces lie within a wider implementation context, thereby supporting the need to extend the original TAM. Further factors within the management style category not previously identified by the Leicestershire Police included the impact of local supervision, senior management buy-in and time to implement mobile technology. Local level factors must also be considered, comprising the fit of the technology to individual roles and individual tasks. Addressing the factors within the adapted H-TAM can further increase adoption of mobile devices and help to manage the cultural change that the technology entails. However, participants within the research of this Chapter perceived that a potential key barrier to user acceptance was the possible negative impact of usage on knowledge sharing. The following Chapter assesses the scale of this barrier by investigating in depth the impact of mobile technology on knowledge sharing.
Chapter Six: The impact of mobile technology on a UK Police Force and their knowledge sharing

Chapter Preface

Chapter Five found that a potential risk to officer acceptance of mobile technology was a potential loss of knowledge sharing. This chapter presents the findings of research into what impact the mobile technology solution has on knowledge sharing within the Constabulary, and how this can be managed. The Chapter contributes to the literature by adding to the small body of knowledge within this area, as identified in the literature review. This Chapter fulfills objective six of the research. The Chapter is partly based on a journal article\(^1\) that was accepted to the Journal of Information and Knowledge Management.

The research within this Chapter was investigated via a combination of methods, principally focus groups, interviews and questionnaires with the key stakeholders of mobile technology, along with interviews with non-policing organisations to identify lessons learned in other contexts. As discussed in Chapter three, using a variety of methods allowed the researcher to build up a wider picture of the impact of mobile technology and compare results from each method to identify whether a consistent message was being produced. This Chapter presents the results from this analysis and discusses these findings in relation to existing literature.

6.1. Background

6.1.1. The importance of evaluating the impact of mobilisation on information and knowledge processes

As identified in the critical literature review, several authors have suggested that there has been relative neglect in the literature on the potential opportunities and challenges posed by mobile information technologies within a policing context (Norman & Allen\(^2\); Greene\(^3\); Agrawal \textit{et al} \(^4\); Nulden\(^5\); Vaast & Walsham\(^6\); Allen & Wilson\(^7\)). It appears relatively little is known about how mobilising a policing

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\(^1\) Lindsay, R., \textit{et al.} The impact of mobile technology on a UK police force and their knowledge sharing, \textit{Journal of Information and Knowledge Management}, 2009, 8(2), 101-112.


\(^5\) Nulden, U. Police patrol mobility: abstract of paper presented at the Case Western Workshop on Ubiquitous Computing, 24-26 October 2003. \textit{<http://weatherhead.case.edu/pervasive/participants_one.htm>}, 01.02.05, [accessed 11.06.08].

environment impacts on working practices and processes. Norman and Wilson recommend further data is necessary on the nature, use and issues surrounding mobility, and that further real life studies would highlight issues such as those identified in their study. This research contributes to the gap in the knowledge through a multi-method study within the Leicestershire Constabulary.

6.1.2. The research domain

The results of this Chapter are based on the outcomes of the research conducted with the research domain shown in Table 6.1.1 (as previously detailed in Chapter three).

<table>
<thead>
<tr>
<th>Data source of research</th>
<th>Population and sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus groups (conducted as part of a pilot evaluation study) (see Appendices 2a and 2c)</td>
<td>Eight semi-structured focus groups held with 30 operational officers using mobile technology before and after the two-week trial period</td>
</tr>
<tr>
<td>Questionnaire (issued during a pilot evaluation study) (see Appendix 2b)</td>
<td>30 operational officers completed the questionnaire during the focus groups</td>
</tr>
<tr>
<td>Semi-structured face to face interviews (conducted as part of a pilot evaluation study) (see Appendix 2d)</td>
<td>12 call management centre staff</td>
</tr>
<tr>
<td>Observational work-shadowing (conducted as part of a pilot evaluation study) (see Appendix 2e)</td>
<td>18 out of the 30 officers were observed. Observation conducted during 38 incidents throughout the course of 20 shifts</td>
</tr>
<tr>
<td>Focus groups to identify the impact of mobile technology on knowledge sharing (see Appendix 2h)</td>
<td>Seven semi-structured focus groups held with 50 operational officers using mobile data terminals</td>
</tr>
<tr>
<td>Questionnaire to identify the impact of mobile technology on knowledge sharing (see Appendix 2f)</td>
<td>119 operational officers using mobile technology</td>
</tr>
<tr>
<td>Face to face telephone interviews (see Appendix 2i)</td>
<td>External organisations that are also using mobile technology, to identify the impact of mobile technology beyond the police service. Organisations interviewed included Yorkshire Water, RAC, East Midlands Ambulance Service, BT and British Gas</td>
</tr>
<tr>
<td>Informal open interviews (see Appendix 2l)</td>
<td>27 operational officers using mobile technology</td>
</tr>
</tbody>
</table>

6.1.3. Analysis of results

The data were grouped according to the main themes arising. This was done initially through the use of open coding in the qualitative software package Atlas.ti, which allowed exploratory categorisation of the data from the wider evaluation focus groups. A large matrix containing all the data from the focus groups and colour-coded themes from the use of Atlas.ti was created. This allowed one to see at a glance the common themes arising from the focus groups which, alongside knowledge sharing, covered

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a wide range of areas such as culture, productivity, information literacy and user acceptance. From this, individual matrices were created containing all the data from the focus groups for one particular theme. The data relating to the wider theme of mobile information and knowledge sharing was divided into smaller themes and then displayed as a thematic grid. These themes included inputting information, accessing information, locating expertise, sharing information and further opportunities for mobile knowledge sharing. Additional themes that arose from the focus group data and other data sources (see Table 6.1.1) included isolation and productivity. These themes were used to form the sections for the results and discussion within this Chapter. Appendix three within this report contains the thematic grids used within the qualitative data analysis of the focus group data.

6.2. Evaluating the Impact of Mobile Technology

6.2.1. Inputting information

Throughout the focus groups, the ability to input intelligence onto systems there and then using mobile data terminals (MDTs) was felt to improve existing information and knowledge processes. To illustrate this one of the officers stated:

*The update is done and out the way, as quite often [without the MDTs] we go back to the station and then it is time to go home etc so we forget to update the information and it falls by the wayside.* (Officer A)

Inputting intelligence there and then means that there is a greater availability of information to other officers. The tacit knowledge that one officer holds in their head about an incident is captured and codified as explicit knowledge in systems more quickly so that other officers within the organisation can act on the information and make decisions. The previous crime input process meant that officers had to wait three to four days for a crime report to be accessible on the system and this inefficiency has been vastly improved through direct input of information. In the preliminary focus group (see Appendix 2a), it was found that the previous crime recording process resulted in a loss of real-time intelligence, as new crimes cannot be retrieved from the crime information system instantly. Data from the observational work shadowing exercise showed that it took an officer an average of 11 minutes to input details onto the crime and intelligence system, a dramatic reduction from the previous minimum delay of three days. An example provided was an incident involving a shoplifter: the incident was recorded and filed, and the offender cautioned, within an hour, a process that the officer would normally expect to take five hours. Similarly, during the informal open interviews, an officer commented on how direct access to systems is reducing the crime input process:

*A couple involved in a domestic with no previous history can be filed within five to ten minutes rather than three days. This is much quicker than where the crime would previously sit in the crime queue for weeks until it had been inputted onto the system, assessed, allocated and assigned with.* (Officer B)
Chapter Six: The impact of mobile technology on a UK police force and their knowledge sharing

Results from a questionnaire conducted during the two-week pilot of mobile technology revealed that all respondents strongly agreed or agreed that a MDT allowed reports to be submitted in a timely manner. This timeliness means that decisions are more likely to be robust, as timeliness is an innate characteristic of good quality information\(^8\), which mirrors the experience of mobile technology users in the West Yorkshire Police to improve their decision-making\(^9\). This supports the externalisation process of the SECI model\(^10\) and also suggests that the progression up the knowledge stair from information to knowledge\(^11\) occurs in less time as a result of mobile technology, rather than via the old process of either using the radio or waiting to return back to the station to input information. Information that is inputted at the scene may be more accurate because the ‘Chinese whispers’ effect of relaying information to the control room is eliminated. This was a common area of concern to arise within the focus groups.

Greater accuracy of information as a result of direct input into systems was also apparent within the Yorkshire Water organisation. Field technicians are able to correct data via a MDT about pipe positions so that when any subsequent technicians access the same data it is accurate. In addition, key operational data can be directly input into systems, such as water treatment, how a pumping station is operating and electricity meter readings. Similarly, within BT and British Gas field workers are able to update the outcome of a job there and then, such as what has been done, what changes have been raised and whether the job has been successfully completed. The importance of this is that it is similar to direct input of intelligence within policing. Technicians within the field have a greater availability of knowledge to conduct jobs.

An additional benefit to officers directly updating information systems is a reduced reliance on the call management centre to update information. This may imply a removal of information intermediaries from the communication chain and a potential change in the current bureaucratic culture. Allen and Shoard\(^12\) suggest ‘the highly structured and bureaucratic nature of policing creates an overload of information; mobile technology may overcome this by reducing levels of bureaucracy and allowing more direct communication with employees at lower and higher levels of the hierarchy of the organisation.

The ability to input information into information systems directly using mobile technology appears to be a common finding throughout the various data sources of the research. This can be paralleled with the study by Derballa & Pousttchi, who state that mobile technology has a positive contribution to knowledge management by reducing the time lag between knowledge creation and knowledge codification\(^13\). In other words, the ability for operational police officers and field workers to directly enter information and knowledge into information systems and repositories means that information residing within one individual becomes accessible to the whole organisation more quickly.

\(^8\) Wang, R. Information quality: advances in management information systems, 2005, p. 57.
\(^9\) Allen & Wilson, ref. 7, p. 21.
6.2.2. Accessing information

With regard to accessing information, officers participating in the focus groups expressed the benefits of having information at their fingertips (appendix 3a). They identified that having information about an incident written down in front of them en route was less cumbersome than using the radio, and the information was likely to be more accurate and detailed than relying on other sources and then having to remember the information. Similarly, participants in the focus groups conducted after a two-week trial of mobile technology noted that ‘having their entire knowledge base (e.g. history, policies and law) at their fingertips’ meant that they could make arrests and deal with incidents with greater confidence. Furthermore, officers involved in the informal open interviews commented how mobile technology is making information more easily available:

MDTs mean there is an ease of having information at your fingertips whilst at the scene, rather than listening and having to remember information whilst driving and rely on memory and tacit knowledge. This also means fewer blockages on the radio, so in general mobile technology makes me feel efficient. I can provide queries to the person there and then, which means better satisfaction. (Officer C)

I can delve deeper into information, especially when looking at crimes e.g. wanted persons. (Officer D)

The use of mobile technology within the ambulance service offers similar benefits from accessing information. A semi-structured interview with the general manager of the Estates and Logistics department of the East Midlands Ambulance Service found that for emergency responses, paramedics have to respond to an emergency within an eight-minute time frame, from the moment the call is initially taken (‘eight minutes call-connect’). Therefore, there is great reliance on efficient communication in order to meet this target. If information is not communicated efficiently then the information has to be repeated to the paramedic, or searched for again, which delays the response. The provision of MDTs in ambulances has allowed information to be relayed more quickly to the paramedic than using the radio and the information is recorded in front of the paramedic for greater clarity. Paramedics can also access the past medical history of a patient, clinical guidelines and drug information from the information systems within the ambulance service. In addition, before the introduction of mobile technology paramedics had to constantly listen out for their call sign in case of being called out to an emergency. There was constant radio traffic and paramedics had to filter out requests. In parallel with the findings in the police with regard to radio blockage, mobile technology has reduced the level of radio traffic and thus increased the speed of communication to meet the eight-minute target. This supports and makes the business process more efficient in responding to emergencies.

Within the Leicestershire Constabulary, an increased number of arrests had resulted from the additional access to information and real-time access to intelligence afforded by the use of a MDT (compared with the paper-based processes discussed in section 1.1.3). In one incident, for example, this had enabled the connection between a previous and a current incident to be established, leading to an
arrest. This is echoed in findings by Allen and Shoard\textsuperscript{14}, where the majority of survey respondents within the West Yorkshire Constabulary believed that mobile technology enabled them to keep themselves and their colleagues better informed. Furthermore, when an incident was reported prior to mobile technology, staff in the call management centre followed a dynamic threat and risk assessment process to highlight to officers via the radio important related knowledge, such as previous history and warning markers of persons or addresses. This knowledge is held within an information system, yet officers were previously unable to access this explicit information and knowledge whilst on the streets. Since call management staff can be handling several incidents at once the old process held potential to miss important information relating to a particular incident. Mobile technology has overcome this issue by allowing officers to access directly important explicit knowledge held within information systems, regardless of geographical restrictions. Officers can now access information at the scene, such as points of law, situation reports, evidence, briefings, emails, and complete checks using systems. For example, one focus group participant identified:

\begin{quote}
We can conduct CIS checks and check our emails with the MDT, and look up points of law whilst on duty, which we were unable to do without MDTs. (Officer E)
\end{quote}

A senior officer discussed how traffic officers are beginning to make use of accessing web-based CCTV footage in order for an officer at the scene of an incident to look at congestion hundreds of miles up the motorway and make decisions to reduce the impact of an incident. The work shadow observation exercise supported this view, indicating that MDTs improved the availability of information for decision-making purposes. As evident in Figure 6.2.1, during the pilot nearly half of MDT usage was for intelligence checks and the remaining usage was for identification purposes and obtaining information from the intranet. This concept supports Von Guretzky's\textsuperscript{15} view of mobile knowledge management i.e. decision-making on the spot.

\textsuperscript{14} Allen & Shoard, ref. 12.
A wide availability of explicit information in front of the officer is important, as it enables them to make more connections between intelligence and establish a wider picture of a case and to make decisions. Brown and Brudney argue that ‘providing real-time access to databases promotes knowledge creation and learning…wireless networks have allowed…better decision-making’\textsuperscript{16}. Similar to the effect of allowing officers to input information, direct access to information may support the combination stage of the SECI model\textsuperscript{17} and increase progression up the knowledge stairs\textsuperscript{18}. Gottschalk suggests that police officers are reliant on information and gathered facts to draw conclusions\textsuperscript{19}. Thus having the officers’ knowledge base at their fingertips is beneficial to policing performance. Enabling direct access to information may also support the final stage of Gottschalk’s growth model for knowledge management technology\textsuperscript{20}, where specific IT systems are accessed to solve a knowledge problem. This suggests that mobile technology has a positive impact on knowledge management within policing.

Within a different organisational context, the same was found to be true for accessing information by field workers within the Yorkshire Water, British Gas and BT organisations. Telephone interviews with the mobile technology project manager of each organisation revealed that field workers are now able to access databases containing information such as health and safety and safe working procedures whilst out in the field, along with mapping systems that show customer and job locations, often provided along with the job that is allocated automatically by the system. Before mobile technology field workers would return to the depot to collect paper-based details of a job and the customer, but now they are able to access this information via their MDT. The technicians have all the information they need

\textsuperscript{17} Nonaka \textit{et al}, ref. 10, p. 8.
\textsuperscript{18} North, ref. 11, p. 6.
\textsuperscript{20} Ibid., p. 185.
about a customer and the job they are doing at their fingertips through mobile technology. For example, a work order sent to a technician via a MDT will contain information including the location of the work order, the expected time of arrival, who the customer is, details of the work order, health and safety information and details of any other pipework or cables in the area. In addition, the technician can access historical information about the work or customer, allowing them to build up a picture of a situation e.g. common occurring faults. It was common within telephone interviews with these organisations that the timely access and provision to information as a result of mobile technology is having a dramatic impact on the efficiency of existing business processes.

Similarly, patrol workers within the RAC organisation use mobile technology to access information about various types of vehicles on the road in order to assist its customers in the event of a vehicle breakdown. The type of information available to patrol workers via their MDT includes vehicle diagnostics, technical information e.g. location of vehicle bonnet catch or in-depth test procedures, fault codes and general procedures, such as how to break into a vehicle without causing damage if a customer accidentally locks their keys. The patrol team have been using MDTs for seven years. Before then, regional offices existed e.g. in Loughborough, Leicester, Nottingham and Northampton. Patrol workers would return to their regional office to collect a batch of jobs recorded on paper and then return back to the office to collect the next batch of jobs. Besides being a very inefficient way of working, it also means that the patrol workers would have to collate all the required technical information. Now the mobile technology system allows patrol workers to automatically receive jobs based on an automated dispatch process, which uses GPS to locate the position of patrol vans and allocate a job to the nearest patrol worker. When a job is dispatched, all the required information is integrated with the job. For example, if the job involves a wheel change the system will tell the technician how to jack the vehicle, and how tight the wheels need to be. The job can be solved at the roadside, whereas in the past patrol workers would need to search for the required information themselves. In addition to integrating vehicle information with details of the job, summary pages are available via mobile technology. Summary pages display common problems with a vehicle when a patrol worker selects a particular vehicle from the information system. Now the information is available all in one place, vehicles can be repaired at the roadside by accessing the information remotely; 80 per cent of vehicles are repaired at the roadside\textsuperscript{21}. As a result, vehicles do not need to be towed to another location to be repaired, which has created time savings and cost savings for the organisation.

The findings from the various data captured from the Leicestershire Constabulary and telephone interviews with the Yorkshire Water and RAC organisations appear to be consistent. Overall, mobile technology is increasing the access to corporate information and knowledge within these organisational contexts. This finding supports the trend discussed in the small amount of literature of mobile knowledge management, whereby ‘information is provided to where the people need it instead of forcing them to be in the place where information resides’\textsuperscript{22}. Rao comments that mobile technologies are being used increasingly ‘to take knowledge management to another dimension by bringing relevant knowledge directly to the fingertips of a company’s field workers’. This allows decision-making on the spot. Similarly

\textsuperscript{21} RAC. \textit{Breakdown cover, rescue service and roadside assistance by RAC.} <http://www.rac.co.uk/web/breakdowncover/>\textsuperscript{,} 2009, [accessed 17.02.09].

Skyrme\textsuperscript{23} notes that employees can access email and corporate information sources on the move, which is increasing the scope for mobile knowledge management. The findings from the research concur with these views from the literature.

6.2.3. Information and Knowledge Sharing

The focus group conducted before the implementation of mobile technology (see Appendix 2a) revealed that officers share local knowledge via the radio system. Officers in the neighbourhood will get/send any salient information in response to incidents reported via the radio. Officers are always listening to the radio so that they can share their related information on the radio. They recognise that local knowledge is very important. They also recognise that they cannot share everything with every department and therefore there is a need to prioritise information. The type of knowledge shared is usually tacit knowledge regarding how to approach an incident face-to-face; this information is rarely entered onto information systems. Findings from the wider evaluation focus groups suggest that mobile technology enhanced current elements of information and knowledge sharing practices for police officers. Overall officers spoke enthusiastically about the opportunities for knowledge sharing afforded by mobile technology. Six out of the seven wider evaluation focus groups highlighted that information could be shared with their colleagues whilst on duty via email. One participant provided an example of the use of email for knowledge sharing:

\begin{quote}
For ongoing incidents officers can send emails whilst out and about with any additional information that they may have gained from previously dealing with the incident.
\end{quote}

(Officer A)

The above quote shows how officers can increase their knowledge about a particular incident by using mobile technology. Although previously this could have been done using the radio it was considered better to have the information directly recorded in front of them, rather than having to record the information by hand in a notebook. In the focus group conducted prior to the introduction of mobile technology, it was found that the old process was problematic. For example, it resulted in a loss in the richness of information when the call centre sent details to the responding officer: all the details were entered onto the CIS system, but a lot of this was not passed onto the officer who then had to ask for it all again from the member of the public. This also prevented officers from having any ‘thinking time’ in which to consider the salience of the information and how it might affect their response. Also, the level of detail that was passed onto officers from the control room depended on the time of day and the volume of work at the time. When the control room was busy e.g. Friday/ Saturday nights there was not any personal interaction to verify details. Indeed, some officers used to return back to the station to print out the full incident report so that they were in possession of all the salient information before responding to an incident. The introduction of mobile technology has resolved this issue: officers are now able to


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access the crime record in their vehicle. This also reduces the potential for misinformation, where officers may have changed the information given by the call taker through adding their own interpretation.

Chan mirrors the advance in knowledge sharing as a result of mobile technology within the Leicestershire Constabulary, his findings showed that 70 per cent of Australian police officers agreed that IT has led to improved information sharing through the use of email\(^{24}\). Syson\(^{25}\) proposes that mobile technology is a more effective tool to share information than the verbal and paper-based systems used in policing, as it provides constant access to recorded information. For example, he suggests the briefing system to be an ineffective way of sharing knowledge, as ‘officers can be swamped with information such as up to twelve photographs of wanted persons, but officers are unlikely to remember all of these faces throughout the course of their working day’\(^{26}\). One officer reflected this during the informal open interviews for this study:

*Being able to take photographs of suspects and storing them onto my Blackberry for later reference, rather than the photo existing as an image in a single officer’s head, which was good for sharing information amongst other officers. (Officer F)*

Findings from a semi-structured interview with a group of Chief Inspectors responsible for overseeing the operations of each command unit of the Constabulary found that neighbourhood police officers were using the camera facility to capture evidence e.g. anti-social crimes and share knowledge and evidence from domestic incidents.

In addition to the use of email for knowledge sharing whilst on duty, officers offered alternative insights into how mobile technology can be used for knowledge sharing suggesting that tasks and messages, modus operandi and working sheets can be sent and shared with other officers via the crime and intelligence system, which may increase the knowledge base available to officers. An officer also commented how a tool called ‘voice notes’ had been used to record and share information about an article or item of evidence with all officers using a Blackberry. The tool works by recording the officer’s voice and automatically emailing the message to officers via email, which can be very useful for sending urgent messages to all officers or an observation message. Similarly, a semi-structured interview with a group of Chief Inspectors revealed that neighbourhood officers could use the voice recording function to capture minutes of a neighbourhood meeting with members of the community. It can be argued that recording information in voice format can provide a more descriptive analysis than recording information textually. The use of voice notes also reduces the level of traffic on the airwave and can be a lot easier to share information than using the radio. The officer explained how a police force in Canada has trialled voice notes to allow their officers to view an article, describe it and send the information to the control room in real time along with a photograph. Similarly, participating officers were using the camera to capture photographic evidence and share this information with colleagues during briefings, which may help in pursuing specific crimes and cases.

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\(^{24}\) Chan, J. B. L. The technological game: how information technology is transforming police practice. *Criminology and Criminal Justice*, 2001, 1(2), 156.

\(^{25}\) Syson, H. *Knowledge sharing in the UK police service – a research study*, MSc dissertation, Loughborough University, United Kingdom, 2007.

\(^{26}\) Ibid., p. 98.
A key finding from the focus groups with regard to knowledge sharing was that mobile technology provides an additional communication channel. One officer suggested that mobile technology served as an extension to the existing communication channels in place to share information, and in this sense it has enhanced knowledge sharing. Similarly, another officer felt that his colleagues were able to share information more as a result of mobile technology and that it had caused officers to “actually talk to one another now”. Prior to the introduction of mobile technology, the findings from the preliminary focus group revealed that for routine incidents, information often was not shared between officers at all. Officers were able to hear information on the radio, and if they suspected that there was a possibility of violence, they would intervene. Previously, an officer on the beat may have encountered eight to nine incidents per day, but might have only shared information with colleagues about one or two of these (“if they were funny or critical”). If there was a unique Modus Operandi officers would search to see if a similar pattern was recorded in the crime and intelligence system, but the pressure of work and time meant that this would not usually happen. With regards to the exchange of tacit knowledge following the introduction of mobile technology, an officer suggested:

*Mobile technology has altered the dynamics of where we liaise with our colleagues. We probably are in as much face-to-face contact but it is carried out in a different location. We can catch up with colleagues face to face whilst out and about at a job.* (Officer G)

This quote may demonstrate how in terms of the SECI model, mobile technology has not damaged opportunities for tacit to tacit knowledge exchange. Similarly, as a result of mobile technology senior officers have altered the location of where they conduct the command of incidents: rather than the previous need for an extensive operations room facility, incidents can be commanded at the scene, which may allow more effective knowledge exchange. The findings of the survey conducted to identify the impact of mobile technology on knowledge sharing shows that officers make as much use of their colleagues for information with mobile technology as they did before the introduction of mobile technology, with colleagues being ranked the fifth information source accessed on a daily basis (see Table 6.2.1). According to the survey findings, there has not been a dramatic change in the sources of information that officers access on a daily basis. However, it is evident in Table 6.2.1 that the use of face to face meetings has decreased following the introduction of mobile technology, which may suggest that there are fewer opportunities for officers to discuss information and share knowledge on a personal level. Overall, these survey findings may correlate with the findings of the focus group, in that officers are using the same sources to share information and knowledge as they did before mobile technology but within a different location. Officers are mostly reliant on email, followed by the Intranet to access information, as evident in Table 6.2.1. Similarly, a study by Edwards *et al.*27 into the role of technology in knowledge management in a UK police organisation found that the intranet was ranked as the most effective tool for corporate communications and second (after intelligence led policing) for operational communications.

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Table 6.2.1: Information sources accessed on a daily basis before and with mobile technology

<table>
<thead>
<tr>
<th>Daily Rank</th>
<th>Information Source</th>
<th>Freq.*</th>
<th>Before mobile technology</th>
<th>Rank</th>
<th>Information Source</th>
<th>Freq.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Email</td>
<td>100</td>
<td>1</td>
<td>Email</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Intranet</td>
<td>83</td>
<td>2</td>
<td>Intranet</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Databases and information systems</td>
<td>80</td>
<td>3</td>
<td>Intelligence reports</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Intelligence reports</td>
<td>77</td>
<td>4</td>
<td>Databases and information systems</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Colleagues</td>
<td>61</td>
<td>5</td>
<td>Colleagues</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Radio</td>
<td>46</td>
<td>6</td>
<td>Telephone</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Telephone</td>
<td>45</td>
<td>7</td>
<td>Radio</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Official circulars and memos</td>
<td>39</td>
<td>8</td>
<td>Face to face meetings</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Face to face meetings</td>
<td>28</td>
<td>9</td>
<td>Official circulars and memos</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Internet websites</td>
<td>28</td>
<td>10</td>
<td>Internet websites</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Legal documents</td>
<td>27</td>
<td>11</td>
<td>Legal documents</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Departmental files and guidelines</td>
<td>19</td>
<td>12</td>
<td>Mass media (newspapers, TV etc)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Mass media (newspapers, TV etc)</td>
<td>14</td>
<td>13</td>
<td>Departmental files and guidelines</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Informants</td>
<td>8</td>
<td>14</td>
<td>Informants</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Government documents</td>
<td>7</td>
<td>15</td>
<td>Government documents</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Training activities</td>
<td>4</td>
<td>16</td>
<td>Training activities</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Conferences</td>
<td>0</td>
<td>17</td>
<td>Conferences</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*NB - Frequency is out of a total of 119 respondents

In contrast to this, a Sergeant participating in the focus group expressed the need and importance of face-to-face contact with officers during meal breaks and briefings about incidents. This highlights that despite officers being able to share information and knowledge via email and it being the most widely used information source (Table 6.2.1), mechanisms for exchanging information face to face should not be removed as a consequence of the implementation of mobile technology. This is supported by findings from the wider evaluation questionnaire, where the question regarding whether officers are encouraged to share new knowledge with close colleagues gained the modal answer was ‘agree’ (1=’strongly agree’, 5=’strongly disagree’) (see Table 6.2.2). Similarly, the question regarding whether officers are encouraged to share new knowledge with everyone in the police received a modal answer of ‘agree’. Questions relating to whether police officers like to spend time to tell about their new experiences and whether it happens rarely that important knowledge is not available when needed also gained modal answers of ‘agree’. These results can be interpreted to mean that officers within the Leicestershire Constabulary strongly recognise the value of sharing knowledge with close colleagues and to a slightly lesser extent within their department or across departments. Mechanisms are in place to allow knowledge to be available to officers when needed. A similar study by Glomseth et al28 (from which these survey questions were adapted) demonstrates the importance of face to face knowledge sharing in that their findings showed there is stimulation of knowledge sharing within Norwegian police investigation units, and as a result had a negative impact on investigation performance. In parallel, the literature

strongly favours the use of informal mechanisms for sharing police related knowledge, as advocated by Holgersson\textsuperscript{29}, Berg\textsuperscript{30}, Borglund\textsuperscript{31}, Allen et al\textsuperscript{32} and Van Laare et al\textsuperscript{33} (refer to section 2.2.4 of Chapter two). Brodeur and Dupont argue that ‘sociological studies of police occupational cultures systematically highlight the power of narratives to convey meaning, exchange tips and provide guidance about the unpredictable nature of police work, in the areas of both patrol and investigations...informal advice on difficult cases is also exchanged laterally between colleagues’\textsuperscript{34}. Therefore the importance of informal knowledge sharing should be an important consideration for police organisations, as their organisational processes begin to alter as a result of mobilisation. Within the ambulance service, a semi-structured interview with the general manager of the Estates and Logistics department of the East Midlands ambulance service found that mobile technology has resulted in paramedics spending most of their time out on the road, which has resulted in little opportunity to share information and knowledge face to face. This is important because paramedics may carry background knowledge about patients or locations and this is not often recorded or widely available to the entire ambulance service. Little opportunity to share such information or knowledge face to face as a result of mobile technology may have a negative effect on the service provided to patients.

Table 6.2.2: Modal scores for wider evaluation survey questions on knowledge sharing
(N.B. minimum = 1; maximum = 5)

<table>
<thead>
<tr>
<th>Survey item</th>
<th>N</th>
<th>Mode</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouraged to share new knowledge with close colleagues</td>
<td>118</td>
<td>2</td>
<td>0.924</td>
</tr>
<tr>
<td>Encouraged to share new knowledge with everyone in the police</td>
<td>117</td>
<td>2</td>
<td>1.032</td>
</tr>
<tr>
<td>Experienced police officers like to spend time to tell about their new experiences</td>
<td>117</td>
<td>2</td>
<td>0.937</td>
</tr>
<tr>
<td>It happens rarely that important knowledge is not available when needed</td>
<td>118</td>
<td>2</td>
<td>0.935</td>
</tr>
</tbody>
</table>


Correspondingly, officers in the evaluation study focus groups reported that they made less use of the radio. They felt this reduced time delays in access to critical intelligence. This is less apparent in Table 6.2.1 but there is still a slight reduction in the level of radio usage. In other incidents, officers only used the radio to request backup at an incident or request directions en-route to an incident. This also demonstrates how mobile technology serves as an additional communication channel for officers, which has a lower level of latency for decision-making than using the radio. In other words, officers have less delay in sending and receiving information via mobile technology than via the radio so can make decisions quicker. This finding may be paralleled with research by Agrawal et al.\textsuperscript{35} and Norman and Allen\textsuperscript{36} into the impacts of mobile computing within a US and UK police department respectively. Both studies identified a strong relationship between the level of communication and time available for officers due to a reduced need for the assistance of dispatch. This finding is ‘a reflection of the usage of the email facility, which helps officers save time through effective communication without occupying the radio channel’\textsuperscript{37}. In contrast, the post-trial questionnaire found that zero respondents made use of email and the majority made use of the radio or force information systems, with a small proportion (17 per cent of respondents) making use of face-to-face communication. This suggests that opportunities for informal knowledge sharing remain with mobile technology. Norman and Allen\textsuperscript{38} suggest that mobile technology complements existing communication channels rather than replaces it, as mobile technology can be used for lower priority requests for information that were otherwise obtained via the radio. In all cases of research (focus groups, questionnaires and observational work shadowing), officers viewed this positively. Reduced latency created by mobile technology may have an additional positive upshot to officers in that they can also share information with other officers in the field more quickly\textsuperscript{39}.

Furthermore, officers involved in the pilot evaluation study felt that knowledge sharing between officers improved as a result of mobile technology; officers suggested that MDTs provided a new avenue for keeping each other up-to-date with events. The work shadow exercise observed instances during the pilot where officers with a MDT completed checks for other colleagues and shared history and warning markers over the radio, enabling non-mobile technology officers also to benefit from mobile technology by becoming better informed. This may improve knowledge sharing at the combination stage of the SECI model\textsuperscript{40}. In the long-term, officers suggested that interpersonal contact may improve as officers will be able to complete administrative tasks whilst on duty. They suggested they would therefore have more free time to share experiences and information with colleagues when they returned to the station, thus increasing the level of socialisation\textsuperscript{41}. It is important to note, however, that all officers did not share this view. Some felt that opportunities for informal interaction would be seriously curtailed as a result of the use of MDTs. In contrast, no survey respondents in the West Yorkshire Constabulary believed that mobile technology had taken the place of face-to-face meeting opportunities, although the level of face-to-face communication had already been reduced by the widespread use of email\textsuperscript{42}. Despite the risk of isolation, the findings of the observational work-shadow research indicated that during the trial itself,
most officers reacted in a positive manner to being able to stay out of the station and therefore attend more incidents. Similarly, Norman and Allen found that despite the introduction of mobile technology, officers still chatted amongst themselves in the office and there was a good level of team spirit. However, in the long term changes to communication and work patterns as a result of mobile technology may result in a potential loss of important salient knowledge acquired via the radio whilst completing other tasks (e.g. ‘warning markers’). Officers in other UK police forces have expressed similar concerns that ‘there will be a loss of incidental knowledge as a result of the transfer to a more personal information environment’\(^43\). Information will be sent to an individual officer in accordance with their role or availability of knowledge so knowledge will only be shared directly to particular officers, rather than ‘by virtue of coming over the voice radio system’\(^44\).

The impact of mobile technology on face to face interaction was explored further within the focus groups conducted as part of wider evaluation. Participants were asked what impact mobile technology has had on isolation. The findings demonstrated a mixed view towards this area, with nearly half of the focus groups participants suggesting mobile technology has not impacted on isolation, whilst the other half of participants suggested it has impacted on isolation (see Appendix 3b). Amongst the participants that felt mobile technology had impacted on isolation, the majority referred to officers staying out of the station more as a direct result of mobile technology. For example, an officer commented:

\[
I \text{ feel I am on my own a lot more as a result of mobile technology. Now there is even less reason to go back to the station. We are expected to stay out more and now that our location is being tracked on IR3/ORB I feel that there is more pressure to be out alone.}
\]

(Officer H)

Similarly, another officer stated that his shift was staying out of the station more but did not regard this in a negative light because they felt it meant they could be more self-sufficient and more productive, supporting the findings from the pilot (previously discussed above). One shift sergeant noted that all sergeants should be encouraging their officers to be out of the station, whilst another shift sergeant felt that he saw less of his officers, but appeared to view this in a positive manner as he felt that is how the mobile information project is supposed to work. One of the focus groups revealed that in the long term there are plans to allow 15 returns to the station over three shifts, which equates to around five returns per shift, compared to a current number of 23 times per shift. Furthermore, there are potential plans to deliver shift briefings to officers in the wider rollout of mobile technology via electronic presentations and podcasts. In addition, there are also plans to allocate a mealtime and a refreshment break out in the community rather than back at the station. Whilst doing so may increase visibility levels, it may prove to be detrimental to policing performance, as suggested by one focus group participant:

\[
\text{Having meal breaks out in the community rather than back at the station would remove opportunities for sharing that bit of information in your head and identifying links.}
\]

(Sergeant A)

\(^{43}\) Norman & Allen, ref. 2, p. 216.
\(^{44}\) Ibid., p. 216.
Officers participating in the pilot evaluation study suggested that in the long term, the upshot of spending more time alone in the vehicle might result in increased isolation and reductions in teamwork, interpersonal contact and less effective knowledge sharing. Some participants felt that changes to start times and briefings as a result of other policing initiatives had already eroded shift unity and cohesion. The informal open interview exercise identified various opinions that strongly demonstrate the importance of face-to-face contact and shift culture, for example:

There is always knowledge sharing going on, it’s what makes the world go round. At briefings we collect information and pass on what we have learned in the past 24 hours to other officers, for example how we successfully dealt with an incident. Local knowledge about people and vehicles in the area is vital to our job e.g. a criminal was detained but from experience I knew they were violent and have refused to be interviewed in the past. (Officer I)

Generally the attitude to knowledge sharing is friendly and proactive so officers are willing to share, but this depends on the shift culture. I am a friend with all the officers on my shift so there is no reason for us not to share knowledge. (Officer I)

Experiences are widely shared with officers on my shift; officers give advice with colleagues about local nominals and procedures (Officer J)

I believe that it is not in anyone’s interest to hoard knowledge. (Officer K)

The importance of a positive shift culture is that it appears to improve policing performance, by allowing officers to identify links between pieces of information that lead to an arrest. Findings by Glomseth et al\textsuperscript{45} indicate that knowledge sharing has a significant influence on organisational performance. They suggest that the more knowledge police officers share with one another, the better results they achieve with their investigations, thus officers must work together to solve cases. Research by Collier\textsuperscript{46} and Ng & Ang\textsuperscript{47} reflect this notion of mobile technology causing a risk for tacit knowledge sharing and organisational learning. In accord, Norman and Allen identify fears of officers’ ‘road warrior lifestyle being made even lonelier by the use of mobile technology’\textsuperscript{48}. Introna\textsuperscript{49} notes that employees prefer interpersonal face to face communication, as this has a contextual and involvement element not present in technologically mediated communication. Similarly, respondents within the Metropolitan Police Service state that face-to-face communication is the most effective way of sharing knowledge\textsuperscript{50}.

In contrast, some participants in the focus groups suggested that mobile technology had not impacted on isolation. This was due to two reasons. Firstly, the majority of officers who felt that mobile

\textsuperscript{45}Glomseth, et al, ref. 28., p. 106.
\textsuperscript{46}Collier, P. M. Policing and the intelligent application of knowledge, Public Money and Management, 2006, 26(2), p. 113.
\textsuperscript{48}Norman & Allen, ref. 2, p. 217.
\textsuperscript{49}Introna, L., Management, information and power: a narrative of the involved manager, 1997, p. 41.
\textsuperscript{50}Syson, ref. 25, p. 94.
technology had not caused isolation issues were still returning to the station, mainly because of technical issues affecting the use of the MDT. Two sergeants felt it to be acceptable for their officers to return to the station for some tasks e.g. lengthy statements. Participants highlighted the need to return to the police station due to technical issues, such as signal strength and logging in:

*If the MDTs worked properly then we might see less people in and around the station.* (Officer L)

*At the moment it is easier to come back to the station rather than wait to log onto the MDT so I still see my colleagues.* (Officer A)

*There is still a returning to the station culture due to issues of signal strength and logging in etc.* (Officer E)

These technical issues are currently being resolved by the mobile information project team. The impact on isolation could become greater once they have been rectified, as there may be less need to return to the police station. However, officers may continue to return to the station for cultural reasons. Secondly, officers felt that mobile technology had not impacted on isolation because, as previously discussed in this section, it serves as an additional communication channel to keep in touch with their colleagues. There are still other communication mechanisms to keep in contact with other officers, such as the point-to-point facility on the radio and a new mechanism available on the Blackberry known as Blackberry pins:

*Mobile technology has not impacted on isolation - we still brief in person and we can still contact officers via the point-to-point facility on the radio.* (Officer H)

*We still have point to point so we can share information with colleagues despite being out of the station for longer. We use point to point to contact a colleague to obtain information that they may have in their head.* (Officer H)

*Blackberry pins allows us to speak to all the other Blackberry users via text message, like an instant messaging service. I used it to talk to my colleague when I could not talk to them on the airwave due to it being busy. It is not always a good idea to be on point-to-point when something is happening, as you cannot hear what is going on.* (Officer H)

Similarly, telephone interviews revealed that within the RAC organisation field workers are able to use a messenger service available on the MDT to get in contact with other members of patrol. Field workers within the Yorkshire Water organisation use blogs and mobile phones daily to talk about work they are doing or ask for assistance e.g. lifting a heavy manhole cover. These communication mechanisms, along with SMS and video conferencing, are also in place for field workers within BT and British Gas following the introduction of mobile technology. As they are being removed from their social
networks by starting their day from home, they need opportunities to communicate with field workers. However, these communication mechanisms do not support interpersonal face-to-face communication, as advocated by Itrona\textsuperscript{51} and Syson\textsuperscript{52}. In contrast, other participants felt mobile technology had not impacted on isolation and face-to-face interaction because it had altered the location where officers liaise with their colleagues. These findings can be paralleled with findings within the focus of how mobile technology has changed the dynamics of where officers network. One officer commented that the nature of incidents and the fact that there are few officers within their area means that officers are still at the same job so still see each other, whilst similarly another officer observed:

\textit{I have noticed there are less people in the station and I am out on the front line much more so can speak to other staff much more whilst completing operational duties.} (Officer A)

This finding was also apparent within the RAC, Yorkshire Water, BT and British Gas. It was common for field workers to meet informally whilst out in the field, such as in exchange buildings within BT and within village halls within British Gas. A telephone interview with the Strategic Development Manager within the RAC revealed that field workers now meet up during the course of their shift in public locations, such as a Tesco car park:

\textsuperscript{51} Itrona, ref. 49., p. 41.
\textsuperscript{52} Syson, ref. 25., p. 94.
Generally speaking, patrol workers will find a Tesco’s car park and sit there and meet up. Patrol workers are fully mobile so they never need to return to the office. I was on patrol and went to the office twice. Patrols are divided into cells, with a manager for each postcode or area. Even though they are always out in the field there are still opportunities for them to meet up.

Although patrol workers within the RAC have adjusted to this way of working, police officers are already meeting the concept of having meal breaks etc out in the community with some resistance perhaps due to a potential loss of shift culture. The notion that mobile technology is altering the dynamics of knowledge sharing was supported by the IT manager within the Yorkshire Water organisation, who commented that:

*There is still a lot of sharing of information and handover and support with work that happens. It is just that mobile technology makes sharing information more streamlined and automated. It cuts down on travelling time and we are always getting someone to the job from the chap that is closest to the location. I think in a lot of ways, the technology is not a substitute for all the other good things that are there to share information, mobile technology just supports and complements them and makes existing processes easier and faster.*

Overall, despite concerns of mobile technology on knowledge sharing and isolation the evidence presented suggests that it is having a positive impact on knowledge sharing. The risks with regard to isolating officers and possible damage to shift culture should be managed. The IT manager within the Yorkshire Water organisation advised that there is a danger of pushing the full mobility too far and thus isolating people and creating silos of information. He suggested that mobile technology must not serve as a substitute for all the other communication mechanisms that do work, such as briefings, but that it complements those mechanisms and replaces processes that do not work like the inefficiencies e.g. paper based forms. Their field technicians do not meet on a daily basis but at least a couple of times per week through regular team meetings to update on operational aspects and monthly ‘team talks’ to share company information. The organisation has not pushed too far the insistence on technicians to stay out in the field, not returning to the depot, and removing team interaction. When the technology was first introduced into the organisation, field technicians were pushed to stay out in the field all day every day, and were only allowed to return to the depot if they needed to collect any equipment. However, the organisation discovered that this began to destroy the team interaction and team identity, which led to creating inefficiencies as a result of low morale. Instead, technicians are able to return to the depot from sometimes once a day to about three times a week. Similarly, within BT and British Gas a key finding was maintaining face-to-face interaction in order to share experiences and background knowledge about customers e.g. how to deal with them, whether to ask for a drink whilst at a job; information that can help improve customer satisfaction but is not often recorded within information systems. These are important lessons for other organisations looking to implement mobile technology and are taken into consideration as part of recommendations included at the end of this Chapter.
6.2.4. Locating Expertise

A small proportion of the focus groups identified that mobile technology made it easier for officers to contact other officers for expertise. Two officers from separate focus group discussions suggested they can now search for contact details via the Intranet on the MDT, whereas before they would either have to obtain the contact information by returning to the station to use the address book on the intranet or asking other people. Another officer suggested that it is now easier to get in contact with their colleagues. This can be paralleled with other organisations that have introduced internal ‘yellow pages’ to point to employees with the right set of knowledge and skills for a problem. Granting officers direct access to the internal directory may assist and increase the level of problem solving involved with cases and crimes. This supports stage two – ‘officer to person’ - of Gottschalk’s growth model for knowledge management technology, whereby IT is used to find other knowledge workers. The ability to locate expertise within a mobile setting maintains Holgersson’s argument that police officers require network-related interaction skills in order to complete their duties.

6.2.5. Further Opportunities for mobile knowledge sharing

Along with the discussions highlighting the positive impact that mobile technology is already having on knowledge sharing, some officers within the focus groups offered suggestions and ideas for the use of mobile technology to share knowledge in the future. For example, one officer suggested that if an officer is viewing an item of information related to a specific incident then this information should be able to be broadcast to other officers via the MDT. In other words, the ability to flag recently added or pertinent intelligence to other officers on duty in the same area via the MDT would be beneficial. At present this can be done via the radio system but there are delays in doing so. Similarly, another officer suggested it would be useful for the control room to flag pertinent information to MDTs rather than via the radio, so the information is in front of them and shared to more officers. An additional suggestion made by one officer was a mechanism to share shortcuts and handy tips for using the MDTs. At present the shortcuts are only shared via word of mouth within the officer’s social network so not all officers within the Constabulary are able to learn new and innovative ways of using the mobile technology, such as the ‘voice notes’ discussed earlier. The fact that officers within the focus group discussions were suggesting new ideas could imply that they are embracing the technology. A semi-structured interview with a group of Chief Inspectors identified that there are plans to introduce a website with ‘top tips’ and blogs from super-users where best practice and shortcuts can be shared amongst officers. The tips may also be placed in the newsletter for Police Community Support Officers, where super-users strongly advocate the use of mobile technology, thus enabling best practice to reach a wider audience.

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53 Field, A. Locking up what your employees know. <http://hbswk.hbs.edu/archive/3465.html>, 05.12.03, [accessed 19.05.09].
54 Gottschalk, ref. 19, p. 185.
55 Holgersson et al, ref. 29, p. 51.
6.2.6. Impact on Productivity

A full 100 per cent of post-trial questionnaire respondents agreed or strongly agreed that it had helped them be more productive. Appendix 3c shows the thematic grid for the impact of mobile technology on productivity, according to the focus group data. Within the grid it is evident that the focus groups raised both positive and negative issues with regard to productivity. In terms of the positive issues, officers within all seven of the focus groups highlighted that mobile technology had removed the need to travel back to the station to access information, thereby creating time savings that could be used to complete operational duties rather than administrative tasks and consequently increasing the level of public visibility and reassurance. This also has cost savings in terms of mileage and vehicle maintenance. For example, officers commented:

*We can be more productive and not have to keep returning to the station.* (Officer A)

*The main benefit is not having to travel about 20 miles back to the station… there are fewer miles needed for generally accessing information.* (Officer M)

*There is less need for me to come back to the station to update things.* (Officer M)

*There are time-savings from not having to return to the station to view incidents.* (Officer H)

*Mobile technology keeps us out of the station more, we are out and about a lot longer completing paperwork and catching up. Before mobile technology we would only have to attend two to three incidents and then working sheets would need updating. Now there is no rush to return to the station to hand keys over or grab a desktop machine before the next shift start.* (Officer N)

Senior officers also reported greater visibility as a major benefit:

*Theoretically, officers can take the MDT out of the station, do all of their normal patrol work, attend incidents and update information whilst mobile. So the necessity to come back to the police station is removed. Officers are more visible and it is more cost effective.* (Senior officer A)

The work shadow data strongly support the finding that officers spend less time in the station. For almost 90 per cent of incidents the officer did not return to the station. This had resulted in an associated increase in public visibility for the Constabulary. Out of the hours/shifts shadowed, officers were visible to the public for 97 per cent of the time. In cases where the officer did have to return to the station this was due to an arrest or for administrative purposes – mainly to administer statements, as the
electronic signature facility was unavailable during the pilot (the facility was still unavailable following the wider rollout).

The evidence suggests that as a result of mobile technology, police officers are spending less time in the station completing bureaucratic work and more time on operational work. This may work towards producing the estimated cost savings of £800 000 a year for the average police force, and support the recommendation by the former Chief Inspector of Constabulary, Sir Ronnie Flanagan, and the vision of the former UK Prime Minister (as discussed in Chapter one).

Time and cost savings may also be apparent from the benefits of directly inputting and accessing information. Officers in the focus groups identified that they were able to input incident information whilst at the scene, which saved time in comparison to handwriting information on paper and later entering it into an information system. For example, some officers in the focus groups reported that they were able to enter missing persons information at the scene, whilst another officer suggested for scheduled appointments he could take the MDT into the property and enter details there and then. It was generally agreed that crimes could be input on average within 20 to 30 minutes, which in itself was quicker than having to return to the station to fax paper forms, thereby improving productivity. Officers participating in the trial reported on the task log analysis sheets that the time they had spent on data access and input (compared to not using an MDT for a specific incident) decreased; an officer participating in the post-trial focus groups stated that the use of an MDT was saving him and his colleagues five to ten minutes on each incident. As discussed in section 6.2.1, using the MDT it took an hour to file an incident involving a shoplifter, a process that would normally take around five hours. Direct access to information e.g. for identification purposes, checking history of a person en route to an incident and viewing incidents as they are coming in, means that officers are able to respond more quickly to incidents and improve their level of decision-making. As a result, productivity levels may increase because more arrests are possible, as discussed in section 6.2.1, and officers can deal with incident and crime queues more quickly. The ways in which officers are using MDTs to access information directly suggests a more proactive approach to policing may be taken. Within the two-week pilot of mobile technology, observation and discussion in focus groups found that the use of MDTs had allowed response officers to take a more proactive and self-reliant approach to their work, carrying out their own intelligence checks, and on occasions, responding directly to incidents queued on the system without waiting for dispatch instructions. This can be paralleled with research by into how technology is transforming police practice in Australia: 72 per cent of 506 Australian police officers felt that information technology had made a great difference to police work (as discussed in Chapter one). Similarly, Manning suggests that the introduction of two-way radios and MDTs has increased the capacity to respond to crimes. Brown and Brudney concur that IT is being employed to turn police officers into problem solvers, with 60 per cent of officers surveyed agreeing that IT greatly supports their problem solving abilities. A greater capacity for problem solving is important as it can lead to a greater number of arrests or cases solved, thereby increasing productivity.

Within three of the focus groups, officers revealed that the public perception of the Constabulary had improved as a result of mobile technology, and it was helping to create a more professional image:

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57 Chan, ref. 24, p. 156.
59 Brown & Brudney, ref. 16, p. 41.
Chapter Six: The impact of mobile technology on a UK police force and their knowledge sharing

The MDT creates a professional image, we can park up and ask questions, whereas before MDTs officers would sometimes forget to ask the necessary questions to the victim or suspect and have to call them back. Now MDTs mean that there is a checklist of questions in front of me so I can collect all the necessary information without having to call the person back, which looks more professional. (Officer N)

The MDT is a brilliant idea and there is good public perception overall. (Officer A)

You just sit up in your car and this looks good to members of the public. (Officer N)

With regard to public perception within the two-week pilot study of mobile technology, similar findings were apparent. The experience had been very positive: officers believed that MDTs had made them appear more up-to-date and professional. Members of the public had made comments such as ‘It’s about time’. The literature suggests that police cannot keep away from technology to improve processes and provision to customers and stakeholders\(^6\) i.e. the public. However, one officer suggested that some members of the public had a negative perception of the new technology because they had to wait longer whilst the information was input.

Time savings and productivity gains were also reported during the focus groups due to officers being able to make greater use of ‘dead time’, such as completing administrative tasks and checking emails during the course of the shift or whilst waiting in a custody suite. One officer reported that they were saving about 40 minutes per day just sat doing administrative work during down time. Officers within the two-week pilot study identified that they were able to submit crimes and completed tasks on their crime queue whilst waiting for vehicle recovery, in-between jobs or attending to a prisoner in custody. In some cases, officers were able to return at the end of their shift with little paperwork to complete.

From a different perspective, some of the focus group findings show that mobile technology may have a negative impact on productivity (see appendix 3c). These generally relate to technical issues with the MDT itself, such as a loss of signal causing information to be lost so that it is taking longer to capture and download information. Officers widely reported the lack of the electronic signature facility meant that they had to revert to using the paper forms for taking and approving statements. This issue has not yet been addressed, as the facility is still awaiting approval Criminal Justice Service. The logging in process was reported to be quite lengthy, thereby having a negative impact on time-savings and preventing officers from accessing information before attending an incident. The majority of officers suggested it to be impractical to use an MDT when single crewed (where an officer patrols alone in a police vehicle), which may mean that not all officers are gaining from efficiency savings offered by mobile technology. One officer stated that when single crewed, information is received in slow time, as they have to park up before going to an incident to obtain and update the information. Some of the electronic forms required officers to input duplicate information, such as the address of the victim, which increased the amount of time needed to submit a form.

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Overall, these technical issues can be improved over time, which may reduce the negative impact on productivity. Reviewing the evidence, it seems that the positive impact of mobile technology on productivity e.g. increased number of arrests and increased time spent out of the station outweigh the negative impact caused by a small number of technical issues.

6.2.7. Lessons learned

The focus groups and observational work shadowing exercise found that some officers are still returning to the station due to comfort issues, which may reduce the potential level of productivity gains. This may relate to the wider cultural change that is involved with mobile technology, which some participants discussed within the focus groups:

The MDTs and Blackberries are going to become more and more valuable as the officers and staff become more cultured with the technology. Once they become more conversant with cumbersome logging in process they will get more use out of the technology. Officers are ingenious when it comes to using technology in different ways. The Police Service is one of those strange organisations that find it difficult to have a culture change. You get inbred into certain methods of working and this is a new method of working. Officers have got to change their working practices and culture to get the best out of this kit. (Officer N)

There has been a ten-year culture of coming back to the station to use a computer, which needs altering. (Officer O)

Officer O raises an interesting point, which relates to the research by Hughes and Jackson\(^6^1\) (discussed in Chapter 2.2). They acknowledge that before the introduction of computers into police stations, officers did not return to the station and did not have access to information systems. Instead, data perceived to be important were forwarded to central offices for storage by a ‘collator’\(^6^2\), who ensured that operational officers received and recorded important information. Since the introduction of computers, police officers have become used to returning to the station in order to access information. The introduction of mobile technology provides information to officers out of the station so should over time remove the need to return to the station. However, the change process must be managed. Within a semi-structured interview with a group of Chief Inspectors, two senior officers commented on the issue of managing the change:


\(^6^2\) Ibid., p. 66.
It is a big cultural change. There are people in the room now who started off without any kind of computer and used to do exactly what we ask officers to do with the MDT, but instead with paper. Officers now have the ability to record their own crimes but they do not understand how much freedom it gives them. That’s the cultural change we have got to try and address. (Chief Inspector B)

I think the problem is the Police Service as a whole is a rather conservative or traditional organisation and we do not adapt to change particularly well, which is why we have to resort to using a ‘stick’ to try and beat out the negatives that result with the use of mobile technology, and that’s something we have to overcome. (Chief Inspector A)

Telephone interviews with other organisations that have had mobile technology for several years aimed to identify how to manage this change process and get the most out of the technology. Within the RAC organisation, BT and British Gas, a group of super-users were created across the various operational locations in the country, so that when any new technology is released into the field then positive word of mouth is given to all the patrol. This is a quick and easy way to sell the benefits of mobile technology. Within the Leicestershire Constabulary the research has come across users who are very proficient with the technology and these could be utilised to a similar effect. The use of super-users or project champions is a common feature within the knowledge management literature, where previous research showed that it worked to a positive effect.

As previously discussed in section 6.2.3, the research findings within other organisations demonstrate that within a mobile information environment, they have developed mechanisms to encourage knowledge sharing. There are still opportunities for field workers to have face-to-face interaction to avoid creating silos of information. Employees are encouraged to meet informally whilst out in the field and make use of instant messaging mechanisms in order to share knowledge. Knowledge sharing remains to carry emphasis within their organisational cultures. This is an important lesson for the organisational culture of policing organisations that wish to mobilise their information and knowledge environments. They are keen to encourage police officers to stay out of the station in order to increase visibility levels, but without this lesson they could be at risk of doing so at the detriment of current information and knowledge sharing practices and the positive shift culture. In order to avoid this, mechanisms to allow information and knowledge sharing need to be encouraged, to maintain face-to-face interaction and the shift culture, such as those identified within other organisations. This important lesson is echoed in research by Schlenkrich and Upfold, where several managerial models were analysed and combined into a theoretical model for virtual team managers. The model strongly advocates that the possible negative effects of teams working remotely with technology should be managed by providing opportunities for participation and open, informal communication, and focusing on

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maintaining a team culture, which can be likened to the importance of maintaining a shift culture\textsuperscript{67}. The following section discusses in further detail recommendations to preserve knowledge sharing within the Leicestershire Constabulary.

### 6.3. Recommendations

The findings show that to a large extent, mobile technology has enhanced knowledge sharing capacities because officers have greater opportunity and more time to share information whilst on duty than before and mobile technology has provided a new communication channel. However, there is a potential danger that mobile technology may lead to specific tacit knowledge becoming isolated amongst a few officers, as officers begin to spend less time in the station. In order to preserve knowledge sharing, the following recommendations have been made which may be of benefit to similar types of organisations using or about to implement mobile technology:

1. Although organisations have to cut costs, they should still provide enough time so that officers can discuss work and social events face-to-face. A reduction in the time spent in police stations could lead to a loss of team spirit and morale, possibly damaging the existing shift culture, or a reduction in formal and informal exchange of information, knowledge and intelligence.

2. The findings showed that it can be difficult for officers to get into contact over the radio to share information and knowledge, and officers are heavily reliant on email. Some police officers have begun to use Blackberry pins, an instant messaging service, to share information and knowledge. Policing organisations may wish to consider introducing an instant messaging service for MDTs so that officers can get in contact with colleagues without tying up the airwave or overloading them with unnecessary emails. However, the practicalities of this recommendation should be considered, since operational police officers may not be able to use such a mechanism in busy pressured situations.

3. To overcome the risk of isolation it is recommended that senior management implement a long-term initiative to create a knowledge culture.
   a. To encourage a knowledge culture an open-plan environment with breakout areas and other informal meeting amenities should be placed into all of the Constabulary’s operational premises, for example staff canteens. This provides officers with an opportunity to discuss informally work related experiences during breaks and pass on their tacit knowledge to other officers across the organisation.
   b. Other mechanisms to encourage a knowledge culture might include the continued use of face-to-face briefings; regular use of double crewing and

\textsuperscript{67} Ibid., p. 113
encouragement to meet informally during refreshment breaks or in organised social and team-building events.

In order to improve the performance of MDTs, it is recommended that specific technical issues that were common in the observation and post-trial focus groups be addressed. To do so, the following recommendations are made:

4. Not all details could be recorded electronically due to the lack of an electronic signature facility. A critical feature that would incur significant efficiency gains is the provision of an electronic signature function acceptable to the Criminal Justice Services (CJS), which is date and time-stamped to provide an audit trail. This is currently awaiting approval from the CJS.

5. During some work-shadowing exercises, it was found that officers could not log onto the MDT at the start of the shift because the previous user had not logged out correctly. The importance and process of logging off correctly needs to be emphasised as part of user training. However, training should not just address technical use of equipment, but should also cover changes in new communication and work protocols, and relevant health and safety practices. Any additional systems to be made available via the MDTs should be accompanied by appropriate training in their use.

6. Post-trial evaluation found that concerns were raised relating to health and safety and ergonomics: for example, the positioning in the vehicles meant that officers were knocking their knuckles on the docking station when using the indicator. The integrated keyboard was identified as being too small and therefore awkward to use. From a different perspective, the USB keyboard did not fit easily into the glove compartment and whilst it was stowed in the compartment, keys were inadvertently pressed causing blank records to be submitted. It was pointed out by a number of participants that an illuminated keyboard would be useful, as would a wireless keyboard that obviated the need to have trailing cables.

6.3.1. The applicability of the recommendations

To test the applicability of the recommendations, an interview was held with the acting Chief Superintendent. The Chief Superintendent is responsible for the overall program that incorporates the mobile information project within the Constabulary. During the interview, the first recommendation was fully accepted by the Chief Superintendent, who strongly acknowledged the need to retain start of shift and post shift briefings and maintain a level of face-to-face contact between officers. The proposal to encourage a knowledge culture through an open plan environment was recognised by the Chief Superintendent. He suggested that the Constabulary already encourage this to some extent and are seeking to provide more informal meeting amenities in their Strategic Estates review as a result of recommendation 3a. The Chief Superintendent expressed a clear understanding of the issue of isolation,
and consequently actions will be taken to encourage a balance between increasing the level of police visibility and maintaining face-to-face contact. For example, limiting the number of times officers return to the station from after each incident to during meal and refreshment breaks and at the end of the shift; along with the actions suggested in recommendation 2b.

### 6.3.2. Practical implications

The implementation of mobile technology is likely to have significant impact on the current working practice of the Constabulary. For example, shift patterns are likely to change as a result of reductions of shift time spent in the station and greater time spent on patrol. In terms of crewing arrangements, mobile technology may conflict with the existing policing strategy to deploy single crewed officers to achieve higher visibility levels. The study has found that the use of MDTs whilst single crewed appears to be impractical, as officers did not have time to complete the full range of checks prior to attending incidents. They had to resist the temptation to view information on the MDT whilst driving. They were also not able to use the MDTs to check intelligence when attending grade one incidents. Consequently, the continued use of double crewing is important in order to maximise the benefits to be had from MDTs and to minimise the impact on officer isolation. More importantly, the study has shown that mobile technology carries significant practical implications for existing business processes, such as the crime recording process and allocation of incidents. Crimes can now be recorded directly onto the crime recording system, which bypasses the need for crime input personnel. Officers can view incidents on the operational intelligence system, reducing the need for incidents to be dispatched via the radio. There is potential for job losses as a result of this but there are significant efficiency gains to be had as a result of the changes to the business processes.

In terms of the implications of the research findings for the wider target audience, other police forces can apply the lessons learned from the study. By doing so they may be able to minimise the risks, such as isolation and technical issues, to ensure that their deployment of mobile technology provides maximum business benefits and thus public funding is spent wisely. The lessons can also be applied to other non-policing organisations that are looking to invest in mobile technology.

### 6.4. Summary

The Chapter has explored, from a knowledge management perspective, the impact of mobilising technology on a UK police force and its effect on knowledge sharing by using a qualitative ethnographic approach. The small numbers of current studies within this area are still relatively underdeveloped in terms of theoretical learning. This research has brought together practical findings with a theoretical underpinning and to address findings in a specific context.

The results contain some interesting outcomes. Overall, the findings suggest that mobile technology has had a positive impact on policing and knowledge sharing. The findings from the various evaluation elements are consistent and indicate that both operational and senior officers who participated in each element of the research were positive about the opportunities and benefits offered by the use of
MDTs. The benefits to the Constabulary include a reduction in the amount of time to perform routine tasks resulting in fewer returns to the station, better time management and increased visibility; during the pilot officers were visible to the public for 97 per cent of the time shadowed. Overall this may be seen as an improvement to the policing performance provided.

Benefits to knowledge sharing are apparent from the findings. Firstly there was an improvement in the timeliness and accuracy of information meaning greater availability of information for decision-making purposes. It took officers eleven minutes to input information using mobile technology rather than the previous three days with the paper-based crime recording system. In addition, the delivery of knowledge to officers regardless of geographical restrictions meant that officers could make decisions with greater confidence. This may contribute to the concept of a learning organisation and support the upcoming concept of mobile knowledge management. Secondly, officers had better control over information and knowledge available to them as a result of mobile technology, rather than receiving too much or less critical information from the call management centre. Thirdly, it was found that since mobile technology has a lower level of latency than audio information (e.g. radio) officers could share information with other officers in the field more quickly and locate specific expertise more easily. Finally, officers in the pilot believed that knowledge sharing had improved because mobile technology provided a new avenue for keeping each other up to date with events e.g. completing checks for other colleagues and sharing warning and history markers with non mobile technology users whilst on patrol. However, these findings may have been limited by the involvement of mainly ‘pro-mobile data’ personnel in the initial pilot study. Future research may wish to consider the impact across a wider variety of users.

However, the positive findings of mobile technology on knowledge sharing only reflect the outcome of initial usage of around five months. Other research studies\(^{68, 69, 70, 71}\) suggest that mobile technology can have a negative impact on knowledge sharing and reduce opportunities for the informal exchange of knowledge and intelligence. This is important because previous research has found that the more knowledge that is shared between officers, the better the results of an investigation\(^{72}\). A reduction in opportunities for knowledge sharing may be detrimental to the performance of the Constabulary and to the safety of the public. Overall, the benefits afforded by the use of mobile technology appear to outweigh the risks. With regard to the previous Chapter, it can therefore be argued that the positive impact of mobile technology on knowledge sharing means that this factor is not a barrier to user acceptance. However, as evident by the research within this Chapter, the impact on knowledge sharing still needs to be considered during the implementation process.

Provided that the risks are recognised and managed by policing organisations in the long term, mobile technology will have an optimal effect on existing information and knowledge processes within policing, and therefore successful undergo a technological change. However, the effectiveness of knowledge sharing within a mobile information environment depends on the impact of the information seeking behaviour of police officers and the quality of the information being shared, and this is investigated within the following Chapter.

\(^{68}\) Collier, ref. 46., p. 364.  
\(^{69}\) Ng & Ang, ref. 47., p. 364.  
\(^{70}\) Edwards, ref. 60., p. 119.  
\(^{72}\) Glomseth et al, ref. 28., p. 106.
Chapter Seven: Implications of mobile access to information systems for data quality and information literacy

Chapter Preface

In order for police officers to retrieve information from mobile information systems, it is important firstly for the information to be of good quality. Secondly, the overall positive impact of mobile technology on knowledge sharing may hinge on the information literacy\(^1\) skills of police officers and quality of information. If police officers have poor information literacy skills then they may become more dependent on face-to-face mechanisms to seek information, and if generally good information literacy is apparent then face-to-face knowledge sharing may potentially decrease, so it is important to ensure that knowledge is widely shared. This Chapter presents findings of research into the implications of mobile technology for data quality and information seeking. The Chapter contributes to the literature by adding to the small body of knowledge within the areas of data quality and information literacy of a mobile policing environment, as discussed in Chapter 2.3. This Chapter fulfills objective seven of the research. It is also partly based on a conference paper\(^2\), regarding the implications for data quality, presented at the International Conference of Information Management and Evaluation in Cape Town, South Africa in March 2010. The findings regarding information literacy are partly based on a journal paper, to be published in a special edition of Online Information Review\(^3\).

The research within this Chapter was investigated through a mixed methods approach of a questionnaire, semi-structured interviews and focus groups. Quality of data directly input onto the Crime and Intelligence System (CIS) via a MDT during the two week pilot was monitored and compared to the same details held within written working sheets and statements and the Police National Computer system. However, this monitoring process was not conducted prior to or after the initial pilot, as much larger volumes of data were input over a wider time-period. It also proved difficult to make comparisons between differing records to those input during the pilot. Experimental methods were considered to provide a more objective understanding towards information literacy skills (see Appendix 2g), but proved impractical due to reasons discussed in section 3.6.1. Results from the various methods were triangulated in order to develop a coherent picture of how police officers search for information within a mobile information environment, the level of training provided in searching for information, and the current level of data quality and the implications of this within a mobile environment. The Chapter presents the results from the analysis of data produced from the methods and discusses these findings

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\(^1\) N.B. The term Information literacy throughout this Chapter refers specifically to the ability to retrieve required items of information via a mobile data terminal, rather than the general ability to operate a mobile data terminal.


in relation to existing literature and the impact on policing performance (e.g. accuracy of information, time available to attend incidents, public confidence). The Chapter also aims to produce recommendations to assist with any information seeking issues, in order to maximise the benefits of providing information remotely via mobile devices.

7.1 Background

7.1.1 The importance of understanding the implications of data quality and information seeking behaviour in a mobile environment

Section 2.2.1 highlighted the importance of a high level of data quality in terms of applying existing information to make good decisions. In addition to the ability to retrieve information whilst on the beat via mobile devices, police officers are granted the ability to input information directly into information systems, which alters the paper-based crime recording process (see section 1.1.3). As discussed in Chapter 2.2, there is a complex range of sources that officers have to update within a time-critical environment. This may have implications for data quality and subsequently, retrieval of information. Police officers must develop adequate skills in order to access the required information from vast sources rapidly and precisely. This issue has been recognised by Carpineto et al. and Kamvar and Baluja within a commercial setting, but Chapter 2.2 found that little investigation has been done within a policing context.

The research endeavoured to address this gap by investigating how data quality is measured and the perceived impact that mobile technology has on data quality. It also sought to investigate how officers rate the input of information into commonly used information systems along with any issues that they have, and the level of training provided into inputting information and understanding the importance of data quality. As well as perspectives from the human side, it also investigated the technical aspect, such as the nature and structure of systems. A set of recommendations to enhance the level of data quality were also produced.

The research addressed the gap in information literacy outlined in Chapter 2.2 by reviewing the search strategies used by police officers within the Leicestershire Constabulary; the perceived level of information literacy among police officers; and the implications of mobile technology on the perceived information literacy. It provided solutions to assist with any mobile information seeking behaviour (MISB) issues, in order to maximise the benefits of providing information remotely via mobile devices.

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7.1.2 The research domain

The results of this Chapter are based on the outcomes of the research conducted with the research domain shown in Table 7.1.1 (as previously discussed in Chapter three).

<table>
<thead>
<tr>
<th>Phase of research</th>
<th>Data source of research</th>
<th>Population and sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data quality</td>
<td>Face to face semi-structured interviews to identify measures used to monitor data quality within the Constabulary and to understand reasons for the perceived level of data quality and attitudes towards data quality (see Appendix 2k)</td>
<td>Operational officers, IT staff and employees within the Constabulary responsible for monitoring data quality</td>
</tr>
<tr>
<td></td>
<td>Monitoring of quality of data input directly by officers via a MDT during the initial two-week pilot study of MDTs.</td>
<td>96 incident records input directly using a MDT by operational police officers</td>
</tr>
<tr>
<td></td>
<td>Focus groups to examine the ease of inputting information into information systems</td>
<td>15 x focus groups with 78 operational police officers</td>
</tr>
<tr>
<td>Mobile information seeking</td>
<td>Questionnaire to investigate the information seeking behaviour of police officers (see Appendix 2f)</td>
<td>48 responses gained during focus groups; 71 out of 474 responses gained from further electronic distribution providing 22.7 per cent response rate</td>
</tr>
<tr>
<td></td>
<td>Focus groups to investigate the impact of mobile technology on information retrieval (see Appendix 2h)</td>
<td>50 operational officers using mobile data terminals</td>
</tr>
<tr>
<td></td>
<td>Semi-structured interview (see Appendix 2i)</td>
<td>5 senior officers</td>
</tr>
<tr>
<td></td>
<td>Semi-structured telephone interviews to determine how they have assisted their field workers with information retrieval within a mobile setting (see Appendix 2i)</td>
<td>External organisations that are also using mobile technology, to identify the impact of mobile technology beyond the police service. Organisations interviewed included Yorkshire Water, RAC, East Midlands Ambulance Service, BT and British Gas</td>
</tr>
</tbody>
</table>

Measurement of data quality was investigated by mapping aspects of the data quality monitoring process identified via qualitative data from semi-structured interviews (see Appendix 2k) against the key attributes of data quality derived from the literature review (as shown in section 2.2.1). Quality of data directly input onto the CIS Intelligence System via a MDT during the initial two week pilot was monitored by comparing the details directly input into the CIS against the details held in written statements and the Police National computer system. Focus groups were used to explore the perceived ease of inputting information into mobile information systems. The study intended to conduct a series of observational ‘work-shadowing’ exercises to explore this issue in a more objective manner. However, a large number of officers that are using mobile technology in police vehicles are single-crewed, meaning it is difficult to
input information whilst driving and completing operational duties. Therefore, the use of observation was trialled but only a small amount of data could be collected. The method was later rejected for the research. Qualitative methods were largely used to explore the issues in-depth; whereas quantitative methods such as a questionnaire may lack this in-depth understanding. It is recognised that the one interview deployed to identify measures used to monitor data quality offers limitations in terms of assessing the data quality process, however the participant for this interview was selected on their level of expertise (see section 7.2.1).

7.1.3 Analysis of results

Data from the focus groups and both sets of interviews were analysed using the qualitative analysis software package Atlas.ti to identify themes from the data. Thematic grids were then produced for each theme in order to analyse common occurrences and build up a picture of data quality and information literacy. A statistical analysis software package was used to analyse responses from the mobile information seeking behaviour (MISB) survey.

7.2 Data Quality

7.2.1 The data quality monitoring process

This research sought to extend understanding of how data quality is assessed within the Leicestershire Constabulary. This was mainly achieved through a semi-structured interview with the key person within the Constabulary who is responsible for overseeing the implementation of the Code of Practice regarding the Management of Police Information (MOPI) (referred to as the MOPI project manager (PM) throughout this Chapter). MOPI was introduced into UK police forces in 2005, in direct response to the tragedy of the Soham murders, which was partly caused by poor quality information regarding the offender, Ian Huntley, being held on disparate information systems. MOPI aims to ensure that intelligence and information held on people is fully accurate, and therefore data quality plays a pivotal role. Data quality is a key aspect of the role of the manager of MOPI and he was therefore considered to be a good source of information for this element of research.

The interview with the MOPI manager highlighted the importance of data quality; for example for one person their details may be held within 32 different systems. If each of the 32 records has varying field entries, it can make it difficult to uniquely identify the 32 records as the same person, which can lead to poor decisions being made. For example, if the address of person X is recorded as 19 Arcadia Avenue within one system, but is recorded as 91 Arcadia Avenue within another system, an officer may choose to break and enter the wrong address, which may reduce the level of public confidence within the police service. Therefore monitoring the quality of data within systems may reduce such misjudgements.

Figure 7.2.1 represents the main data quality-monitoring process that is followed within the Constabulary on a monthly basis. The process only monitors the accuracy of a small amount of data – the names and dates of birth (DOB) fields of records held within the main systems (crime and intelligence system, custody system, child abuse system and firearms system). However, these fields are the main fields that are used when searching for people within systems so it is important that they are checked for accuracy. As shown in Figure 7.2.1, the fields are checked for accuracy and placed into three categories – ‘good’, ‘sparse’ and ‘bad’, and statistics are produced on the levels of data within each category. ‘Good’ data includes name and DOB fields that are completed correctly; ‘sparse’ data means that names and DOB fields of systems lack some data, such as first name; and ‘bad’ data means that name and DOB fields of system are completed incorrectly, such as ‘1853’ entered as a year.

It was revealed during the interview that the Constabulary used to have the greatest numbers of ‘bad’ data than the other police forces within the East Midlands region, but since this monitoring process was introduced the MOPI PM suggested that the level of ‘bad’ data has been dramatically reduced (see Table 7.2.1). It is also apparent within Table 7.2.1 particular points in time where the level of ‘good’ data has increased. For example, between the 8th May 2007 and 12th June 2007 the level of ‘good’ data dropped from 96.16 per cent to 93.30 per cent. This was due to a change in the crime recording process. All domestic abuse reports are recorded on the CIS, however as there are often counter-allegations then all parties are usually registered as joint aggrieved, which does not require entry of dates of birth. However, the CIS has a mandatory field for the date of birth, which leaves officers recording dates of birth as 01/01/1900. Prior to the 12th June 2007, this data was filtered from the data quality monitoring process – hence a drop in the number of good data submissions. This decision was made to ensure that persons involved locally in domestic abuse allegations were circulated nationally, even with known fictitious dates of birth. Similarly, between the 8th April 2008 and 13th May 2008, the level of ‘good’ data increases from 93.03 per cent to 94.03 per cent. During the interview it was found that this was related to the ongoing data quality monitoring process, whereby returns are sent monthly to the business areas for the CIS with a request to investigate and amend accordingly. It was suggested this could also be due to the initial introduction of MDTs. The level of ‘good’ data further increased from 94.93 per cent to 95 per cent between 9th September 2008 and 14th October 2008, which was suggested in the interview to be related to the full roll-out of mobile technology. This may suggest that mobile technology is having a positive impact on certain elements of data quality, since information is captured whilst at the scene thereby increasing the level of accuracy.

Following the analysis of data, ‘good’ data are submitted to the Impact Nominal Index, which is an information system that allows forces to establish whether any other force holds information on a person of interest within their local systems\(^{11}\). After 2010, these data will be uploaded to the Police National Database, which provides a single point of access for searching for information held across all of the forces’ local systems and national systems\(^{12}\). Since these data are to be used on a national level for decision-making within other police forces, it is important that it is accurate. ‘Sparse’ and ‘bad’ data

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are returned back to the owner of the relevant system, who amends the error and resubmits for the following month.

**Figure 7.2.1:** The main data quality monitoring process within the Leicestershire Constabulary
### Table 7.2.1: Levels of ‘good’, ‘sparse’ and ‘bad’ data within the Leicestershire Constabulary (source: Internal statistics generated within the Constabulary)

<table>
<thead>
<tr>
<th>Submission Date</th>
<th>‘Good’ data</th>
<th>‘Sparse’ data</th>
<th>‘Bad’ data</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-Dec-2005</td>
<td>96.72%</td>
<td>2.87%</td>
<td>0.40%</td>
</tr>
<tr>
<td>16-Jan-2006</td>
<td>96.19%</td>
<td>3.33%</td>
<td>0.47%</td>
</tr>
<tr>
<td>15-Feb-2006</td>
<td>96.78%</td>
<td>2.83%</td>
<td>0.39%</td>
</tr>
<tr>
<td>15-Mar-2006</td>
<td>96.85%</td>
<td>2.77%</td>
<td>0.38%</td>
</tr>
<tr>
<td>19-Apr-2006</td>
<td>96.82%</td>
<td>2.80%</td>
<td>0.38%</td>
</tr>
<tr>
<td>15-May-2006</td>
<td>96.83%</td>
<td>2.79%</td>
<td>0.37%</td>
</tr>
<tr>
<td>01-Jun-2006</td>
<td>96.83%</td>
<td>2.80%</td>
<td>0.37%</td>
</tr>
<tr>
<td>06-Jul-2006</td>
<td>96.85%</td>
<td>2.78%</td>
<td>0.36%</td>
</tr>
<tr>
<td>03-Aug-2006</td>
<td>96.31%</td>
<td>3.08%</td>
<td>0.61%</td>
</tr>
<tr>
<td>07-Sep-2006</td>
<td>96.29%</td>
<td>3.11%</td>
<td>0.60%</td>
</tr>
<tr>
<td>10-Oct-2006</td>
<td>96.25%</td>
<td>3.15%</td>
<td>0.60%</td>
</tr>
<tr>
<td>14-Nov-2006</td>
<td>96.22%</td>
<td>3.18%</td>
<td>0.60%</td>
</tr>
<tr>
<td>12-Dec-2006</td>
<td>96.20%</td>
<td>3.19%</td>
<td>0.60%</td>
</tr>
<tr>
<td>09-Jan-2007</td>
<td>96.20%</td>
<td>3.20%</td>
<td>0.60%</td>
</tr>
<tr>
<td>13-Feb-2007</td>
<td>96.17%</td>
<td>3.23%</td>
<td>0.60%</td>
</tr>
<tr>
<td>13-Mar-2007</td>
<td>96.16%</td>
<td>3.24%</td>
<td>0.60%</td>
</tr>
<tr>
<td>10-Apr-2007</td>
<td>96.16%</td>
<td>3.24%</td>
<td>0.60%</td>
</tr>
<tr>
<td>08-May-2007</td>
<td>96.16%</td>
<td>3.24%</td>
<td>0.60%</td>
</tr>
<tr>
<td>12-Jun-2007</td>
<td>93.30%</td>
<td>6.40%</td>
<td>0.31%</td>
</tr>
<tr>
<td>10-Jul-2007</td>
<td>93.55%</td>
<td>6.28%</td>
<td>0.16%</td>
</tr>
<tr>
<td>14-Aug-2007</td>
<td>93.50%</td>
<td>6.34%</td>
<td>0.16%</td>
</tr>
<tr>
<td>11-Sep-2007</td>
<td>93.45%</td>
<td>6.41%</td>
<td>0.15%</td>
</tr>
<tr>
<td>09-Oct-2007</td>
<td>93.50%</td>
<td>6.36%</td>
<td>0.15%</td>
</tr>
<tr>
<td>13-Nov-2007</td>
<td>93.68%</td>
<td>6.17%</td>
<td>0.15%</td>
</tr>
<tr>
<td>11-Dec-2007</td>
<td>93.72%</td>
<td>6.13%</td>
<td>0.15%</td>
</tr>
<tr>
<td>08-Jan-2008</td>
<td>93.74%</td>
<td>6.11%</td>
<td>0.15%</td>
</tr>
<tr>
<td>12-Feb-2008</td>
<td>93.75%</td>
<td>6.10%</td>
<td>0.15%</td>
</tr>
<tr>
<td>11-Mar-2008</td>
<td>93.87%</td>
<td>6.07%</td>
<td>0.05%</td>
</tr>
<tr>
<td>08-Apr-2008</td>
<td>93.93%</td>
<td>6.05%</td>
<td>0.01%</td>
</tr>
<tr>
<td>13-May-2008</td>
<td>94.03%</td>
<td>5.96%</td>
<td>0.01%</td>
</tr>
<tr>
<td>10-Jun-2008</td>
<td>94.18%</td>
<td>5.81%</td>
<td>0.01%</td>
</tr>
<tr>
<td>08-Jul-2008</td>
<td>94.91%</td>
<td>5.08%</td>
<td>0.01%</td>
</tr>
<tr>
<td>12-Aug-2008</td>
<td>94.92%</td>
<td>5.07%</td>
<td>0.01%</td>
</tr>
<tr>
<td>09-Sep-2008</td>
<td>94.93%</td>
<td>5.06%</td>
<td>0.01%</td>
</tr>
<tr>
<td>14-Oct-2008</td>
<td>95.00%</td>
<td>4.98%</td>
<td>0.01%</td>
</tr>
<tr>
<td>11-Nov-2008</td>
<td>95.04%</td>
<td>4.94%</td>
<td>0.01%</td>
</tr>
<tr>
<td>09-Dec-2008</td>
<td>95.15%</td>
<td>4.83%</td>
<td>0.01%</td>
</tr>
<tr>
<td>13-Jan-2009</td>
<td>95.22%</td>
<td>4.77%</td>
<td>0.01%</td>
</tr>
<tr>
<td>12-Feb-2009</td>
<td>95.24%</td>
<td>4.75%</td>
<td>0.01%</td>
</tr>
<tr>
<td>10-Mar-2009</td>
<td>95.24%</td>
<td>4.75%</td>
<td>0.01%</td>
</tr>
<tr>
<td>14-Apr-2009</td>
<td>95.24%</td>
<td>4.75%</td>
<td>0.01%</td>
</tr>
<tr>
<td>12-May-2009</td>
<td>95.23%</td>
<td>4.75%</td>
<td>0.01%</td>
</tr>
<tr>
<td>10-Jun-2009</td>
<td>95.23%</td>
<td>4.76%</td>
<td>0.01%</td>
</tr>
</tbody>
</table>

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Change in crime recording process: dates of births for joint aggrieved persons in domestic incidents are left blank, causing default date of birth to be entered as 01/01/1990, hence decrease in ‘good’ data

Introduction of MDTs; ‘bad’ data investigated and amended by system owner

Full roll-out of MDTs
In addition to the monitoring of names and addresses, the MOPI PM revealed that the audit department within the Constabulary also monitors the quality of data held within internal information systems. Whilst the audit department mainly ensures compliance with business processes, he explained that they can also detect some data quality issues during the audit. These issues are then raised at the Information Management Board, which is responsible for the overall data quality within the Constabulary. At the Board, actions are produced for the owners of the relevant information system, who will then rectify the issues and feed them back to the next Information Management Board, which is held once a month. This process is represented in Figure 7.2.2:

![Figure 7.2.2: The data quality monitoring process within the Internal Auditing department](image)

In addition to these two monitoring processes, the MOPI PM revealed that on occasions, users of information systems may detect data quality issues. For example, if a user searches for a person but cannot find them due to the person being spelt incorrectly, they may request for the spelling to be corrected if all their other details (e.g. address, date of birth) produce a match. At the same time, they may post an article onto the ‘latest news’ section of the Force intranet to reinforce to other users that they must ensure details are entered correctly. The MOPI PM revealed that the importance of this is that officers are becoming more aware about the importance of data quality.

Whilst the MOPI PM suggested that these processes have proven to be quite effective, he also implied that they are more of a reactive process and do not detect issues at source i.e. when data are input. He explained how a feature has been developed just for the Constabulary to assist users in entering information into the crime and intelligence system (CIS) and Custody system. The feature is an
icon that looks like a ‘fox’ and works in a similar way to the ‘paperclip’ wizard that appears within Microsoft applications. The icon appears when a user is entering data into the ‘name’ and ‘date of birth’ fields and validates the data if they appear to enter something that appears not to make sense, e.g. entering the year ‘1858’ instead of ‘1958’. The Constabulary have decided not to make the ‘fox’ icon available for all fields, as users could become frustrated and close the icon every time it appears, which would reduce its effectiveness. The icon detects data quality issues at source and as a result has helped to improve the level of data quality within the CIS. However, this is to a lesser extent within the Custody system and the MOPI PM explained the reason for this is unknown. The feature aligns with the key lessons learned from a study into data quality issues within the telecommunications industry, where a uniform valid point of entry is recommended\(^\text{13}\). Within a mobile information environment, such a feature is especially important as officers can now directly input information into information systems, so it is better to detect issues at an early stage. During focus groups, police officers suggested that replicating the existing systems within a mobile environment would be unsatisfactory. Therefore the implementation of this feature may support the preferences of police officers, which are discussed further within section 7.2.2, along with further suggestions to detect data quality issues at source.

### 7.2.2 Assessing the Design of the Crime Input interface

This research sought to extend understanding of how officers input information into the crime and intelligence (CIS) information system. This is critical given that the mobile data units will enable officers to input information directly onto the system.

Prior to the introduction of mobile technology, focus group participants expressed the need for the CIS interface to be simple and easy to use, as the emphasis will be on the officer to input information. This is illustrated by the following examples:

**“The interface must be different – it is no good just replicating the old CIS on MDTs”**

**“There is a need for entering checks to be in place. There are current frustrations over the lack of content of information”**

These findings were mirrored by officers following the rollout of MDTs, again suggesting the need for prompts to avoid missing important information and removal of duplicating information such as the address of the victim:

**“When inputting crimes we have to input duplicate information e.g. the aggrieved address. Prompts are necessary so that we do not miss important information”**

“Drop-down categories should be introduced to fields such as ‘property’ to improve on searchable fields and data quality”

Within the wider-evaluation focus groups, a group of officers were asked on a scale of one to five (with one being easy and five being difficult) how they would rate the input of information into the CIS, and rated this as 3.5. This indicates that the input of information is more difficult than the paper-based crime recording process. They suggested that this was due to a number of reasons. Firstly, the CIS input screens do not follow a logical order, meaning that officers sometimes forget important information within a later screen. Secondly, they stated that the CIS has some mandatory fields that must be completed before the system allows data to be saved, but mandatory fields can be overridden by entry of inaccurate data. Thirdly, they asserted that the gazetteer within the CIS (Figure 7.2.3) used to look up addresses contains many errors and requires a high degree of accuracy to look up and enter the correct location:

“The ability of the Gazetteer to locate an address despite poor spelling or inaccurate information needs improving”

This issue means that locations often have to be entered as free text, which may reduce the level of data quality. The final issue was that they suggested free text fields allowed inaccuracy of data, for example when inputting details of stolen properties it can be difficult to know what information to enter (Figure 7.2.4).

Figure 7.2.3: Input of crime location details via the Gazetteer on the CIS
Another issue raised within the post-trial focus groups was the lack of integration of systems. For example, the Command and Control system is not linked to the CIS so both systems have to be updated in order to provide full details of a crime. Before mobile technology, crime related information was input and shared by the call management centre to officers via the radio. Officers in the post-trial focus groups were concerned about the expectation to input into the various information systems whilst at the same time completing their operational duties. Similarly, the MOPI PM suggested that a problem is that nobody coordinates the purchasing of systems and as a result they lack integration.

These issues carry particular relevance for data quality: entry of data into large number of free-text fields and several systems whilst a police officer is working within a time-critical operational environment may negatively affect the accuracy, completeness, timeliness, accessibility and consistency of data held within police systems (Table 7.2.2). This impact is likely to be magnified during the entry of data via a mobile device (Table 7.2.2), unless changes are made to suit data entry within a mobile information environment. The design of the CIS interface and integration of a complex range of data entry interfaces remain open questions in order to maintain quality information whilst allowing information systems to be updated remotely.
Table 7.2.2: Screen design issues versus data quality problems

<table>
<thead>
<tr>
<th>Screen design issue</th>
<th>General vs. MDT specific issue</th>
<th>Data quality issue affected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General screen design issue</td>
<td>MDT specific screen design issue</td>
</tr>
<tr>
<td>Interface needs adapting to suit a mobile environment</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Can miss important information due to a lack of prompts</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Lack of drop-down categories; too many free-text fields; hard to know what information to enter and takes more time.</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Poor ability to locate an address using the Gazetteer; record may have been misspelled via free-text entry</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>The CIS system is not integrated with the incident management system, so both systems have to be updated separately</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

7.2.3 Mapping the data quality process

Based on the evidence so far, the aspects of the data quality monitoring process were mapped against the key attributes of data quality (identified in the literature review – refer to Table 2.2.1), as shown in Table 7.2.3. Any of the 26 attributes listed in Table 2.2.1 with a frequency of 8 or more from the systematic review were identified as a key attribute, and selected for inclusion as one of the seven attributes in Table 7.2.3.

From this mapping, it appears that the Constabulary are heavily focused on the attribute of completeness therefore monitoring the degree to which fields have been completed accurately and in the correct format. Other attributes, such as the accuracy of data therefore whether the correct information is held on a person; timeliness, relevance, understandability and consistency are not audited on a regular basis within the Constabulary.

The analysis of findings above is supported by results of the semi-structured interview. When questioned about the effectiveness of these data quality-monitoring processes, the MOPI manager explained that they do not ensure the correct details are entered into fields, such as the correct date of birth for a person. For example, entering the date of birth “1st January 2009” would meet the data standards but would not necessarily mean good data quality, as this might not be the actual DOB of the person. He suggested that the term data quality is difficult to define, as it can be a subjective term that means different things to different people, making it difficult to measure unlike common formats for data.
entry/ data standards. As a result, there are few processes in place to monitor the actual level of data quality. Since there is no definitive understanding of what data quality is and no specific measures, it was suggested in the interview that data standards are used instead as a comparative measure against other police forces. Umar et al\textsuperscript{14} recognise this issue within the telecommunications industry, and recommend the development of metrics that focus on measuring the impact of data quality problems and the improvement of data quality problems, such as data reconciliation cost savings (such as labour costs) and performance (such as volume of errors).

\textsuperscript{14} Umar et al, ref. 13, p. 285.
Table 7.2.3: Mapping of elements of data quality within the Constabulary to the academic attributes of data quality

<table>
<thead>
<tr>
<th>Data quality attribute within academia (based on evaluation in literature review – see Table 2.2.1)</th>
<th>Definition</th>
<th>Data quality attribute within the Leicestershire Constabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>The correctness of data with respect to real life</td>
<td>On the whole accuracy is not apparent within the data quality monitoring process; main focus is on the completeness of fields within systems and that information is completed to a correct format (see below) but does not ensure that the information about a person is correct e.g. their correct date of birth or surname. However, some users can request spellings of names and other details to be changed if they conduct a search and cannot find that person due to incorrect details.</td>
</tr>
<tr>
<td><strong>Completeness</strong></td>
<td>The degree to which values are present in data collection and sufficient(^{15}).</td>
<td>Monitors the level of 'good' data (e.g. names and date of birth fields completed correctly), 'sparse' data (some fields lack data e.g. forename) and 'bad' data (e.g. name and date of birth field completed incorrectly; 1853 entered as year) held within the CIS, Custody, child abuse and firearms systems (see section 7.2.1 for details). Icon within systems to ensure that data is entered into fields in the correct format.</td>
</tr>
<tr>
<td><strong>Timeliness</strong></td>
<td>Whether the information is available in the required timeframe of the user(^{16}).</td>
<td>Not monitored within the Constabulary, but there is a maximum target of one day</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>Whether the information addresses the users needs</td>
<td>Not monitored within the Constabulary</td>
</tr>
<tr>
<td><strong>Understandability</strong></td>
<td>The ease of comprehending the information(^{17}).</td>
<td>Not monitored within the Constabulary</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>Determines the degree to which information can be retrieved when required(^{18}).</td>
<td>Has been considered to some extent through the development of the Police National Database and GENIE, which integrates information from several different systems</td>
</tr>
<tr>
<td><strong>Consistency</strong></td>
<td>Ensures that two or more data items do not conflict with each other(^{19}).</td>
<td>Not monitored within the Constabulary</td>
</tr>
</tbody>
</table>


Section 7.2.7 discusses potential solutions to overcome the issues of incorrect spelling and disparate systems and incorporate wider attributes of data quality other than the level of complete data.

### 7.2.4 Perceptions of data quality

**Initial perceptions: before the introduction of mobile technology**

Prior to the introduction of mobile technology into the Constabulary, the issue of data quality was perceived as a major concern for several stakeholders of the project. These stakeholders were mainly those who would be affected by the direct input of information. A group of crime input checkers were apprehensive about police officers in effect doing their job, stating that ‘the immediate rollout of CIS in its current form as an input device on MDTs is likely to cause data quality issues, and is unlikely to increase the speed of inputting information unless there is a programme of training’. Similarly, a group of police officers suggested that data quality could potentially be compromised, as the current checking processes carried out by the Crime Bureau would be bypassed. In contrast, another group of police officers participating in pre-pilot focus groups felt that data quality was likely to improve in terms of accuracy, comprehensiveness and timeliness. In particular, officers stressed the benefits of crime records being added without delay. They suggested that there will be fewer errors as a result of no longer having to rely on transcription from illegible handwriting and on account of crime reports being recorded whilst still fresh in the mind of officers.

**Perceptions following the introduction of mobile technology**

Following the introduction of mobile technology, overall police officers participating in post-trial focus groups felt that data quality had improved, as information could be input there and then. For example, one officer stated that ‘direct inputting means that data gets entered onto the system far more quickly, and hence is more likely to be accurate’. This was generally the opinion of officers participating in a series of wider evaluation focus groups, who identified the benefits of not having to write down information and pass it onto a third party, such as not having to rely on the call management centre staff for information. The majority of officers participating in the wider evaluation focus groups held the view that information obtained from the call management centre might sometimes lack full depth of information. They implied that officers are keen to deal with incidents effectively and this creates a greater onus for officers to get the information right, rather than the call management centre that is not working on the front line. This contrasts with some initial perceptions amongst police officers, who were concerned about the removal of a quality checking process conducted by the Crime Bureau, but confirms the initial perceptions of other police officers who expressed the benefits of updating details without delay (see section above). However, call management centre respondents, who commonly access and input information into related systems, concurred that the accuracy of data on the intelligence systems might be reduced in the long-term as a result of input error by officers. Similarly, the MOPI PM revealed that he suspected mobile technology has reduced the level of data quality, as the role of the gatekeeper for the CIS and PNC information systems has been removed. Data input is now done at source, which he felt
was good in terms of capturing information early, but with a wider range of people inputting information
directly he felt it is now harder to isolate issues. However, he cautioned that there was no evidence to
support his claim because there are few processes in place to monitor the quality of data input into
systems (as discussed in section 7.2.1). This demonstrates the dichotomy between the perceptions of
operational and managerial police officers and staff: overall managerial staff appeared to show negative
perceptions whereas operational police officers were generally positive about the impact on data quality.

Reviewing the evidence so far, there appears to be conflicting perceptions of the impact on data
quality amongst various stakeholders. Data from the work-shadowing exercise (conducted during the
two-week pilot) are more objective than focus group data, which are largely based on opinion. The work
shadowing exercise showed that 50 per cent of officers recorded details electronically and 42 per cent of
officers used the MDT and paper forms to record details (mainly due to the deactivation of the electronic
signature facility for statements). Pocket notebooks were not used for any incidents. This supports the
opinion of officers with regard to a reduction in recording information onto information systems at a later
point in time; information is entered into information systems during the occurrence of the incident, which
may have long-term positive implications for reducing bureaucracy and data quality.

Although there were concerns raised prior to the pilot regarding data quality, as officers would
now be directly inputting information directly into information systems making it difficult to retrieve critical
but poorly located information, the data quality monitoring exercise (section 7.2.1) identified that 82 per
cent of incidents input via an MDT had no data quality issues. As discussed in section 2.3.1, data quality
is fundamental to successful information management\(^\text{20}\). It is essential that all information be recorded
completely and accurately at the outset. Failure to do so at the outset will lead to further work and an
increased likelihood of missing a potentially vital link. Good quality information helps to ensure that
appropriate action is taken and that it can be accessed and shared between other Forces. Police officers
suggested that in the long-term there would be fewer errors as a result of removing the need to rely on
transcription from illegible handwriting and on account of crime reports being recorded whilst still fresh in
the mind of officers. Norman and Allen\(^\text{21}\) mirror these findings: officers within UK police forces anticipated
the quality of information to increase as a result of mobile technology. Officers can now perform many of
the tasks that were once dependant on radio dispatch. Dependence on radio operators has been virtually
eliminated for communication among operational officers; the priority calls can be signalled directly to the
officers via MDTs. In the long term, this may also increase the accuracy of information received via a
MDT than via the call management centre due to removal of intermediaries, which can affect the quality
of searches and input: officers can delve further into systems and remove a source of error by
conducting searches themselves\(^\text{22}\). Therefore, despite conflicting opinion amongst key stakeholders,
from this and the objective evidence it can be concluded that mobile technology appears to have a
positive impact on the level of data quality.

\(^\text{20}\) Informatica. Implementing data quality metrics and standards to enhance crime-fighting throughout the force’s jurisdiction and
\(^\text{21}\) Norman, A. & Allen, D. Deployment and use of mobile information systems: a case study of police work. *International Federation
\(^\text{22}\) Ibid., p. 215.
7.2.5 Provision of training into inputting information

Findings from focus groups revealed that some officers believed that they have not received enough training and there are vastly ranging levels of competence in inputting information. They felt that they needed more training across the entire organisation to understand how to input information effectively into the CIS. This mirrors the findings from the survey about the level of training provided (see section 7.3.4).

The MOPI PM identified that police officers are becoming more aware about the importance of data quality from posts on the local Intranet when errors are found from fellow colleagues (see section 7.2.1). The interview also found that posters are being developed and placed in training classrooms to explain the significance of putting in good data in order to retrieve good information from systems, and thus make arrests successfully. With the advent of the Police National Database (PND), emphasis is being placed on ensuring details are input correctly at the point of data capture so that officers within the Constabulary are not letting down officers in another part of the country at a later point in time. The MOPI PM explained that the trainers within the Learning and Development department are ‘slowly gearing up to data quality’ and it is being incorporated into key elements of the MDT training course. However, he raised concerns that more experienced officers may have missed out on these key messages. Since refresher courses are rare due to tension over removing officers from the street, there is a danger that these officers may still continue to input a lower quality of data. Despite this, the MOPI PM felt that a more corporate approach is now being adopted towards the implications of poor data quality for the whole nation. He suggested in the future, he would like to increase awareness by delivering a marketing campaign that contains positive and negative case studies related to data quality, but in an appealing manner to ensure that the messages are well-received rather than as a dry ‘health and safety’ subject. He also felt strongly that data quality should be defined and baselined, in order to overcome the current lack of agreement on data quality monitoring (as discussed in section 7.2.1), and felt that this was a ‘huge organisational task’.

7.2.6 The nature and structure of information systems

In addition to the human elements such as training that can affect data quality, the research also investigated the technical aspects related to the nature and structure of information systems. In particular it investigated the age of data and information systems, and the use of data and information standards.

Age of data

The MOPI PM indicated that before MOPI, data held within systems used to be stored within information systems for different lengths of time for different police forces. The MOPI Code of Practice now ensures that data is stored for a standard length of time, and all police forces have until December 2010 to achieve this. Since the MOPI Code of Practice is derived from the Data Protection Act, each bit of information stored on a person must be stored for equal proportions of time. The interview found that under MOPI, for each record stored within an information system about a person, a risk assessment
must be conducted in terms of the level of threat they represent to the public. Records are graded from MOPI grade one to MOPI grade four according to the following:

- Grade one records involve high-risk offences such as murders, rape etc and so are kept within systems for 100 years or until the offender dies. These records are reviewed every ten years for accuracy;
- Grade two records involve offences such as sexual assaults and are also kept for 100 years. However, in line with the Data Protection Act, if records are not being kept for a policing purpose then they are deleted from information systems;
- Grade three records involve offences such as burglaries, thefts etc, whilst grade four records involve miscellaneous, low-risk incidents such as missing persons. Grade three and four records are held within information systems for six years, but if a grade three incident is felt to represent a higher risk to society then the record is kept for a longer period of time.

This review process of records is beginning to happen now, but is a huge task for the Constabulary, as there are over one million records held within the core local information systems (e.g. CIS, Custody, child abuse, firearms).

Overall, the findings here suggest that the age of data may not be an issue in terms of data quality, as the Constabulary has a process in place to review data held within information systems and check its accuracy, as older data may become out-of-date. Although some data are held for a long period of time, it is reviewed on a ten-year period following the MOPI guidelines.

Age of Information Systems

The interview with the MOPI PM found that the CIS is 12 years old, and has been updated to version 50 so he felt the system was fit for purpose. However, he stated that the Police National Computer is 30 years old and this is a problem because the system is too vast and complex to replace. This can therefore cause some data held within this system to be extremely old. The Custody system is only two years old, but still retains data from legacy systems that date back to the 1980’s. The system containing child abuse data is ten years old. The only current system is the General Enquiry system (GENIE), which acts as a single search interface to all other systems, and this is one year old. The MOPI PM suggested that all police forces in the country can use GENIE if they agree to share their data. However, the findings show that with several systems that are nearly ten years old and few processes to check data quality at present, police forces may be at risk from basing decisions on out of date information. The age of systems may account for some usability issues identified in section 7.2.2 as older systems may no longer meet the current needs of police officers. It was revealed in the interview that the IT department within the Constabulary is too small to develop new systems, so this has to be done by external companies, making it too expensive to upgrade systems.
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Data and information standards

One of the key lessons learned from the data quality issues identified in a study by Umar et al.\textsuperscript{23} within the telecommunications industry was the need for a single repository that provides the definitive source of metadata information for the various information systems. However, findings from the interview revealed that within the Constabulary, there is no one set of data or information standards such as metadata in place. There are differing rules and conventions for PNC and CIS, and the MOPI PM suggested this may be due to lack of consideration at the procurement or later development stages. In addition, there are no standards for entering data, for example, telephone numbers, meaning that the General Enquiry system (GENIE) within the Constabulary has to search all possible combinations, which can make the search process more time consuming. This mirrors the findings of Li and Yang, who, as identified in the literature review, recognise that ‘the major difficulties in the retrieval of relevant information are the lack of explicit semantic clustering of relevant information and the limits of conventional keyword-driven search techniques (either full-text or index-based)’\textsuperscript{24}. Despite a lack of a common language provided via information standards, the MOPI PM felt that they would be a good idea, and the development of the Police National Database would act as a driver for the provision of metadata in the long term. He stated that the Police National Database will contain data standards and metadata. This is supported by findings from a short informal interview with the East Midlands Regional Coordinator for the IMPACT programme, who has involvement in overseeing implementation of the PND. Here it was revealed that the PND will contain an XML schema known as ‘Update Grams’. All data from forces must adhere to this schema for the PND to work effectively, and it was suggested that this will make it easier to interrogate and retrieve information from the PND.

7.2.7 Solutions to sustain data quality in a mobile information environment

Measurement of data quality

It is recommended that the Constabulary agrees a definition of data quality and introduces some metrics to measure the quality of data within systems. Although this is a more subjective matter, if a common agreement is reached this might help to eliminate the level of subjectivity. Metrics could include those discussed in section 7.2.1, such as data reconciliation cost savings (e.g. labour costs) and performance (e.g. volume of errors).

Managing perceptions

Within a broader sense, maintaining data quality levels within a mobilised environment may be addressed by delivering messages about the importance of data quality in relation to decision-making, via development of a wider corporate marketing campaign. This might help to resolve conflict amongst the Call Management Centre (CMC) and the Crime Input Bureau (CIB), who currently feel that officers

\textsuperscript{23} Umar, ref. 13, p. 285.

\textsuperscript{24} Li, K. W. & Yang, C. C. Automatic crosslingual thesaurus generated from the Hong Kong SAR police department web corpus for crime analysis. \textit{Journal of the American Society for Information Science and Technology}, 2005, 56(3), 273.
are doing a worse job than them at data input. If officers are trained to input data correctly and are more aware of the implications, the CMC and CIB may feel more reassured.

Inputting information

Controlled vocabularies were further explored as a possible solution to the issues with input of property and location details into the CIS (identified in the previous section). Prototypes and screenshots were developed and feedback was gained from a small group of police officers that are using MDTs. Figures 7.2.5 and 7.2.6 show examples of controlled vocabularies that could be used to input location details into the CIS crime recording form (see Figures 7.2.5 and 7.2.6) and Figure 7.2.7 shows an example of a controlled vocabulary used to input details of a stolen property into the CIS crime recording form.

Figure 7.2.5: Example of controlled vocabulary to input location details of a town beginning with the initial ‘M’
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**Figure 7.2.6:** Example of controlled vocabulary to input location details of a county beginning with the letter ‘L’

**Figure 7.2.7:** Example of a controlled vocabulary to input details of a stolen property beginning with the letter ‘S’
In addition to developing controlled vocabularies for the location and property elements of the crime recording form, another important field that is currently entered as free text is the surname field. This is a vital element of ensuring that accurate information is held on suspects and witnesses, as there can be many ways of spelling a single surname. For example, in Figure 7.2.8, when a user is inputting the surname of a witness with the surname of ‘Smythe’, several options for the surname are displayed in order to prompt the user to enter the correct surname, which could have been entered otherwise as the more obvious spelling of ‘Smith’.

These screen shots were shown to a group of officers during a semi-structured interview where they were asked to provide feedback. It was found that a large number of officers felt that the controlled vocabularies would assist with the input of information, especially within a mobilised operational setting. They suggested that when inputting information, they prefer to have prompts rather than free text fields, as sometimes under time pressure they can misspell details or enter information incorrectly. Therefore the development of controlled vocabularies can help to optimise the capture of data at crime scenes and consequently allow the reuse of data for future decision-making. However, it is recognised that for some fields such as ‘property’ and ‘surname’ there may be practical limitations to the use such techniques. For the input of towns and counties, this may prove more straightforward because these entities can be

Figure 7.2.8: Example of a controlled vocabulary to input the surname of a witness with the surname ‘Smythe’
selected from a simple alphabetical list without the need for further classification. For the ‘property’ field, in order to save time and narrow the choice of entries it may be useful to classify the brands according to products. Without such a classification system, the user may be limited because presenting a simple list of all property beginning with the letter ‘S’ may produce an extensive range of brand names to select from. Rather, a user would be able to select a product, for example a car, and then the related car brand names beginning with the letter ‘S’ would appear. However, such a system may be less applicable to the ‘surname’ field because it is difficult to devise a logical classification system for surnames. In this case, whilst a controlled vocabulary may prompt the correct choice of spelling of a surname, it may also present the user with so many options that they may simply lose perseverance with locating the correct spelling and select the first option in the list. It is important to recognise the implication of this practical limitation for data quality.

However, this research is based purely on opinion of police officers and does not evaluate in a more objective manner the performance of controlled vocabularies. A comparison of data input and retrieval via a controlled vocabulary against manual techniques was considered via quantitative measures (such as task completion time) from an experiment or scenario. Such data collection proved impractical for reasons discussed in section 3.6.1, and is recommended for future research.

A lack of integration between the various information systems was identified as a potential risk to data quality within a mobile information environment. A one-key system should be developed to allow officers to input information into a single system and update all relevant systems in the background, other forces within the UK, such as Hampshire Constabulary, have developed similar interfaces. It also supports findings by Chen et al., Bromby & Wall, Van Laare et al. and Allen et al. where an integrated input interface is recommended for police officers within a mobile setting in order to ensure robust decisions.

Ensuring that good quality information can be input into mobile information systems may increase the chances of the correct information being retrieved and reapplied during operational situations. However, this also depends on the information behaviour and information literacy skills of police officers. This is discussed in the following section.

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7.3 Mobile Information Seeking

7.3.1 Analysis of Results

The structure and distribution of the MISB survey is discussed in Chapter three, and can be found in Appendix 2f. The survey had four sections and asked 40 questions intended to address the objectives of the study (outlined in section 7.1.1). The questions were adapted from questionnaires used within a number of academic studies, which specifically related to information seeking.\(^{29} 30 31 32 33 34\)

Responses were statistically analysed using a statistical package (SPSS) to identify any significant differences between questions and groups of demographics. Descriptive statistics were used to obtain frequencies. Any association was investigated using cross tabulations and Chi-square.

The qualitative data collected from the focus groups (questions detailed in Appendix 2h) and interviews (Appendices 2i and 2j) were coded using a qualitative analysis package in order to identify common categories of individual differences in MISB.

7.3.2 Characteristics of the survey sample

Ninety-two respondents (77.4 per cent) were male and twenty-seven (22.6 per cent) were female. A high percentage of respondents were police constables (88 per cent) followed by sergeants (nine per cent). There were also three Inspectors among the respondents. Low numbers of higher ranking respondents were apparent; since mobile technology is more commonly used by operational officers, this was not considered detrimental to the objectives of the study.

The highest number of respondents had two to five years of policing experience (42.9 per cent), followed by 27 respondents (22.7 per cent) who held six to ten years’ experience. The smallest proportion belonged to those who held 21 to 25 years of experience (3.4 per cent). A relatively small number of respondents (10.1 per cent) held less than a year’s experience, suggesting that a considerable number of respondents are familiar with the information systems within the Constabulary. There were 10.9 per cent of respondents with 11 to 15 years of policing experience, followed by five per cent with 16 to 20 years and five per cent with over 26 years experience. The majority of respondents (84 per cent) were using mobile technology, with 74.8 per cent using MDTs (see Table 7.3.1), which are the main type of technology in focus.

\(^{32}\) Syson, H. *Knowledge sharing in the UK police service – a research study*, MSc dissertation, Loughborough University, United Kingdom, 2007, p. 20.
Table 7.3.1: Type of mobile technology used by respondents

<table>
<thead>
<tr>
<th>Type of mobile technology</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDT</td>
<td>89</td>
<td>74.8</td>
</tr>
<tr>
<td>Handheld device (e.g. Blackberry or PDA)</td>
<td>11</td>
<td>9.2</td>
</tr>
<tr>
<td>Not using mobile technology</td>
<td>15</td>
<td>12.6</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>119</td>
<td>100.0</td>
</tr>
</tbody>
</table>

7.3.3 Searching for general information

The questionnaire investigated general information searching experiences (i.e. non work-related) and workplace information searching experiences. Respondents were asked about how often they searched for information. A large percentage of respondents search for general information zero to five times per day (25 per cent), followed by 21 per cent searching six to ten times per day and 16 per cent searching for information 16 to 20 times per day. Quite a few respondents (14 per cent) also searched over thirty times per day.

Using search engines

The questionnaire investigated the search engines that officers use (non-work related) and how often they use them. Most respondents use Google and a few (two respondents) use the less known alternative search engines, such as Kartoo and Answers, which display search results in a visual format.

A substantial amount of respondents (60) use search engines on a weekly basis, although it must be noted respondents can select more than one search engine so these are not mutually exclusive. Twelve respondents never use a search engine; a significant number of which were of police officer rank and had a relatively low level of policing experience (2-5 years). Interestingly, of those using Google on a daily basis, 69 per cent stated they found what they were looking for 75 per cent of the time. This may suggest that the Google search engine interface works well most of the time for the majority of users. However, regardless of search engine used, only 50 per cent of respondents found what they were looking for on the first search that they run for general information, suggesting that their search strategies may not always be effective and precise. The relationship between how often users find required information on the first search they run and the search engine used was tested, but no significance was found. Of those gaining accurate search results on the first search run for 75 per cent of the time, a considerable number used three keywords to search for information (see Figure 7.3.1). This may indicate that officers must build more complex search strategies to retrieve relevant information. Previous research indicates that users employ an average of two keywords. This may imply that police officers
search skills are slightly above those of the general public\textsuperscript{36 36 37}. However, it was also found that the majority of respondents (nearly 60 per cent) did not make use of advanced search tools. This is reflected in previous research, where fewer than 10 per cent of user make use of advanced tools to optimise their results\textsuperscript{38}. Almost 82 per cent of respondents felt that they gained irrelevant results when searching for workplace information only some of the time.

![Figure 7.3.1: Accuracy of search results on first search run vs. number of keywords used](image)

**Figure 7.3.1:** Accuracy of search results on first search run vs. number of keywords used

### 7.3.4 Perceived level of information literacy amongst police officers

**Ability to employ an effective search strategy**

The majority of respondents (nearly 60 per cent) rated their ability to employ an effective search strategy as good (see Figure 7.3.2). Nearly 40 per cent of respondents rated their ability as average or below. These findings support those of Al-Daihani and ur-Rehman\textsuperscript{39} where they reported that out of 118
respondents, the majority of police officers did not have any capabilities in deploying a search strategy. In order to test for statistical relationships for information skills among police officers in relation to personal variables such as gender, rank and level of policing experience, Pearson's chi-square test was conducted. However, relationships were found to be insignificant for all three variables.

![Figure 7.3.2: Ability to employ an effective search strategy](image)

Retrieving information from information systems

Almost 80 per cent of respondents felt that they were able to find the required information from a work-related information system for the majority of the time (see Figure 7.3.3). This question was correlated with the ability to employ an effective search strategy using Pearson's chi-square and it was found that there was a significant association between the ability to find required information from information systems and the ability to employ an effective search strategy $\chi^2 (3) = 26.38 \ p < .000$. 


Consulting colleagues

Overall, the majority of respondents (59.6 per cent) contact a colleague before searching for information for a small amount of the time (Figure 7.3.4). Almost twenty per cent of respondents never contact a colleague before searching, whereas the same proportion contact a colleague most or half of the time. This may suggest that the vast proportion of respondents do not need help to find information, but it may indicate that they simply do not know whom to ask.
Most important information sources

As rated by respondents, information systems along with intelligence reports were the joint most important sources of information. This is unsurprising, since the Constabulary relies heavily on these information sources for the majority of their information (e.g. history, suspects, vehicles). Methods of personal communication including radio and email along with colleagues, were also important sources of information (see Appendix 4a for details). The findings suggest that if officers become more reliant on mobile technology, they may lose out on information that is obtained verbally i.e. via the radio and so it is essential that these mechanisms are not replaced by the technology. These findings contrast with Al-Daihani & ur-Rehman\textsuperscript{40} whereby official circulars and memos and the media were ranked as the most important information sources, and databases and intelligence were ranked as less important. This may reflect the impact of local culture on information seeking behaviour.

Provision of training for information searching

Survey respondents were asked about the level of training they had into how to search effectively for information within databases, Internet websites, the intranet and intelligence reports (Figure 7.3.5). It is apparent that for the majority of sources, respondents have received at most a short

\textsuperscript{40} Al- Daihani & ur-Rehman, ref.30, p. 622.
period of training. In another question, respondents were asked how long the total duration of their training was. A large percentage of respondents (43 per cent) have received two to five hours of training, with a mode of 2 (which is also equivalent to two to five hours of training). This suggests that more training should be provided to officers with the advent of mobile technology.

Furthermore, respondents were questioned about what they thought of the quality of training provided in searching for information (see Appendix 4b). A significant number felt that the training was average, which is supported by a modal answer of 'average'. Feedback from focus group participants and senior officers in an interview corresponded with this finding and felt that greater depth in searching for information should be provided in the training course. Semi-structured interview findings with British Gas stated that simulation training was provided to their field workers, where they were given real-life scenarios and access to test databases so that technicians became comfortable with retrieving information in an operational context. This supports the suggestion that more could be done to improve the quality of training and thus the information literacy skills of police officers.

With regard to how recently participants had received training (Figure 7.3.6), a substantial percentage of respondents have recently received training into how to search for information within databases and information systems and Internet websites. However, for searching information from the Intranet and intelligence reports, a considerable number have only received training four or more years ago. This may indicate that officers should be given ‘refreshers’ for the Intranet and intelligence reports.

Overall, the findings here indicate that the training provided in searching for information is less than adequate in the light of mobile technology placing greater emphasis on officers’ ability to retrieve records. Previous research by Al-Daihani & ur Rehman41 reports similar conclusions: appropriate training programmes are recommended for developing information skills of Kuwaiti police officers.

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41 Al-Daihani & ur-Rehman, ref. 30, p. 619.
Figure 7.3.5: Level of training provided for searching for information within sources

Figure 7.3.6: Recency of training into searching for information within information sources
7.3.3 Implications of mobile technology on perceived information literacy skills

Time spent looking for information

As well as investigating the information seeking behaviour of police officers, this study also aimed to investigate the impact that mobile technology is having on information seeking. Research by Hughes and Jackson\textsuperscript{42} into the influence of technical factors on the effective use of information in a policing environment argues that before the introduction of computers into police stations, the time spent looking for information may have been significantly lower. The current questionnaire explored this further by examining the amount of time that police officers are now spending looking for information compared with that before mobile technology, whereby officers more often than not obtained information via the radio. The questionnaire found that the number of respondents that are spending one to five minutes looking for information decreased as a result of mobile technology (Figure 7.3.7). However, as a result of mobile technology, the number of respondents spending six minutes or above looking for information increased. This finding is supported by calculation of modes, where it is evident that prior to mobile technology the modal answer was ‘1 to 5 minutes’, however with MDTs, the modal answer was ‘6 to 15 minutes’.. The differences in modal scores could still indicate that mobile information use may be having a negative impact on the quality of policing. The majority of focus group participants along with senior officers in an interview echoed this outcome, suggesting that they found the control room to be quicker to relay information, and are currently using MDTs less to access information. Weighing up the evidence, it could be argued that the advent of mobile technology may be having a disadvantageous effect on policing, since officers spending more time searching for information would have less time to provide a service to the public. From an alternative viewpoint, it could be argued that the greater provision of information may improve policing practices overall, as previous work has shown that mobile technology improved the availability of information for decision-making purposes\textsuperscript{43}.


\textsuperscript{43} Lindsay et al, ref. 3.
Searching for information using mobile technology

With regard to the impact of mobile technology on the quantity and quality of information, a vast proportion of respondents felt that mobile technology had improved these aspects (Figure 7.3.8). This is reiterated by a calculation of modes, where the question regarding whether mobile technology has increased the quantity of information gained a modal answer of ‘strongly agree’, and a modal answer of ‘agree’ on a 1 to 5 scale (1=strongly agree, 5=strongly disagree) for whether MDTs had improved the quality of information. An increase in the amount of information may suggest that officers are beginning to experience information overload. The evidence from this study may imply that officers find it difficult to retrieve information effectively from an increasing amount of data as a consequence of mobile technology. Despite this, it was generally agreed that mobile technology is also improving the quality of information, perhaps indicating that better decisions can be made. This was reinforced in the majority of focus groups, where officers suggested it was more effective to search for information via the MDT than the control room, where information was felt to be less accurate. Moreover, most respondents felt that the Constabulary’s databases allowed them to retrieve records effectively, with a modal answer of ‘agree’ (1=strongly agree, 5=strongly disagree). Coupled with the finding that over 60 per cent of respondents felt that mobile technology had made the task of searching for information easier, the study indicates that mobile information retrieval has a positive effect on policing; despite officers spending longer searching for a single piece of information (as discussed earlier in section 7.3.3). This is supported by a positive relationship between the impact of mobile technology on the quantity of information and the impact of mobile technology on the task of searching for information $\chi^2 = 25.58 \, p < .000$. Other questions were
correlated against each other using Pearson's chi-square but no significant associations were found, nor were any between questions and demographics.

Furthermore, focus group findings and an interview with senior officers revealed that the provision of an integrated search interface within the Constabulary known as GENIE on the MDT had made the task of searching for information easier. The system provides a 'one stop shop' to access all the required systems, rather than having to search each system separately. This mirrors findings by Chen et al., Van Laare et al. and Allen et al. where an integrated search interface is recommended for police officers within a mobile setting. A key concern for police officers within the focus groups was the expectation to input and retrieve information from various information systems whilst at the same time completing operational duties. Therefore the automated delivery and integration of information are important considerations within a mobile policing context.

Impact of mobile technology on information sources used

Questionnaire respondents were asked about the sources of information used before and after the introduction of mobile technology. It is evident that the most commonly used information sources are email (100 respondents or 84 per cent use daily); Intranet (83 respondents or 69 per cent use daily); databases and information systems (80 respondents or 67 per cent use daily) and intelligence reports (77 respondents or 64 per cent use daily). Colleagues (61 respondents or 51 per cent use daily), radio (46 respondents or 38 per cent use daily) and telephone (45 respondents or 38 per cent use daily) were the subsequent most commonly used information sources. These results highlight the importance of the

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46 Allen, et al, ref. 28.
need for information literacy skills within a mobile environment in order to access information from commonly used information sources, such as the intranet, databases and intelligence reports.

More importantly, it is interesting to analyse whether mobile technology has changed the information sources used and the frequency of use. The introduction of mobile technology does not appear to have caused change in the information sources most commonly used, since as previously discussed, email remains the most commonly used sources before and with mobile technology. However, it is evident in Figure 7.3.9 that mobile technology has resulted in a change in the information seeking behaviour of police officers, with alterations to the level of information sources used. The introduction of mobile technology has considerably reduced the level of usage of the main verbal information sources, including telephone, face-to-face meetings and colleagues. The usage of electronic and written sources of information such as email, databases and information systems, official circulars, legal documents and departmental files increased following the mobilization process. This demonstrates how officers are becoming more reliant on mobile technology for information rather than asking their colleagues, thereby implying a greater need for information literacy skills.

![Figure 7.3.9: Impact of mobile technology on usage of information sources](image-url)
7.3.4 Supporting mobile information seeking: solutions

Controlled vocabularies

It is argued that information must be captured in a standardised format to allow effective storage and dissemination\(^\text{47}\). The questionnaire investigated attitudes towards information structuring techniques (as discussed in section 2.2.2). Specifically, it asked whether officers have difficulty writing free text into information systems and their preference for a more structured or automated approach to searching and input, such as a controlled vocabulary or predictive text mechanism. Of those who have problems inputting information, the majority said they would not prefer a predictive text mechanism to search and input information. However, nearly 30 per cent of respondents said that they would prefer to see a more automated approach. Subsequent cross-analysis of results showed that of those who said they would not prefer a more automated approach, a considerable number had two to five years of policing experience. This group of respondents may feel that they are more proficient in using the technology and any technological improvements may be seen as a negative reflection on their capabilities. The use of controlled vocabulary techniques may be recommended in order to facilitate information retrieval via mobile devices.

7.4. Recommendations

7.4.1 Recommendations to manage data quality

Figure 7.4.1 represents a picture of the main factors affecting the level of data quality within the Constabulary, as identified from this research. Within the picture, it is evident that the main issues relate to a combination of technical and human issues.

With regard to the technical issues, these include the data entry interface within the CIS into which it is not very easy to input; a lack of integration between the various information systems, and no common format to record items of information; and a lack of data and information standards. Therefore it is recommended that to improve data entry into the CIS (and other relevant information systems), controlled vocabularies are developed to improve the entry of data at source. In the research, the screen shots demonstrating the use of controlled vocabularies were well-received amongst mobile technology users. A one-key system should be developed to allow officers to input information into a single system and update all relevant systems in the background; other forces within the UK, such as Hampshire Constabulary, have developed similar interfaces\(^\text{48}\). The development of metadata and other data and information standards is also recommended to provide a common format for recording information and thus improve the level of data quality.

To test the applicability of these recommendations, an interview was held with the Chief Superintendent, responsible for the overall program that incorporates the mobile information project


within the Constabulary. During the interview, all three recommendations were recognised and received positively. However, he suggested that to do so the practical implications of money and limited resources, such as a small IT department (see Figure 7.4.1), would make it difficult to implement the recommendations and improve the quality of data.

The main human issues that appear to be impacting on data quality relate to the level of awareness amongst police officers about the implications of poor data quality, and a lack of an agreed understanding of data quality. It is therefore recommended that the Constabulary continues with their corporate approach to delivering messages about the importance of data quality in relation to decision-making, and a wider marketing campaign is developed to deliver such messages. This might help to resolve conflict amongst the Call Management Centre and the Crime Input Bureau (see Figure 7.4.1), who currently feel that officers are doing a worse job than them at data input. If officers are trained to input data correctly and are more aware of the implications, the CMC and CIB may feel more reassured. With regard to the second issue, it is recommended that the Constabulary agrees a definition of data quality and introduces some metrics to measure the quality of data within systems. Although this is a more subjective matter, if a common agreement is reached this might help to eliminate the level of subjectivity. Metrics could include those discussed in section 7.2.1, such as data reconciliation cost savings (e.g. labour costs) and performance (e.g. volume of errors). During the research, the MOPI PM suggested that he would like to create a team to focus on monitoring data quality. However, this was again met with resistance by the Chief Superintendent due to limited funding and resources available to develop a new team.
Figure 7.4.1: Summary picture of the main data quality issues within the Constabulary

7.4.2 Recommendations to manage mobile information seeking

The study has found that overall police officers consider their information literacy capability to be average. The need for such skills may be magnified as officers become more reliant on electronic sources of information as a result of the introduction of mobile devices. Consequently, the study aimed to
produce recommendations to assist with information seeking issues arising from the results, such as the time spent looking for information and ability to find the required information using mobile technology. In addition to the recommendation to integrate and automate the delivery of information (section 7.4.1), two other aspects were explored in the study: the use of controlled vocabularies and provision of training into searching for information. The research found that officers felt structured vocabularies techniques might be useful in providing a more automated approach to searching and inputting information. This is recommended in order to maximise the benefits of providing information remotely via mobile devices. The development and effectiveness of structured vocabularies should be explored in future research.

The research also found that training in retrieving information from information systems could be improved to provide longer and more in-depth courses, perhaps involving the use of simulations and scenarios to allow officers to feel more comfortable with searching for information within an operational setting. Refresher training should also be provided to all officers following the advent of mobile technology within policing.

7.5 Summary

This Chapter has investigated the impact that mobile access to information systems is having on the data quality of police information systems. Domains other than policing encounter issues with data quality, such as inconsistency among systems, lack of standardisation and silos of information, but these are magnified in law enforcement due to the need to gather information and reapply it to new situations in a time-critical fashion in the interests of public safety. Furthermore, the ability to directly input information into police systems within a mobile environment creates further ramifications for data quality.

The evidence from this study discourages the notion that UK police forces have sufficient measures to manage data quality within a mobile environment. At present, only completeness of data is measured, and other measures of data quality including accuracy, timeliness, understandability and consistency are not considered. Since police officers can now input information directly via MDTs, this may cause vital links between items of data to be missed to the detriment of the vulnerable. This issue is being addressed to some extent by the development of the Police National Database, which will act as a driver for ensuring good data quality so that information input from a local source will be correct in order to be used as a basis for decision-making on a national scale. However, in the meantime it is recommended that further metrics be established to address data quality on a wider basis.

The study highlighted a dichotomy over the impact of mobile technology on data quality between operational police officers and non-frontline staff. Police officers were generally positive about the benefits afforded from inputting information without delay, but non-frontline staff met the possibility of direct input of data with apprehension, as it might create a source of input error. However, evidence from observation shows that the majority of police officers recorded information directly, thereby removing intermediaries to input information. This may indicate that mobile technology has a positive impact on data quality, although there is little benchmark data available to assertively make this assumption. Within a broader sense, the gap between the acceptance of direct input amongst the varying stakeholders of
the technology might be addressed via the development of a corporate marketing campaign to raise
awareness of the importance of good quality data for a mobilised policing context.

Inputting information into law enforcement systems is currently difficult due to the ineffective
design of crime input-form interfaces, which does not take into account the limitations of entering data
whilst attending compromising and dangerous situations. There are also several information systems that
lack integration, causing duplication of data entry. These issues have implications for data quality within
a mobile environment, as the they serve as a potential source of error which may later jeopardise
decision-making capabilities. To overcome these issues, it is recommended that future research focuses
on approaches which address the design of an integrated input form for accurate and efficient entry of
data. This remains an open question but possible approaches might include the development of
controlled vocabularies to permeate the issue of entering data into free-text fields. In light of the
proposed introduction of the Police National Database in 2010, ensuring good quality data for nationwide
decision-making purposes will become increasingly important for the research and law enforcement
agendas. Addressing these data quality issues will work towards ensuring that information input into
systems is of sufficient quality in order for the correct information to be retrieved.

Subsequently, this Chapter has investigated the impact of mobile information seeking behaviour
on the effectiveness of the use of mobile technology. Domains other than policing have similar problems,
but these are exacerbated in law enforcement due to the need to make reliable and accurate decisions in
a time scale of seconds.

The evidence from this study supports the notion that police officers have sufficient information-
based capabilities to take advantage of the use of MDTs. There was a perception that an increase in
appropriate retrieval and precision of content improved decision-making as a result of using the devices.
This allowed police officers to spend more time on policing in the community than in dealing with
paperwork, even though on occasions some police officers spent more time than usual on information
retrieval.

This study also examined mobile information seeking behaviour in terms of the usage of different
information sources. The introduction of mobile technology has considerably reduced the level of usage
of the main verbal information sources, including face-to-face meetings, colleagues, the telephone,
training activities, conferences and informants. Officers are now making greater use of electronic and
written sources such as email, the Intranet, information systems, and official circulars to seek information
from MDTs. A key implication of this finding is that information obtained verbally e.g. through colleagues
may be missed. An exception to this finding is the use of the radio, which has increased following the
introduction of MDTs. This is important because previous research has shown that the more knowledge
that is shared between officers, the better the results of an investigation. Consequently, it is essential
that these mechanisms are not replaced by the technology. Although survey findings from this study
show that officers feel they possess strong information skills, this may indicate that they prefer to seek
some information from the control room rather than from electronic databases.

Integration of the various information sources is an important design consideration. This Chapter
argues for the need of controlled vocabularies and a single search interface to improve usability. An in-

49 Glomseth et al, ref. 34, p. 106.
house solution is also available to police officers. The ‘General Enquiry Information System’ (GENIE) offers a ‘one-stop shop’ to access most of the information systems required by a modern police force. A combination of these solutions will lead to next generation enhancement to the use of mobile information services.

Although the findings indicate that the use of MDTs has increased the level of successful and timely decision-making, most police officers felt that the training to underpin this technology is too short and somewhat inadequate in terms of content. Clearly, the apparent gap between acceptance of the technology and the identified training needs to use it, can be addressed by a fit-for-purpose training programme. The content and mode of delivery remain open questions. Evidence from the focus groups suggests that delivery may not best be classroom-based. The Chapter contributes to the existing small body of knowledge on data quality and information seeking behaviour within a mobile policing environment. This knowledge can be applied by other law enforcement organisations looking to provide mobile access to their information and knowledge environment without reducing the level of data quality as a result of direct input of information.

Having examined the impact of mobile technology on the sharing of policing knowledge and the ability of a police force to sustain data quality and retrieve information within a mobile information environment, it is important to scrutinize the overall impact of granting direct access to information on existing policing information processes, which is achieved in the following Chapter.
Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

Chapter 1
Introduction

Aims

Objectives

Chapter 2.1
Literature Review: Knowledge Management: Background Context

Chapter 2.2
Literature Review: Knowledge Management: Structure

Chapter 2.3
Literature Review: Knowledge Management: Technologies

Chapter 2.4
Literature Review: User Acceptance Theories

Chapter 3
Research Methods

Chapter 4:
Developing an evaluation framework to select mobile technology

Chapter 5:
Adaptation of the technology acceptance model for policing

Chapter 6:
The impact of mobile technology on knowledge sharing in policing

Chapter 7:
Implications of mobile access to information systems for data quality and information literacy

Chapter 8:
The impact of mobile technology on business processes

Chapter 9:
Overall discussion

Chapter 10
Conclusions, Research Limitations and Recommendations

Future Research
Chapter Eight: The Impact of Mobile Technology on Business Processes

Chapter Preface

Having examined the impact of mobile technology on the sharing of policing knowledge and the ability of a police force to sustain data quality and retrieve information within a mobile information environment, this Chapter scrutinises the benefits and risks of granting direct access to information on existing core policing information processes. In light of a UK governmental drive to realise significant benefits, the Chapter assesses whether tasks are completed more efficiently or have replicated the old ways of working, and ultimately the readiness for change in key information and knowledge intensive business processes.

The research within this Chapter was investigated through a mixed methods approach of a questionnaire and semi-structured interviews. A questionnaire and interviews were conducted with operational police officers, and interviews were conducted with personnel within the control room, crime input bureau as well as officers of more senior rank. This allowed an in-depth understanding of the perceived impact of mobile technology across the Constabulary. The Chapter presents the results from the analysis of data produced from the methods and discusses these findings in relation to existing literature. The Chapter also produces recommendations to address any risks of mobile technology to modern-day policing. This meets objective eight of the research.

8.1 Background

8.1.1 The importance of assessing the impact of mobile technology on policing processes

It is apparent that mobile technology may have a significant positive impact on existing bureaucratic business processes, allowing officers to spend more time on patrol. However, in view of the aim of this study, little is known the extent of its impact. Norman and Allen identify that there is a relatively small understanding about how mobilising a policing information environment impacts on processes¹. This Chapter focuses on this area of research by investigating the state of core policing processes, such as the crime-recording process and incident allocation process, twelve months after the full roll-out of mobile data terminals (MDTs). It concentrates on the specific benefits and risks that mobile technology has provided to these processes. It also examines the underlying issues that need to be addressed to allow the full potential or impact of mobile technology to be realised.

8.1.2 The research domain

In order to evaluate the impact of mobile technology on policing processes, it was necessary to conduct research with the key stakeholders involved at each end of the core processes, and those responsible for ensuring compliance with the change in processes. Crime recording and allocation of incident details were selected as the two main processes because these are the core information and knowledge dependent activities of the policing environment. More objective methods could have been used, for example observation to identify the use of MDTs and to monitor time spent on functions such as administrative tasks or in the station. However it was believed that this would not provide sufficient depth to understanding the underlying issues affecting the realisation of the potential of mobile technology. Therefore, a mostly qualitative design was followed. Table 8.1.1 shows the research domain used for this phase of research, and the subsequent paragraphs in this section discuss justification for the domain.

Table 8.1.1: The research domain

<table>
<thead>
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<th>Phase of research</th>
<th>Method</th>
<th>Participants</th>
<th>Sample</th>
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<tbody>
<tr>
<td>i. Stakeholders involved at each end of core policing process</td>
<td>Semi-structured face-to-face interviews</td>
<td>Command and control room personnel</td>
<td>11 participants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crime input bureau personnel</td>
<td>8 participants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operational police officers using MDTs</td>
<td>12 participants</td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td>Operational police officers and sergeants using or supervising MDTs</td>
<td>74 participants</td>
</tr>
<tr>
<td>ii. Stakeholders responsible for enforcing the change in policing processes</td>
<td>Semi-structured face-to-face interviews</td>
<td>Inspectors supervising use of MDTs in their local policing unit</td>
<td>12 participants; 3 for each set of participants involving one participant from each Basic Command Unit: Leicester City Centre, North and South Leicestershire</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chief Inspectors responsible for strategic development of mobile technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Superintendents responsible for strategic development of mobile technology</td>
<td></td>
</tr>
</tbody>
</table>

Phase I of research

To determine the impact on the core crime recording process, semi-structured face-to-face interviews were individually conducted with operational police officers and personnel from the crime input bureau. Similarly, interviews were separately completed with control room staff and the same set of operational police officers from the interviews regarding the crime recording process. Interviews were conducted individually to avoid stronger opinion of participants possibly overshadowing that of other participants. Respondents were selected on the grounds of convenience purposive sampling, in terms of personnel who had involvement with or used MDTs. Interviews were the preferred choice of method in order to allow a qualitative in-depth exploration of how mobile technology has changed the core daily tasks of these key stakeholders, and the way crimes are recorded and incidents are allocated following the use of MDTs. The interviews also probed emergent problems for these key stakeholders when dealing with crime reports and handling incident related information; additional tasks that may be

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Denscombe, M. *The good research guide for small-scale social research projects*, 2003, p. 167.
completed more or less efficiently; and the perceived impact on bureaucratic business processes. The overall time spent dealing with bureaucratic elements of business processes, such as administrative functions, travelling to and from the station and use of a computer in a local police station, was further investigated in interviews with police officers.

Following these interviews, it was necessary to collect data on a larger scale in order to determine the wider impact of mobile technology. Therefore a questionnaire was administered to the main users of MDTs, operational police officers. A questionnaire was used to allow wider coverage than the interviews would have practically allowed. Again, respondents were sampled via purposive sampling on the basis that they had experience in using mobile technology. Respondents from a variety of geographic locations of local policing units, including urban and rural areas, were sampled (Figure 8.1.1).

![Figure 8.1.1: Local policing units (LPUs) sampled within the questionnaire](image)

The questions were designed and adapted based on the outcomes of the interview with operational police officers. The questions covered the following:

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a) Efficiency and effectiveness of crime recording and allocation of incidents via MDTs compared to via paper or the radio;

b) Frequency of use of paper forms, a computer in the local policing station, Blackberries and MDTs;

c) Time spent on administrative functions compared to before the use of mobile technology;

d) Additional functions used on a MDT and/or a Blackberry besides crime recording and incident allocation;

e) Overall positive or negative comments about how mobile technology has affected modern-day policing and the completion of daily tasks.

A seven point Likert scale was used for a, b and c, ranging from 1 as either ‘never’; ‘less difficult than paper’; ‘slower than paper’; or ‘decreased’, to 7 as either ‘always’; ‘more difficult than paper’; ‘quicker than paper’; or ‘increased’. The scale had a neutral point (4) to allow the respondent to select if there had been no impact (e.g. ‘sometimes’, ‘the same as paper’ or ‘stayed the same’). A set of functions via checkboxes and a freetext field for any ‘other’ responses was used for d, and a freetext field was available for e.

The questionnaire was designed for electronic completion to avoid duplication of data entry at a later point in time. The survey software available within the Constabulary (Snap Survey Software\(^4\)) was used to design the questionnaire and allow electronic access to it when visiting Constabulary premises. Due to restrictions on Internet access within the Constabulary, the use of other electronic survey kits was not practical. The electronic questionnaire was administered face-to-face at the start of a shift, as several other questionnaires were in circulation via email at the same time. This also ensured a higher response rate than distributing via email, for example. A response rate of 100 per cent was achieved.

The sample consisted of largely police officers (71 per cent). In addition it included representation from police community support officers (12 per cent), police sergeants (13 per cent) and Inspectors (four per cent). Of this, just under half of respondents (around 40 per cent) had six to 10 years of policing experience, followed by a quarter with two to five years, and just under 20 per cent with zero to one year of experience. A small number had 11 years or more policing experience. Three quarters of respondents were using a MDT whilst the remaining was using a BlackBerry device. The county is geographically divided into three basic command units (BCUs): Leicester City Centre BCU, North Leicestershire BCU and South Leicestershire BCU. A significant percentage of respondents were from local policing units within Loughborough of the North BCU (25 per cent), Keyham Lane (20 per cent) or Mansfield House (18 per cent) or Syston (13 per cent) of the City BCU. The remaining respondents worked in either Beaumont Leys, Hinckley Road, Welford Road of the City BCU, Melton Mowbray of the North BCU, Market Harborough or Wigston of the South BCU (refer to Figure 8.1.1).

Phase II of research

Following the research conducted in phase I with operational personnel, the second phase of the study identified the impact and viewpoint of mobile technology from a strategic viewpoint, which involved the key stakeholders responsible for enforcing changes to policing processes. This was explored qualitatively, as evident in Table 8.1.1, through face-to-face semi-structured interviews. The key strategic stakeholders included three Inspectors responsible for supervising the use of MDTs within their local policing unit in a town of Leicestershire; and three Chief Inspectors and three Superintendents overseeing the strategic development of mobile technology within regions of Leicestershire. Via purposive sampling, one stakeholder from each BCU was selected (providing a total of 12 participants) to investigate the impact on rural as well as urban areas, each with differing local communities and incident types. Senior ranks beyond Superintendent level have a lesser involvement in the strategic use of mobile technology and are distanced from the operational changes in policing processes. Those involved in the specific implementation of mobile technology were avoided for this phase of research, as the successful delivery of the MDT project is part of their yearly personal career objectives, and this could bias responses. The interviews explored the benefits and risks of mobile technology to core policing processes; impact on existing bureaucratic processes; strategic measures to monitor the usage of mobile devices; and the importance and perceived issues affecting the level of success of the project.

8.1.3 Analysis of results

As for data within Chapter Six, the researcher grouped the data according to the main themes arising from the data. This was done initially through the use of open coding in the qualitative software package Atlas.ti, which allowed exploratory categorisation of the interview data, similar to a grounded theory approach. Individual matrices or thematic grids were created containing all the data from the interviews for one particular theme. This allowed the researcher to see at a glance the common themes, in terms of the positive and negative aspects of the impact of mobile technology, arising from the interview data. The main themes arising were:

- Effectiveness and efficiency of completing core business processes (crime recording and incident allocation) via mobile devices;
- Technical issues inhibiting fully mobile policing processes;
- Adaptation to the change entailed with completing policing processes via mobile devices;
- Overall impact of mobile technology on existing bureaucracy.

These themes have been used to form the sections for the results and discussion within this Chapter. The thematic grids used within the qualitative data analysis of the focus group data are available on request to the reader (due to their length they have not been included in the thesis).

From the electronic questionnaire data, a spreadsheet was automatically created, which was then exported into the statistical analysis software package, SPSS. Simple descriptive statistics were

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Chapter Eight: The impact of mobile technologies on business processes

performed on this data, including median, mode and chi-squares, to identify the frequency of use and efficiency and effectiveness of MDTs versus paper-based methods for crime recording and incident allocation. Ultimately this may work towards determining the impact of mobile technology on existing bureaucracy. The results of this analysis are examined in the following section.

8.2 Impact of mobile technology on policing processes

8.2.1 Crime recording process

Positive changes

As discussed in Section 8.1.1, the paper-based crime recording process involved recording crime details on a paper form, returning back to the station to fax the form to the crime input bureau, where a record would be created on the crime information management system (CIS) (Figure 8.2.1).

Figure 8.2.1: The paper-based crime recording process within the Leicestershire Constabulary

Around a third of police officers and Chief Inspectors participating in semi-structured interviews stated that recording crimes using MDTs had allowed members of the public to gain relevant information, such as a crime number, without delay. This was thought to create a more professional image, as illustrated by the following comment:
Chapter Eight: The impact of mobile technologies on business processes

It's much better for the public as well, because what happens is they ring us to come out, we say 'it's all been dealt with, there's no suspects etc for follow up, but xyz has happened' and we can send the crime details off there and then. So for the public it's fantastic, rather than them having to wait a week later. (Officer 5)

As evident in Table 8.2.1, the questionnaire supported these interview findings. It found that there were two positive aspects of recording crimes via MDTs: firstly it creates a more professional image (4.1 per cent of respondents) and secondly it has removed intermediaries in the process (13.5 per cent of respondents).

Table 8.2.1: Positive factors of recording crimes via mobile devices

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Creates professional image</th>
<th>Removed intermediaries in the process</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of respondents</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>% of respondents</td>
<td>4.1%</td>
<td>13.5%</td>
</tr>
</tbody>
</table>

Similarly, it was suggested in the interviews by a police officer, two Chief Inspectors and a Superintendent that this provided an element of reassurance to the public, due to an element of visibility and recording details directly:

My view is that mobile technology releases police officers from the office, from being tied to computers, and therefore not being visible. So it's all about accessibility and being visible in neighbourhoods. It's about providing information to victims or to people who might stop and ask an officer a question in the street. It's a reputational thing as well; we're forward looking…when you look at commercial organisations - British Gas or the RAC - they turn up with all this mobile data and instantly they can give feedback and customer service views. So I think it's long overdue to be honest.

(Chief Inspector, North BCU)

Previous research has shown that 57 per cent of the public feel they have no influence over the Police\(^6\). Although only a small proportion of data from this study suggests there is a positive influence on the perception of the public, this still goes some way towards improving confidence in the Police.

A third of police officers spoke positively of benefits of reducing the number of intermediaries in the paper-based crime recording process. It was suggested that there was less reliance on a third party to complete the flow and input of information into information systems, as crime details could be input

directly through the use of a MDT or a computer in the police station. One police officer provided an example of this:

The problem in the delay of accessing information has been removed as a result of mobile technology…and in addition we are reading information directly from information systems, which has reduced issues with other people interpreting information.

(Officer 9)

Equally, at the opposite end of the crime recording process, a number of interview participants from the crime input bureau suggested that the level of ‘double-keying’ that they complete in their job had been reduced as a consequence of direct crime recording. However, as exemplified in the following comment, this reduction is not as widespread as anticipated:

Double keying has reduced. Probably not to the great extent with CR1 and 10s\(^7\), as there are officers out there that prefer the old way. A lot of the older officers find it easier just to write down a few details on paper and then scan it on. It’s not their fault, they’re out there to catch the bad guys. So double keying is still apparent for these reasons. (Crime input bureau interview 1)

In relation to this, officers spoke highly of the increased level of accuracy as a result of reducing the reliance on the crime input bureau and the provision of electronic prompts for data entry; as did a Chief Inspector (see below). Within another UK police force, accuracy of information improved as a result of removing a link from the supply chain and source of error for inputting information\(^8\). However, participants from the crime input bureau strongly believed that accuracy would be compromised as a result of direct input. This may suggest that the dichotomy between operational police officers and the crime input bureau over data quality identified in Chapter seven remains several months later. However, little benchmark data is available to validate such improvements in the accuracy of information.

Officers can create crime reports live, so they don’t have this system whereby you’re filling in a piece of paper and then faxing it through to another Department who then inputs it onto the system; you’re inputting directly onto the system, which is cutting down on a lot of problems. Also, that’s a vast reduction in bureaucracy and will reduce the possibility of information not being recorded correctly, i.e. in terms of the written letter/number/word, you’re relying on what you’ve written by hand to be read by someone else, and then faxed which will distort it yet again. So by putting it onto the system directly you should improve on your accuracy of information, and also the timeliness of the information going onto the system. (Chief Inspector, City Centre BCU)

\(^7\) CR1s and CR10s refer to the main paper forms used to record crime details.  
\(^8\) Norman & Allen, ref. 1, p. 215.
This evidence may suggest that the objectives of the Flanagan Review and mobile technology in terms of double keying are being addressed, but still have some way to go due to the alteration in working procedures that must be adopted by police officers. The interview data amongst all participants strongly suggest that recording crimes electronically is more efficient and slicker than the paper-based process, but a small number of participants suggested that it could be improved further due to cultural and technical issues. This is examined further in the following section.

**Negative changes & impacts**

The questionnaire investigated how frequently over the past 12 months respondents used paper, a computer in the police station; a BlackBerry and a MDT for recording crimes and allocation of incidents, on scale on one to seven, representing never and always respectively. Ideally, it is anticipated that the usage of paper and a computer should be used less than MDTs whilst BlackBerries and MDTs should be used more often. However, this is not apparent in Figure 8.2.2: a large proportion still use paper frequently, and a significant number always use a computer inside the police station (mode = 7 – always). A small amount of respondents only use a MDT regularly. The questionnaire found that the most frequent factors affecting usage of MDTs related to poor signal, poor input interface and a complicated logging on procedure (see Table 8.2.2), causing officers to make more frequent use of desktop computers in the station to record crimes. However, no statistical significance was found between these factors and the level of usage. Further questionnaire data should be collected to identify any significances, but this was constrained by the practical limitations of collecting the data face-to-face within a short timescale.

![Figure 8.2.2: Frequency of use of various techniques for recording crimes and allocation of incident over past 12 months](image-url)
Table 8.2.2: Negative factors affecting recording crimes via mobile devices

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Limited device functionality</th>
<th>Uncomfortable to use in vehicle</th>
<th>Poor connectivity</th>
<th>Time-out period too short</th>
<th>More training needed</th>
<th>Poor input interface</th>
<th>Fiddly to log on</th>
<th>Electronic signature facility needed</th>
<th>Incompatible to use MDT when single-crewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of respondents</td>
<td>14</td>
<td>11</td>
<td>26</td>
<td>12</td>
<td>2</td>
<td>21</td>
<td>25</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>% of respondents</td>
<td>18.9%</td>
<td>14.9%</td>
<td>35.1%</td>
<td>16.2%</td>
<td>2.7%</td>
<td>28.4%</td>
<td>33.8%</td>
<td>2.7%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

These issues were consistent within the interview data. Poor connectivity was widely reported amongst all participants, including the crime input bureau. It was suggested that crime details input via a MDT were regularly lost due to a poor signal, which sometimes affected the level of public satisfaction. This caused officers to either input crime details via a MDT in a police vehicle rather than in a property of a victim, or to return to a local policing unit (LPU): -

*The risk to the business is...we’ve experienced this on the North and you’ve probably heard about this loads of times...is signal strength and therefore reputation. You turn up at somebody’s house with all this fantastic kit and you can’t get a signal, or you do a load of work on it and the signal is lost and you have to do it again, or you say ‘I can give you a crime number but I need to drive half a mile to the top of a hill to get a signal then I’ll be back’ - well it doesn’t look very good to the member of public. So there’s a reputational risk there I think. Therefore you also get a lack of confidence with the kit and therefore a decrease in usage amongst staff, because officers don’t want to look a fool in front of people or explain why we have this kit and it’s not working correctly, so the officers would rather do it the old way. So the risk is you’ve invested all this money and the return is diminishing.* (Chief Inspector, North BCU)

*In general, it’s all down to frustration, such as losing information that I’ve spent 45 minutes inputting because of a poor connection or log out. This affects the quality of service, as we cannot give the person a crime number there and then...they see this bit of Gucci kit in our car that doesn’t work and that makes us look silly.* (Officer 11)

Most police officers participating in the interviews appeared enthusiastic to record crimes directly, but suggested that this was hindered by three elements. The first was no facility to take electronic signatures, secondly the electronic unavailability of some forms such as domestic abuse crimes, and thirdly the timeout facility on the devices for security reasons. One Superintendent also validated their claim, stating that their officers are returning to the station to record crimes mainly to print a hard copy of a statement in order to get it signed.

Furthermore, compared to the paper-based crime recording process, it was found that 29 per cent more respondents find a computer in a local policing unit (LPU) less difficult than paper to use than those who find a MDT less difficult than paper (Figure 8.2.3). The results show that 18.4 per cent more respondents rated recording a crime via a MDT more difficult than paper (on a scale of one to three) than
that of recording a crime using a computer in the LPU. This is supported by a significant association between the usage of a MDT and the level of ease/difficulty of using a computer $\chi^2 (14) = 25.51$, $p, < 0.05$. This seems to represent that a MDT is used less frequently because respondents find it easier to use a computer in their LPU for crime recording. Correspondingly, a wider number of interview participants suggested the input interface via MDTs to be poor, and combined with minimal training it was common throughout the interview data for officers to record a crime via an easier option of a computer in a LPU. A positive relationship was found between the usage of a computer in a LPU and the level of ease/difficulty of using a MDT $\chi^2 (42) = 62.38$, $p, < .025$. Usually, the association should have no expected count less than five, but in this case 79 per cent of cells had a minimum count below 5. Again, in order to verify these statistical associations further data should be collected to boost the proportion of cases falling into each category$^9$, but due to the previously discussed practical limitations this was not possible.

![Figure 8.2.3 Ease of use of a computer in the local policing unit vs. a MDT to record a crime compared to paper-based process](image)

The usage of a computer in a LPU was plotted against the level of difficulty/ease of using a MDT (Figure 8.2.4). The positive upward trend of the graph supports the previously discussed positive relationship of the chi-square test. This suggests that those who find recording a crime via a MDT more difficult than the paper-based crime recording process use a computer in the police station frequently. Although most respondents perceive recording a crime via a MDT easier than via paper, they may still frequently use a computer in their LPU, as supported by the qualitative interview data. Participants from the crime input bureau stated that their workload had not fully decreased due to officers making less use of MDTs for direct crime recording:

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I don’t think there has been any real change, widely agreed, we’ll still have the copy typing etc. We are still doing what we used to e.g. indexing, call taking and copy typing. I don’t think any of the old inefficiencies have been removed. Some officers are still calling up for a crime number. Even when they are at an incident they are asking for a crime number. (Crime input bureau interview 1)

Figure 8.2.4: Usage of a computer in a LPU vs. level of ease associated with recording crimes via a MDT

Questionnaire respondents were asked about the efficiency of crime recording via MDTs and desktop computers compared with paper (Figure 8.2.5). It is evident that most respondents find the direct crime recording process to be more efficient using a desktop computer than a MDT. A positive relationship exists between the usage of a MDT and the efficiency of recording a crime via a computer in the LPU $\chi^2 (49) = 67.33, p < 0.05$. This may indicate that a MDT is used less frequently for crime recording because users find it is more efficient to use a computer in the LPU due to the technical issues arising within the questionnaire and interview data.
Figure 8.2.5: Level of efficiency of recording crimes via a computer in the local policing unit vs. a MDT compared to paper-based crime recording process

The Constabulary collected internal monthly usage figures of CIS, which may serve as more objective data to supplement the questionnaire results. A snapshot of this usage data during September 2009 supports the notion that the take up of recording crimes via MDTs is low (Figure 8.2.6), and this is consistent for the subsequent nine months (when usage figures were first recorded). The chart was plotted on a semi-logarithmic scale to show more explicitly the wide ranging values between usage of CIS to input and view details. It is clear that the greatest number of transactions are associated with viewing details on CIS, as opposed to inputting details on CIS. It is also interesting to observe that CIS usage across the board is highest within the City Centre BCU, possibly where connectivity is improved.

Figure 8.2.6: Usage of CIS via a MDT
The findings demonstrate more frequent and perceived more effective and efficient use of a computer than a MDT for crime recording. Recording crimes via the old paper-based process appears to have decreased, and most users within the sample are following a more direct crime recording process. However, this is largely being completed inside the walls of police premises, which goes against the anticipated increase in visibility via mobile crime recording. The take up of mobile crime recording appears to be relatively low, with greater usage of CIS to complete brief checks rather than lengthy input. The underlying reasons behind this may be related to the technical issues outlined in Table 8.2.2 and via the qualitative data. The main issues include a poor signal, a poor input interface and a complicated logging on procedure, which may be forcing even enthusiastic officers to return back to the station. Alternatively to the technical issues, the level of usage may be related to the cultural change associated with recording crimes electronically whilst operational. A chi-square was used to test for any associations between the length of policing experience and the usage of MDTs, but no statistical relationships were found. Again, this might be bound by the sample size. Despite this, it appears generally in Figure 8.2.7 that those who use a MDT frequently hold fewer years of policing experience (0-5 years), and those who rarely use a MDT have more years of policing experience (16-26+ years). This may imply that younger officers are less engrained into the paper-based crime recording process than those who have served in the police force for longer periods and are used to the paper-based crime recording process. However, it must be noted that these conclusions are limited by the sample in terms of the total number of respondents with 16 to 26+ years of policing experience.

Figure 8.2.7: Usage of MDT versus years of policing experience held by respondents
Senior officers participating in the research concurred with this notion, suggesting that the crime recording process remains similar to before but instead is being completed within a different location. It was suggested by several senior officers that this may be related to the cultural change associated with completing additional tasks away from the police station, as exemplified by the following:

*If you look at the usage data, I understand that if you look at the creation of crimes from the scene, that is still very patchy or not as was hoped. Officers will say ‘it’s because the system is slow, the system crashes’ - anything else apart from ‘it’s down to me’: If you look at the amount of intelligence transactions done by an officer using a MDT…in other words what they want to use it for, that is massive. So officers are using MDTs for what they want to use it for and not what the organisation envisaged they would be used for; I think that’s apparent. It’s quite clear that some officers have never even turned on their device, whereas others are embracing it and going with it. So all of those little issues need to be resolved in the full scale of time.* (Superintendent, South BCU)

Based on the evidence, direct crime recording has changed the paper-based crime recording process (Figure 8.2.1). The crime recording process has become less reliant on intermediaries in the process, such as the crime bureau, to input details onto the crime information management system. In theory, the mobile crime recording process should follow something similar to that in Figure 8.2.8. Officers attending a crime should gather and input crime details directly onto the crime information management system whilst in a property of a victim or suspect. This thereby increases visibility and accuracy and reduces duplication and the level of intermediaries, as established in the Flanagan Review and The Green Paper.

![Figure 8.2.8: The ideal MDT crime recording process](image)

However, the evidence suggests that the ideal MDT crime recording process is not being followed, due to the technical and cultural issues discussed previously. Instead, a crime is recorded mainly back in the police station (Figure 8.2.9) or sometimes back in a police vehicle after attending the
scene of a crime (Figure 8.2.10). Whilst recording a crime directly back in the police station has addressed duplication and bureaucracy of the crime recording process in terms of removing intermediaries in the crime input bureau, it still has not addressed the target of increasing visibility. Visibility is increased via recording a crime in a police vehicle, but this does not follow the ideal, slicker crime recording process outlined in Figure 8.2.8.

![Figure 8.2.9: The computer-based direct crime-recording process](image)

![Figure 8.2.10: The actual MDT-based direct crime-recording process](image)
8.2.2 Incident allocation process

Positive changes

Prior to the introduction of MDTs (Figure 8.2.11), a call taker in the call management centre (CMC) would input incident details onto the operational intelligence system (OIS). A dispatcher in the CMC assessed the incident and dispatched it to an available officer according to its level of priority. The details of the incident were passed to an officer via the communications radio by a dispatcher, with the officer sometimes recording details on paper. After attending the incident, an officer informed a dispatcher of the outcomes of the incident via the radio. A dispatcher then updated the incident details in OIS and closed the incident.

The evidence from this study suggests that MDTs have to some extent enhanced this existing process. For example, respondents were asked to rate on a scale of 1 to 7 how easy and efficient they find using a MDT for obtaining incident details compared with paper-based methods and the radio. As apparent in Figure 8.2.12, generally speaking most respondents find using a MDT to obtain incident details the same or less difficult/ quicker than using the paper and radio.
Figure 8.2.12: Ease and efficiency of a MDT to obtain incident details compared to paper/ radio based process

The interview data supported this finding, with the majority of police officers, CMC personnel, Inspectors and Superintendents identifying that full checks can be completed via a MDT rather than calling up on the radio. A small number of CMC personnel suggested incident allocation and sharing of incident details via a MDT had improved their daily task of allocating an incident to an available officer. This was because officers using MDTs were no longer travelling a significant distance to view incident details at their LPU, as demonstrated by the comment below. Customers may receive a better service as a result of this, as attendance times may reduce. Agrawal et al\(^\text{10}\) report similar findings of the use of MDTs in a US police force, where the availability of real-time information removed the need to rely on a cumbersome process based on radio dispatch.

However, it was also suggested by some that greater effectiveness and efficiency was only apparent when officers were double-crewed, had good connectivity, were able to log onto a MDT, or were attending a lower priority incident. It was identified in the interviews that more often than not, these conditions were not apparent, causing the same level of reliance on the control room and no change in the effectiveness of the incident allocation process.

*If officers are dealing with something in the area we can ask them to have a look at another incident nearby, which is good for small incidents such as road obstructions, can sort it quicker and saves a lot of travelling to less important incidents.*

(CMC interview 2)

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These two sets of results were analysed against the local policing units, as one may expect a difference between incident allocation in urban and rural areas due to the type of incidents and level of connectivity. However, no marked differences were found; further data within rural areas should be collected. Despite this, there was a significant negative association between the level of ease of acquiring incident details via a MDT and the number of years of policing experience held $x^2 (4) = 9.77$, $p < 0.05$. Usually, the association should have no expected count less than five, but in this case 44 per cent of cells had a minimum count below 5. Again, in order to verify these statistical associations further data should be collected to boost the proportion of cases falling into each category$^{11}$, but due to the previously discussed practical limitations this was not possible.

Around a third of questionnaire respondents stated that MDTs have provided greater availability of information when attending incidents (Table 8.2.3). A small proportion also believed that they were now able to deal with more incidents, possibly because of fewer delays in the incident allocation process in terms of waiting to receive incident details over the radio. Similarly, the interview data suggests that across the board, participants spoke favourably of the ability to view incident details in greater depth via MDTs, rather than relying on a third party to share relevant details over the radio. Prior research concurs that information became available in a timelier manner as a result of MDTs$^{12}$. A small number of officers, CMC personnel and Inspectors suggested that this had reduced time spent using the radio, making MDTs more efficient for dealing with incidents. This set of findings was supported by the majority of comments from CMC participants that related to a reduction in workload in terms of deciding which information to share. The comments below demonstrate this finding:

The control room aren’t always the quickest to allocate incidents and aren’t always the most factual…they aren’t the best at verbally conveying information, sometimes they say ‘can you go to this quick job’ and it turns out to be a rape. (Officer 12)

There is an awful lot of intel for an incident, it is too much at times so sometimes we cannot share all of this information with a police officer, whereas with the MDT we can do this. (CMC interview 2)

Table 8.2.3: Positive factors of obtaining incident related information via mobile devices

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Greater availability of information</th>
<th>Can deal with more incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of respondents</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>% of respondents</td>
<td>32.4%</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

The qualitative data supported the notion that officers now have a greater availability of information at their fingertips when attending incidents. A large number of police officers, control room personnel, Inspectors, Chief Inspectors and Superintendents were in agreement that MDTs allow officers

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$^{11}$ Field, A. ref. 9, p. 696.

$^{12}$ Colvin, C. A. & Goh, A. Validation of the technology acceptance model for police. Journal of Criminal Justice, 2005, 33, 94.
to be better informed, thereby improving officer safety when attending an incident. This is demonstrated in the quotes below. However, one participant suggested that this might have a negative impact on safety. The location of a colleague may be less obvious to fellow MDT users than to radio users. Radio users can pick up salient background information whilst completing operational duties, whereas MDT users have to view details of an irrelevant incident. This is an important consideration and is discussed further in the following section (‘Negative impacts’).

I went to a job a few weeks ago and I checked the person on the MDT first and it said ‘double crewed mobiles to attend only’ but that information wasn’t on the incident...so luckily I’d checked on the history and asked for a double-crewed mobile over the radio, but without the MDT I would’ve probably turned up at the incident and got my head kicked in. (Officer 5)

The second biggest reason for me is information flow. To do a decent threat assessment on an incident, you need good information, and whether you can get that from the control room or whether you can get that from yourself if you’re driving and your colleague can tap in. So in terms of information at officers’ fingertips, it enables them firstly to make proper threat assessments in response to jobs and secondly ensures that officers have the necessary information in front of them when they’re dealing with customers. It’s great when you’re sat there dealing with a victim to be able to tap into systems and provide a victim with information. (Superintendent, North BCU)

This evidence supports the notion that since officers have more information at their fingertips, MDTs are used more for quick checks prior to attending incidents rather than completing lengthy tasks, such as inputting crimes (discussed in Section 8.2.1). To address this issue, the Constabulary may wish to consider the provision of computers in the community. As identified in Chapter five, other police forces have made policing systems accessible in local public libraries and schools. This allows officers to complete lengthy tasks such as crime reports whilst remaining visible and outside of police premises. In relation to this, the level of ease and efficiency of crime recording and incident allocation via a MDT was compared. However, the overall results were inconclusive against the qualitative data discussed in this section and the CIS usage data (Section 8.2.1).

**Negative changes & impacts**

As identified in the beginning of this section, with the paper/radio based incident allocation process, incoming incidents were assessed by a dispatcher in the CMC and dispatched to an available officer according to its level of priority. It emerged consistently from police officer and CMC personnel interview participants that the ability for officers to be more proactive by viewing incident queues via MDTs and making autonomous decisions with regard to attendance at incidents, rather awaiting instructions over the radio. Although police officers participating in the interviews viewed this as a benefit, it carries negative connotations for their safety. A major issue highlighted by interviewees was that if
officers did not complete all the necessary intelligence checks prior to attending, or did not communicate their whereabouts to CMC personnel they may place themselves at risk. The ability for officers to be proactive in attending incidents also raised the possibility of officers ‘cherry picking’ the more straightforward or rewarding jobs, rather than giving priority to tasks allocated by a dispatcher. CMC participants suggested uniformly that this made it difficult to plan responses or manage resources, as at times officers may not be in a nearby location. In terms of the quality of service, the implications of this may cause victims to be neglected or waiting longer for a response. However, this issue was not recognised by non-operational senior officer participants; the majority of whom implied that MDTs had simply made officers more productive. This key finding is exemplified in the following two interview quotes: -

MDTs are good for grade one jobs and bigger jobs...not saying that other jobs aren’t important but for jobs that need attending there and then straight away...we’re able to attend an incident sometimes before the control room have even seen the incident, and we think it’s fantastic. (Officer 5)

The annoying thing is there might be an incident quite near to where an officer is but the officer has left and no longer in the area. This can sometimes mean a victim can be waiting a lot longer for a response. (CMC interview 1)

Overall, Control Unit personnel appeared to support the notion that they should retain control for the assignment of incident responses, with officers being ‘sent’ the next job to which they were to attend via the MDT. In order to ensure officer safety, it is imperative that there is clarity of responsibility with regard to carrying out intelligence checks prior to attending incidents. It is recommended that new working protocols are clarified in writing, and are communicated effectively to all personnel.

In relation to this finding, it also transpired in the interviews that officers had less time to follow through an incident effectively. The task of inputting outcomes of an incident within the incident allocation process has now shifted from the CMC via information received from the radio to the officer via a MDT. A key concern amongst officers was that they were expected to attend an incident immediately after a previous incident, without an opportunity to update the incident details. Officers stated that they lacked ‘breathing space’ in between incidents to do so, as the CMC were overloading them with incidents. On the contrary, CMC participants advocated that administrative workload had remained the same since officers were not making full use of MDTs, partly due to technical issues and cultural elements. Some officers also raised concerns over privacy; some passengers had attempted to view details whilst completing intelligence checks.

Evidently, to some extent the incident allocation process has become more effective and efficient. The time spent waiting for information via the radio has reduced, as officers can now complete their own checks by accessing a MDT. Officers are less reliant on third parties to obtain incident related details, which in turn has eliminated some intermediaries within the process. Ideally, the incident allocation process may ensue as described in Figure 8.2.13. The process should be allocated by a
dispatcher, but rather than sharing and updating incident details using the radio an officer can view and update the full set of details through a MDT. Consequently, the level of duplication is reduced.

In reality, there are some apparent differences from the ideal crime recording process. Rather than officers waiting for their next job from a dispatcher, they are making autonomous decisions as to which incident to attend (Figure 8.2.14), which has negative implications for officer safety and the level of service.

Figure 8.2.13: The ideal incident allocation process

Figure 8.2.14: The actual incident allocation process
8.2.3 Additional processes

In addition to crime recording and incident allocation, questionnaire respondents were asked what additional features they used on a MDT. The most popular features included the use of email and the Intranet to check operational related information, with around 70 per cent of respondents respectively. BlackBerries could only be used for these purposes due to a limited availability of information systems on these devices. Around 50 per cent of respondents stated they commonly used features including the Internet to gain directions to locations, and the missing persons database. A small number of respondents (around 10 per cent) also made use of the General Enquiry IS (GENIE), the Custody IS and the Voters’ register. The use of a MDT to send and receive emails and to complete checks for operational and identification purposes also featured commonly within the interviews. Senior officers suggested that they could directly access operational information during the command of serious crimes in progress. This eliminated the inefficiencies in obtaining such information using the radio and then relaying it to police officers in order to command an operation, or inputting decisions into systems from paper days later. A small number of operational and senior participants highlighted the benefits of having access to a MDT during quiet periods, in order to follow up administrative tasks. In addition, one senior officer explained the use of a resource and demand software system (iR3) that is currently being used to identify and monitor priority locations. As recognised in the Flanagan Report, officers are able to remain visible in these priority locations whilst completing operational and administrative duties by using mobile technology.

The question concerning the main functionality used on a BlackBerry was answered by questionnaire respondents who were using a BlackBerry device. Email was the most commonly used function (90 per cent of respondents), and the Intranet (45 per cent of respondents), followed by around a third of respondents using their device to capture evidence using the camera facility, and share it either via emailing it to colleagues or inputting it into a relevant information system. Within the qualitative interviews, the use of the camera facility was also widely reported by BlackBerry users. Some CMC participants also suggested that email was useful to allocate lower priority jobs to Police Community Support Officers with a BlackBerry. Previously, these incidents might not be handled for days: a dispatcher used to record these incidents on paper and pass them to an officer via the radio during quiet periods. Using email these can now be dealt with sooner, allowing the public to receive an improved service. Despite this, it was widely agreed amongst interview participants that as a result of the overall limited functionality on BlackBerries only to a small extent had handheld devices addressed existing levels of bureaucracy.

8.2.4 Impact on bureaucracy within existing business processes

This study also investigated the time spent on administrative functions of core business processes compared to before the use of mobile technology. The questionnaire found 60 per cent of respondents stated that the amount of time they now spend on administrative tasks as a consequence of

mobile technology has not changed. Beside this, only a very small amount of respondents asserted that mobile technology had reduced the time spent completing paperwork. Rather than reducing the amount of time to complete administrative functions, most of the questionnaire sample advocated that mobile technology has simply moved these tasks out of the station and onto the streets. Most operational officers and a small number of senior officers participating in interviews corroborated this, as illustrated in the following example:

_It hasn’t had an impact on the processes because they’re the same. It just means that officers don’t have to perform them in the station; they can do them when they’re out there. So the bureaucracy remains. The need to feed machines with data, worthless data on occasions - a lot of stuff we record for the sake of ‘what if something happens’ - remains. We don’t trust people to remember things. Nothing’s changed apart from where officers perform the inputting task._ (Inspector, South BCU)

They commonly indicated that technical issues outlined in the previous section, along with several single-crewed officers and no facility to capture signatures electronically, limited the impact of mobile technology on bureaucracy. Out of the questionnaire respondents who stated that there has been no change on the time spent on administrative functions, most made daily use of a computer in a LPU and rare use of a MDT. This may further reflect the technical and cultural issues associated with the introduction of mobile technology. Amongst senior officers, it emerged heavily that the limited impact of the project on overall bureaucracy was due to the cultural change associated with using mobile devices. Most participants concurred that in relation to this, the main reason was due to a large number of officers still resorting to the old ways of completing tasks, who have struggled to perceive how the new technology overlays onto existing processes. As a result, the quote below demonstrates how officers are still returning to the station or making use of paper to complete administrative tasks.

_You have to make it the preferred method of choice…rather than just saying we want you to do it like this, the culture is ‘oh well, we’ve always done it the other way, and it’s easier the other way, so why should I change?’ So you have to prevent people of doing the other way to force them into the new way, as some of the officers are luddites._ (Superintendent, South BCU)

In parallel, it is argued that the culture of policing is embedded in traditions and history, which carry accepted principles of conduct that are followed in an unconscious manner. Manning notes that the introduction of MDTs in a US police force caused disruption to existing business processes and patterns of communication amongst officers. For example, officers were able to perform administrative duties and access information whilst on duty, which caused a reduction in the level of time available to

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interact with other officers back in the station. Similarly, within this study, a small number of participants spoke negatively of the impact of new policing processes on existing team interaction. Therefore, the existing culture of returning to the station to complete administrative duties can act as a significant barrier to altering policing processes that have been followed for years. It may be argued that for new policing processes to be adopted into a traditional culture, rather than replicating the existing desktop interface it must be adapted around existing tasks and working environment of officers. Correspondingly, Sorensen & Pica\textsuperscript{18} claim that for mobile technology to have a successful impact, it must be able to constitute the ‘routines of the user…the actualities of the situation and the norms, values and rules governing the role played by the user’\textsuperscript{19}. In other words, the usability of mobile devices cannot be addressed without considering the wider contextual factors of ‘information usage modality and environmental engagement’\textsuperscript{20}.

Furthermore, an alteration in policing processes requires a changed mindset; and since the existing organisational culture is so engrained this may be a possible barrier to successful implementation. It emerged from the interview participants that resistance appeared to be greatest amongst older officers, who may have adopted the paper-based policing processes for a longer periods of time than younger officers. It also emerged that the timescales for implementing the project were short, and communication and a vision about the purpose of the project were minimal. This is highlighted in the comment below. These elements may have inhibited a change in the mindset of officers, and may be a cause of limiting the impact of the project on existing bureaucracy. An equivalent study by Wood\textsuperscript{21} found that a change programme that was implemented into the New Zealand police had a limited impact on improving quality and proactive policing. This was due to misalignment of the vision with the culture, and a lack of communication and a leadership programme caused the project to be perceived as contradictory to the needs of the organisation. Similarly, research in the UK police by Kiely & Peek\textsuperscript{22} highlight that lack of communication from senior to operational ranks also acted as a barrier to improving quality of service.

\textit{It’s a cultural thing really. We’ll perhaps get onto it later…there’s a real tension in as much as I think we will see the benefits of mobile data, it’s just in terms of timescales in terms of changing the culture and getting it done. There is a clear and understandable need and requirement from the Force to get this embedded and working and start seeing the benefits. Actually it’s the timescales…we’ll get there, but I don’t think we’ll get there fast enough for the Chief Officers. But speaking to people in terms of benefits, they do like using the devices, particularly our newer officers. It’s not about officers not being used to technology, because I don’t think we have any officers now that aren’t using the technology, and the interface isn’t that different from the desktop computer…it’s hardly cutting edge stuff anymore albeit it’s good pieces of kit. It’s more about how that actual

\textsuperscript{19} Ibid., p. 143.
technology works when you try to overlay it with their traditional view line in terms of policing. It's not the technology it's just about the way that they do business, and that's where the inconsistency comes from because some will embrace it...our newer officers know the old ways of doing things, you've got new enlightened officers who accept the change is a good thing, and then you've got others who won't change the way that they do business...they think that the mobile data doesn't fit in with the way they do their business. So the benefits are there, they're starting to come but it's not coming as quickly as we'd hoped. (Superintendent, City BCU)

Despite this, the majority of senior officers acknowledged that the performance of the project is being monitored through usage statistics on an individual officer level. These statistics are generated by the mobile data project team, and then passed to relevant Superintendents of each BCU. The statistics are passed down the hierarchy to the relevant sergeants, who seek to promote usage amongst their officers. It was also highlighted that working groups, such as a continuous improvement and performance group, have been established specifically to address usage issues of mobile technology. Although the findings may indicate that the impact of mobile technology on existing bureaucracy is not as anticipated, these actions may work some way towards addressing it. Most senior officers advocated that they are reluctant to impose the cultural change by reducing the number of computers in the station by a dramatic amount until the technical issues are addressed.

The evidence from the questionnaire suggests that to some extent completing paperwork outside of the station may have enhanced the level of officer visibility, but still many users prefer to do so inside a LPU. This was also apparent within the interviews: most felt that MDTs had made officers more visible as administrative tasks could be completed in a police vehicle, but a small number were still doing so in a LPU.

For me it's enabled officers to remain deployed and have a visible presence on the streets so that they don't end up going to a job and come back to the station to commit to the systems what they have dealt with out there. (Chief Inspector, City BCU)

A non-reduction in the time spent performing administrative tasks may also have implications for the quality of service provided. The association between the change in capacity to deal with incidents and the time spent on administrative tasks was tested, but no significance was found. However, it was discovered via the questionnaire that no respondents felt that mobile technology had caused an increase in capacity to deal with incidents. Therefore, mobile technology may not have the desired effect on the time spent policing in the community rather than in dealing with paperwork.

There was a 50:50 divide amongst operational and senior interview participants between those who felt mobile technology had not altered the number of journeys made to their LPU per shift and those who generally felt it had decreased:
MDTs have certainly reduced the number of return journeys to police stations, but not across the board. There are some times where we look at usage figures and see individuals with low usage, and when questioned officers have said they need to come back to the station to print things off and pick things up. They have been addressed. (Chief Inspector, North BCU)

This split was also apparent amongst questionnaire participants. The questionnaire data was analysed in more depth and significant associations were identified between the number of journeys made to a LPU per shift and the level of ease of recording a crime via a MDT $\chi^2 (15) = 34.8 p, <0.01$, and the efficiency of recording a crime via a MDT $\chi^2 (15) = 40.19 p, <0.001$. This may suggest that those who find it more difficult or slower to record a crime via a MDT make more return visits to their LPU, whilst those who find it easier make fewer return visits. Furthermore, most respondents felt that the number of computers in their LPU should either remain the same or be increased; none stated that the number of computers should be reduced. This finding was tested against the level of policing experience and the ease and efficiency of using a MDT but no significant associations were found. However, this strongly suggests that further work needs to be done to enable a wider take up and impact of mobile technology. Since most senior officers agreed that the mobile data project was of high priority amongst their work commitments, it is likely that in the future the project should receive resources and funds to ensue its success in the longer-term. Since the evidence from this study strongly highlights that the success of the project depends on a long-term cultural change, a maintained commitment to the project is essential.
8.3 Summary

This Chapter has investigated the state of policing processes following twelve months of usage of mobile technology within a UK police force. The policing domain has received little attention in this area, despite significant pressures from external bodies to streamline existing processes through the use of mobile technology.

The evidence from this study does not fully support the expectation of the UK Government to decrease bureaucratic elements of core paper-based policing processes via mobile technologies. For example, the adoption of direct crime recording via a mobile data terminal remained relatively low, with many users reverting to the old technique of recording crime details on paper and inputting it either in a police vehicle or returning to a local policing unit; rather than at the scene of a crime. This has implications for the accuracy and timeliness of information and furthermore the time spent on policing in the community rather than in dealing with paperwork.

Although mobile technology granted the capacity for a more proactive approach to policing by viewing incident queues in real-time with less reliance on intermediaries to obtain relevant information, it was also revealed that this may have a negative impact on the safety of officers and the quality of service. At times, more straightforward or rewarding tasks were selected over those allocated by a dispatcher. Additionally, necessary intelligence checks were sometimes neglected prior to attendance. These outcomes may lead to placing police personnel or members of the public at risk. It is therefore important that the responsibility of prioritising incoming tasks remains clear following the incorporation of mobile technology into task allocation processes.

The most frequent use of mobile technology proved to be for completing quick intelligence checks prior to attending incidents, rather than for carrying out more lengthy administrative tasks, such as the direct crime recording process. It was suggested that due to technical, reliability issues and cultural matters, this limited the impact of mobile technology on existing bureaucracy levels. Evidence from this study shows that visibility marginally increased, with many continuing to make return journeys to their home station to complete time-consuming paperwork. Reliable connectivity, ergonomics and interface design remain open questions. In the meantime, provision of desktop computers in the community may help to increase presence in neighbourhoods.

It consistently emerged that the limited impact on existing bureaucratic business processes may also be associated with the cultural change entailed with streamlining policing processes. For many years, the police service has become reliant on fixed computers within police premises to complete its core activities. The advantages afforded by mobile technology may have not been embraced due to this traditional mindset engrained within the police service, also hindered by short implementation timescales imposed by external funding bodies. It is suggested that the gap between usage and anticipated reductions in bureaucracy can be addressed by continued training, communication and a clear vision of the mobile information project. Usage is being promoted through the establishment of dedicated working user and continuous improvement groups, alongside mechanisms to monitor and address usage levels. The majority of key stakeholders in the study suggest that mobile technology is the key vehicle to creating a more efficient era of policing. The success of this depends on a maintained commitment from all levels and bodies.
Mobilising the Information and Knowledge Environment within the Leicestershire Constabulary

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Chapter Preface

This Chapter provides a high-level interpretation of the key themes of the thesis within a broad picture. Each theme is briefly outlined and then discussed where appropriate, within the context of the aims and objectives and the literature review (in Chapters One and Two respectively). The overarching theme of the thesis is the readiness of modern day policing to undergo a technological change and this is assessed throughout this Chapter. The Chapter concludes with a summary, linking together the different themes and what the results might mean for implementation of technology within the policing context. Any limitations identified in the methods are also discussed here.

9.1. Reconsidering the Problem

It has been recognised that twenty first century policing carries a vast amount of bureaucracy, with law enforcement officers required to spend much of their patrol time inside a police station rather than on policing in the community\(^1\) \(^2\) \(^3\). As a result, police forces in the UK have embarked on a recent Government initiative to implement mobile information technologies. Such technology can allow updates of information systems virtually regardless of geographical restrictions. Current research suggests that there has been relative neglect in the literature regarding the potential opportunities and challenges posed by allowing mobile access to information systems within a policing context\(^4\). The overall aim of this study was to evaluate the impact of mobile information technologies on employees and existing information and knowledge processes within a UK police force, the Leicestershire Constabulary. A rigorous evaluation process was conducted during the implementation stage to investigate such an impact. Existing theoretical models, such as the technology acceptance model, were used to provide a theoretical underpinning for the study.

9.2. Implications for the future of policing

Overall, the study found that the success of mobile technology entails a radical cultural change for the organisation, and a change in existing policing processes. This was apparent across all levels of the organisation, from senior management to operational officers and personnel in the core administrative functions (such as the call management centre and crime input bureau). Some argue that

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\(^1\) Arnott, S. Police need more mobile IT. <http://www.computing.co.uk/computing/news/2198497/police-mobile>, 12.09.2007, [accessed 08.11.07].


\(^3\) Carvel, J. What was new in Gordon Brown’s speech? <http://www.guardian.co.uk/society/2007/sep/24/conferences.uknews>, 24.09.07, [accessed 08.04.08].

Chapter Nine: Discussion

This might be as big as a change as the introduction of the two-way radio\(^5\)\(^6\). Over the past ten years, police officers have become engrained in a routine of frequent returns to their police station to make use of a computer for administrative purposes. Through mobile information technologies, this may no longer be necessary, as information can be accessed and updated whilst policing the streets. The study found that this could offer benefits to society, including meeting public demands for increased visibility and levels of protection. These impacts on existing roles across the organisation and existing visibility levels are explored further in section 9.4 of this Chapter.

It was observed that police officers were also able to share knowledge with each other out in the field using mobile devices more quickly than via the radio, which can carry a high level of latency. This can contribute to academia by furthering understanding on the notion of mobile knowledge sharing\(^7\)\(^8\)\(^9\). Furthermore, it can be argued that this allows tacit knowledge of an individual officer, such as a particular piece of intelligence, to be codified more readily and become available to other officers via mobile devices, rather than sharing knowledge verbally via the radio. This is also true for crime prevention, and supports a move from the socialisation stage to the externalisation stage of the SECI model\(^10\). For UK police forces, this could mean a criminal investigation, for example, could be solved more effectively, as the relevant information is readily available in systems and can be accessed by a larger audience. In a similar notion, Brown and Brudney argue that ‘providing real-time access to databases promotes knowledge creation and learning…wireless networks have allowed…better decision-making’\(^11\). Enabling direct access to information also supports the final stage of Gottschalk’s growth model for knowledge management technology\(^12\), where specific IT systems are accessed to solve a knowledge problem. However, it was found that this also increased solo working and levels of isolation. Subsequently, this presented a risk in terms of reduced opportunities for face-to-face knowledge sharing and exchange of tacit knowledge. It is important that such risk is managed appropriately, and is discussed further in section 9.4. The study found that mobile technology increased access to real-time information and the entire operational knowledge base\(^13\), which can offer further benefits to society in terms of response and awareness for the public. Officers can also be better informed before attending an incident, which can improve the quality of service provided to the public and the level of officer safety.

It was revealed in the study that the success of accessing real-time information hinges firstly on the quality of information input into systems; yet the current architecture in place within UK police forces is not sufficient to facilitate this. For UK police forces, they may wish to pursue the introduction of more objective measures of the quality of data input within a mobile information environment, and also the development of mechanisms to assist with data entry. Baumber concurs that the introduction of


\(^{6}\) Chan, J. B. L. The technological game: how information technology is transforming police practice. *Criminology and Criminal Justice*, 2001, 1(2), 156.


\(^{8}\) Rao, M. Knowledge management tools and techniques: practitioners and experts evaluate KM solutions, 2005, p. 18.


\(^{10}\) Nonaka, I., Toyama, R. & Konno, N. SECI, ba and leadership: a unified model of dynamic knowledge creation. *Long range planning*, 2000, 33, 8.


technology to increase access to information may also lead to information quality becoming a priority for the police service. In light of the introduction of the Police National Database in 2010, ensuring good quality data for nationwide decision-making purposes will become increasingly important on the research and law enforcement agendas, and to facilitate the change towards a mobile information environment.

The success of accessing real-time information via mobile devices depends secondly on the ability for police officers to conduct their own searches on intelligence and input information correctly into a complex range of information sources. The extent of this depends on the information searching abilities of police officers. Borglund concurs that officers must possess information literacy skills in order to make full use of search features within intelligence systems. The study found that police forces need to develop further training packages in these areas to increase officer confidence and allow a move away from traditional means of relying on the radio, to further address the cultural change. This could possibly be via scenario-based training to allow officers to improve familiarity with using mobile devices in operational situations. Similarly, Al-Daihani & ur Rehman, Baker, Northrop et al and Brown & Brudney report that police officers rated their abilities to build a search strategy below average.

Despite the apparent benefits of mobile technology discussed above, the findings of the evaluation study confirmed the viewpoint of those who have suggested that the introduction of technology in policing can make it difficult to implement change (for example as previously speculated by Collerette et al; Legris; Claver et al; Walker & Katz; White). In practice, the study found that many officers reverted to recording crimes and obtaining incident details via existing processes, rather than making full use of the technology. In order for police forces to realise full benefits of mobile technologies, they need to focus their energies on winning hearts and minds of the key stakeholders, rather than solely on delivery of the technology solution. Therefore in review of the findings above, it can be argued that the Government initiative was a good idea but they implemented it too quickly to realise any significant business benefits because of the cultural change that the technology entails. A series of new tools were developed to further advance the theoretical and methodological approaches available for the management of the technological cultural change within UK policing, and are discussed within the following section.

14 Baumber, S. The IMPACT Nominal Index: an asset for child abuse investigators?, MA dissertation, De Montfort University, United Kingdom, 2007, p. 16.
15 Borglund, ref. 2.
19 Brown & Brudney, ref. 11, p. 32.
24 White, M. D. Current issues and controversies in policing, 2007, p. 128.
9.3. Managing the technological change

It was indeed evident from the study that a rigorous evaluation process can assist to manage the technological change, rather than simply focusing on the technical questions. The study adopted an in-depth qualitative approach of the organisational issues affecting the implementation of mobile technology, making use of alternative methods to interviews and surveys such as organisational work shadowing. In this sense, it can be argued that it has contributed to academia by enhancing understanding of the opportunities and risks afforded by mobile technology in policing, and how the change can be managed. For policing, these lessons can be applied to increase the benefits of mobile technology. Other related studies have addressed this to some extent, but have adopted a more statistical approach rather than exploring the organisational issues in depth, for example Colvin & Goh.25

It is argued that many projects fail because of a lack of focus on evaluation and key user requirements of a system.26 27 Frisk states that these issues can be overcome by adopting a holistic approach to evaluation, which concentrates on stakeholder perspectives of an IT project. In a similar vein, the study found that it is critical to involve the users in the implementation and selection process. The culture of policing is often hierarchical, with many decisions made from the top of the organisation. For example, in a critical incident there is often little time for consultation between a commanding officer and operational officers. This culture can sometimes also be inherent in the implementation of IT projects in policing. The results show here that a top-down approach to implementation may not necessarily yield a successful result, and instead it is better for management within policing organisations to adopt a bottom-up approach to implementation.

In light of this notion, a tool was developed in this study to assist police forces in the selection process. A key element of the framework is that it involves the key stakeholders within the project to enable user involvement. This builds on existing frameworks taken from the literature, which highlight the importance of considering stakeholder needs over a quantitative, economic approach, but do not allow prioritisation of stakeholder needs. For policing organisations, this can ensure that a solution is selected that meets user needs and avoid the selection process solely from a management perspective. By involving the users in the selection process, sources of resistance to the change may be minimised. In addition, the findings from verification of the framework via interviews with external experts suggested that the framework could provide a more robust, structured approach to decision-making. It was highlighted in the study that policing organisations assume that they will follow a specified process, but without any explicit guidelines this can often be overlooked. This can also be beneficial for policing organisations when seeking funding from external Governmental bodies, as it can provide sound reasoning for a selection of a particular solution, rather than basing decisions on a managerial hunch. A number of UK police forces opted for a personal digital assistant (PDA) solution, but the framework highlighted that such a solution did not meet the requirements of the users within the Leicestershire Constabulary, thus influencing their decision. Overall, users specified the need for a mobile solution that

removed the need to fax paper based forms and enabled incidents to be reported on the move. The functionality of solutions implemented in other UK police forces was limited in this regard. It can be argued that the selected solution, recognised in a national IT industry award, was due to successful application of the tool. This may highlight the usefulness of such a tool within other policing organisations. There are few other frameworks available in the literature that police forces can adopt in the initial selection processes. The framework developed in this study can help to inform future decision making whilst minimising resistance to change.

A large part of research on managing technological change focuses on the interface between the technology and the user, in order to identify the factors that facilitate adoption of the technology. It has been posited that despite high investment into ICT projects, related business performance remains low, and the benefits of the technology depends on the extent to which employees accepted it. The Technology Acceptance Model has held the most attention in the academic community since its publication. Evidence from the evaluation study rejected the claim that the original TAM can fully explain why police officers adopt or reject a technology. The two main attributes of the TAM; whether the technology will enhance the user’s job performance (perceived usefulness) and whether using the system will be free from effort (perceived ease of use) were not sufficient to account for the factors that facilitate acceptance of mobile information technologies. In accordance with the TAM, this study found the main factors affecting perceived usefulness of mobile technologies were improvements in officer performance and safety; functionality of mobile data terminals (MDTs) and the ability to input and access information directly via MDTs. The data showed that the device reliability, security, usability, level of IT skills, training and organisational support linked to the perceived ease of use element of the TAM.

In contrast to the original TAM, additional factors external to the properties of the mobile devices were identified in the course of this longitudinal evaluation study. These factors were within the wider implementation and social context surrounding the technology. Results from the various methods employed in this study showed consistently that within the implementation context, the management style taken appeared to have still negatively influenced usage. Here, specific factors included the low level of officer consultation following the initial selection process and little information given about the purpose of the project. Also, local sergeants did not enforce the use of mobile device and allowed return trips to the station by officers and this was found to be a common factor negatively affecting usage throughout six UK police forces, including Leicestershire. However, the level of buy-in from senior management showed to positively influence the level of usage in Leicestershire, as its senior officers were in favour of the mobile information project from the beginning and therefore invested adequate resources to allow the technical change, but in the five other police forces this was not the case. Furthermore, as discussed in section 9.2, it was commonly agreed that the tight timescales for the project imposed by the UK Government were not sufficient to allow police forces to adapt to the change and this negatively influenced the level of user acceptance. In addition, evidence demonstrated that

cognitive factors in the social context, such as the influence of peers, officer and public perception of MDTs and organisational culture, were not accounted for by the TAM. It also transpired that the fit of mobile devices to local contexts, such as specific roles and tasks, impacted on the PU of mobile information technologies; but the TAM does not give consideration to this.

In contrast to the TAM, the ‘facilitating conditions’ element of the UTAUT related to factors from the study that included the level of training, organisational support and information about MDTs. The ‘social influence’ element of the UTAUT accounted for the external factor related to the influence of peers found within this study. Within the context of this study, this may suggest that the UTAUT is stronger in predicting factors affecting police officers’ intentions to adopt mobile technology. Despite this, this research found that the elements of the UTAUT did not allow consideration of other external factors. These included factors related to officer performance, such as the impact of mobile technology on sharing information. Management style factors similar to those not accounted for in the TAM were also found to be missing in the UTAUT. The evidence showed that cognitive factors including officer perception of MDTs, the influence of public perception and organisational culture were excluded from the UTAUT.

Later work has shown the need to add variables that account for social pressures in order to increase the predictive capability of the TAM\textsuperscript{33}. In spite of these improvements, the model remains insufficient to explain the adoption of a technology in a policing organisation. Within a general context, Money & Turner\textsuperscript{34}, Huang \textit{et al}\textsuperscript{35} and Legris \textit{et al}\textsuperscript{36} contend that a broader model, which incorporates organisational and social factors, is necessary. For police officers in this study and related studies, wider variables in the social context, such as the influence of peers, and within an implementation context, including the level of organisational support and involvement in decision-making processes, have proved to be just as important as perceived usefulness and perceived ease of use of technologies (for example as previously concluded in differing policing contexts by Hu \textit{et al}\textsuperscript{37}, Chu \textit{et al}\textsuperscript{38}, Hu \textit{et al}\textsuperscript{39}; Lin \textit{et al}\textsuperscript{40}, Colvin & Goh\textsuperscript{41}; Collerette \textit{et al}\textsuperscript{42}; Bouwman & van de Wijngaert\textsuperscript{43} and Straus \textit{et al}\textsuperscript{44}). In this sense, the key findings of this study discussed above are affirmed by similar research within the literature in a variety of international policing contexts. This study adds value over these existing research papers by making use of additional methods such as focus groups and observational work-shadowing, rather than basing findings purely on a survey, which add more depth to existing understanding of adoption of

\begin{thebibliography}{99}
\item[32] Venkatesh & Davis, ref. 29, p. 82.
\item[40] Colvin & Goh, ref. 25, p. 90.
\item[41] Collerette \textit{et al.} ref. 20, p.177.
\end{thebibliography}
technology by police officers. These results are important from a research perspective because they can enhance existing theoretical understanding of the applicability of the TAM within a large complex organisation such as policing.

Ferret & Splenhauer\textsuperscript{45} argue that the introduction of change into a police institution is only beneficial if the profession sees them as beneficial in terms of material gain, status and symbolism, in other words external factors mediate a successful change. There are differences between the nature of policing and commercial organisations that may make the TAM less applicable to these findings. For example, it might be asserted that the hierarchical, command nature of policing operations also influences other non-operational activities. Chan\textsuperscript{46} notes that the traditional and rigid structure of policing can sometimes present difficulties to implement change. In operational activities, many decisions are made by more senior members of a policing organisation due to the time-critical and life-threatening demands. In parallel, within this study decisions regarding the mobile technology project were made with little consultation from, or information provided to operational users. This may provide possible causation for the negative influence of managerial style on acceptance of mobile devices. Allen\textit{et al}\textsuperscript{47} concur that mobile technology is being introduced into police forces without consideration on work practices and wider organisational issues.

Findings in this study, where the influence of peers had a strong influence on the level of usage, support the importance of wider social effects on technology adoption. Collerette\textit{et al}\textsuperscript{48} highlight the need to incorporate social dimensions into managing adoption of a new police information system. One possible reason is that since individual officers often team up for task planning, strong bonds are apparent in law enforcement\textsuperscript{49}\textsuperscript{50}\textsuperscript{51}\textsuperscript{52}. It is acknowledged by Orlikowski and Hofman\textsuperscript{53} that the effectiveness of a change process relies on the interdependence between the technology, the organisational context and the management style used to manage the change.

In view of the findings, management within UK police forces can promote usage of technology practically through convincing demonstrations and communication of its usefulness. This may help to address individual attitudes formed towards the technology and overcome some of the cognitive factors to acceptance. In order to address the identified barriers regarding the level of information about the project, management can maintain widespread communication about the purpose of the project and how it will affect on individuals’ jobs. This could be through user groups or through corporate posters, for example. The findings demonstrate the importance of involving users in the decision-making and initial design and conception stage of the project; management may wish to do so through the use of workshops or user groups. In addition, the strong influence of peers on officer acceptance can be

\textsuperscript{46} Chan, J. B. L. The technological game: how information technology is transforming police practice. Criminology and Criminal Justice, 2001, 1(2), 156.
\textsuperscript{48} Collerette\textit{et al}, ref. 20, p. 177.
\textsuperscript{49} Lin et\textit{al}, ref. 40, p. 25.
\textsuperscript{50} Manning, P. K. The technology of policing: crime mapping, information technology and the rationality of crime control, 2008, p. 47.
\textsuperscript{51} Collerette\textit{et al}, ref. 20, p. 171.
leveraged via project champions to promote the benefits of mobile technology via frequent word of mouth from the more proficient officers to the less proficient, resistant technophobes.

From a practical point of view, the findings regarding user acceptance are fundamental for UK police forces in developing a sound understanding of how to succeed with technological change. In response to these findings, the research produced an adapted technology acceptance model, which incorporated these newly emerging external factors into the existing TAM elements. The model is a holistic view of the key factors that should be addressed in order to overcome barriers to user acceptance of new mobile technologies. The newly developed H-TAM was verified with five other police forces through a series of interviews. This sought to test the applicability of the model within a wider policing context. The findings of this phase of research demonstrated that the H-TAM developed in the Leicestershire Constabulary is largely applicable in a variety of UK police forces, with differing organisational contexts. Additional external factors (discussed earlier in this Chapter) were identified in the verification phase and incorporated into the H-TAM, including the impact of local supervision, level of senior management buy-in to the project, time to implement mobile technology and the fit of mobile devices to local contexts. This demonstrates its applicability to a variety of contexts. By incorporating external factors into the H-TAM, Burton-Jones & Hubona find that this can improve predictions of technology usage by up to 250 per cent \(^{54}\). Collier et al\(^ {55}\) argue that cultural barriers in policing need to be addressed to yield appropriate changes in behaviour from the investment of technology. UK police forces and possibly other organisations within the public sector can apply the model as a tool to manage future implementation of technology projects in order to tackle the barriers to cultural change.

9.4. Towards understanding the impact of mobile technologies

In addition to the discussion of the key theme of the readiness of modern-day policing to undergo a technological change and how to manage such change, several key themes arose consistently within each of the subsequent five individual Chapter discussions. The themes related to the impact of mobile information technologies on the following key areas:

- The impact of mobile information technologies on visibility levels;
- The impact on overall knowledge sharing processes,
- The impact on the roles of employees.

This section brings together these themes from each Chapter discussion and discusses the overall emerging patterns and findings of each theme. Academically speaking, in doing so, this works towards answering the aim of the thesis outlined in section 1.2.1 and the overall research problem (see section 9.1). Taking forward the ‘action’ element contained throughout this research, such discussion


may allow other organisations increase understanding the overall impact of mobile information technologies without the need to study the entire thesis.

9.4.1. Impact of mobile technologies on the level of visibility

The overall evidence from this study has shown that mobile information technologies have not had a large impact on visibility levels. Despite this study being mainly qualitative, with little pre-benchmark data to indicate a change in the level of visibility as such, there was a general notion that anticipated improvements in visibility levels were not met. This was partly due to the cultural issues (discussed in section 9.2 to 9.3) and the technical issues (reflected in sections 4.2.1, 5.2.3, 5.4.2, 8.2.1 and 8.2.2), such as poor connectivity and a lengthy log on procedure, which caused officers to return to the station. It is interesting to note that there were marked contrasts between the level of visibility observed in the initial two-week pilot study and the wider evaluation. Within the pilot, it was observed generally that the level of visibility had improved, but in the later evaluation stage the general conclusion was that visibility levels had not changed. Such contrast may be due to the inclusion of more enthusiastic users in the pilot, who were keen to make the most out of the technology in terms of policing and visibility. It is therefore important to recognise that the positive results from the pilot study may not be fully representative of full implementation. These differences are discussed in further details within the subsequent paragraphs.

Participants within the pre-implementation stage of the pilot study were principally enthusiastic about the impact that mobile technologies would have on visibility, since they would not need to return to the station to fax crime reports and instead could input crimes directly (sections 5.2.1 and 6.2.1). Similarly, as identified in section 6.2.2, pilot participants spoke positively about a reduced need to return to the station to access information, and for almost 90 per cent of incidents observed during the work-shadow exercise the officer did not need to return to the station. This had resulted in an associated increase in visibility and level of service for the ‘customers’ of Constabulary; the ‘customer’ being members of the public. Positive findings were also reflected in from other organisations studied in this research beyond the Police Force, including the RAC, Yorkshire Water, British Gas and British Telecom (BT). Here, as found in section 6.2.2, technicians no longer returned regularly to their local warehouse to access customer and job related information. instead, they were able to access such information via their mobile device in a timely manner, prior to or whilst attending a repair. Although visibility may be a lesser priority within private sector organisations, it may reflect a similar improved service to their customers in terms of more efficient attendance to customer calls. Participants within all of the wider evaluation focus groups highlighted that mobile technologies has the same potential to remove the need to make repeated return trips to their local policing unit to complete administrative duties. However, whilst a small proportion agreed in section 8.2.1 that direct access to information in the field had provided an element of visible reassurance to the public, it was revealed that the improvements were not as widespread as anticipated. Rather than the intention to record crimes directly and remove the need to return to a local policing unit to fax information or update information systems, findings demonstrated that this was largely being completed inside the walls of police premises via a desktop computer. The take-up of mobile crime
recording overall appeared to be relatively low, with greater usage of the crime information system to complete brief checks instead of lengthy input.

Possible reasons for the contrast in visibility within Chapter six and Chapter eight may be due to the previous comments regarding the fervour on the part of the officers concerned. The findings within Chapter eight involved participants that were less enthusiastic users than those engaged in the pilot study largely discussed in Chapter six, and were less keen to make full use of the technologies. Another possible explanation may be due to the concerns highlighted in section 6.2.3 from all elements of the research over spending increased amounts of time on patrol in isolation. A significant number here were apprehensive about the potential negative effects on team interaction and identity. Organisations like BT initially began to push the full mobility element too far, and were keen to see vast improvements in the time spent on patrol (see section 6.2.3). However, they later realised that this would impede on the efficiencies gained through teamwork and therefore allowed its staff to make return trips to their home base. This is a key concern that needs to be managed in order for mobile technologies to have any effect on visibility levels, and is discussed further in section 9.4.2. This notion of a need to take into account the impact of technologies on the wider organisation and existing interactions perhaps mirrors a key argument from the knowledge management field (see section 2.1.4), where the people and processes must be considered alongside the technologies.

Likely accounts for the differences in visibility or number of return trips to a base between policing and private sector organisations may allude to the organisational context and nature of the job, and the different approach taken to implementation. Due to the less time critical environment, technicians within private sector organisations can perhaps afford to complete lengthy tasks whilst on patrol and remain visible. Furthermore, the positive impact on visibility within the RAC et al may also link to the amount of time that these organisations have had to adjust to a new way of working. In parallel with the discussion in section 9.2, it was exposed that companies like the Yorkshire Water, RAC, British Gas and BT have had around ten years to realise any gains over the time spent in the field, whereas in the police service this has been a relatively new project.

These results correlate with a key concern raised in the recent press that only one in ten officers is visibly available to the public. Therefore more needs to be done in order to increase visibility, and the evidence shows that it is not just a case of providing technologies. The cultural and technical issues must be accounted for. Whilst these are largely considered in the h-TAM (see sections 5.5 and 9.3), there are also some specific points that must be brought together into this discussion from the various parts of the thesis.

Firstly, as identified in section 5.4.2, it is important to use of the command-driven culture of policing to the benefit of the organisation through the utilisation of local supervision. Sergeants and team leaders should encourage their staff to remain on patrol and only make return trips if absolutely necessary. Other police forces involved in this study have employed similar techniques and seen benefits in their visibility levels (see section 5.4.2 – ‘management style factors’).

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In addition, it was shown that other police forces have encouraged visibility by creating remote access to information systems in public places via a desktop machine. This proved to be good for completing lengthy tasks that cannot be done on a mobile device, but law enforcement officers remained visible to members of the public, such as in a local library or hospital. Evidence illustrated examples of whereby an officer was able to prevent a public situation by their presence.

However, as discussed previously, it is important not to expect users of mobile technologies to remain visible for the entire working shift. For example, expecting employees to take meal breaks out in the community to preserve visibility levels may damage team culture and opportunities for face-to-face knowledge sharing. This might be maintained by providing places for employees to meet in public (as identified in section 6.2.3) whilst not compromising on visibility levels. This is also an important consideration for existing knowledge sharing practices, and is discussed in the following section.

9.4.2. Impact of mobile technologies on knowledge sharing processes

This research aimed to evaluate the impact of mobile technologies on existing information and knowledge processes within the Constabulary (as outlined in sections 1.2.1 and 9.1). Generally speaking, this study established that mobile technologies had a positive impact on knowledge sharing. It was a common finding throughout all elements of the research that employees were able to share information with colleagues in the field more quickly and act on it to make decisions. However, there were also some risks posed by mobile technologies to face-to-face knowledge sharing. In addition there were some contradictions between anticipated usage of mobile technologies and actual usage from the pilot and wider evaluation studies. These are discussed collectively in this section.

Prior to the introduction of mobile technologies, it was anticipated that MDTs would enhance the gathering and recording of information (as outlined in section 4.2.1). Within the pilot study, it was widely observed that mobile technologies had allowed information to be submitted in a timely fashion (see sections 5.2.1 and 6.2.1). This allowed tacit knowledge from one officer to be codified as explicit knowledge more quickly, for example via email or information systems, so that more employees within the organisation can act on this information/knowledge to make decisions. It was commonly agreed throughout the research that this also allowed officers to access a greater depth of information than the control room provided over the radio (section 6.2.2). This was also a common finding in the wider evaluation phase of the research, for example as outlined in section 5.2.1 whereby the direct input of and access to information positively influenced the perceived usefulness of MDTs. As identified in section 5.4.2, this finding was reflected in other UK police forces. In parallel, a study by Derballa and Pousttchi who suggested that mobile technologies have a positive contribution to knowledge management by reducing the time delay between knowledge creation and codification.

However, this notion was not followed through in the findings within Chapter eight. Instead it was apparent that participants from this element of the study made little use of mobile technologies to submit information directly (section 8.2.1), due to the previously discussed technical and cultural issues. In parallel with the findings in section 6.2.2, participants within this element of the research made most use

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of mobile technologies for accessing information and completing quick checks, since this fit best with the demanding nature of policing. Furthermore, with regard to this view, focus group participants agreed that they were able to access information in real-time and have it at their fingertips, rather than having to write it on paper or rely on memory or the ‘cumbersome’ radio (see section 6.2.2). During the pilot study, questionnaire data indicated that nearly half of MDT usage was for identification purposes and obtaining information from the intranet. It can be argued that this supports the viewpoint of Brown and Brudney\(^59\) (outlined in section 9.2) and Von Guretzky\(^60\) of decision-making on the spot. These findings were consistent with those from the wider rollout, where officers were able to make greater decisions and number of arrests by making connections between items of information (sections 6.2.6 and 8.2.2). Within a wider implementation context, technicians within a variety of organisational contexts employing mobile technologies for their business processes (such as the Yorkshire Water, British Gas and British Telecom) are now able to have the entire range of information about the customer and the job at their fingertips. Whilst this finding was discussed in section 9.4.1, it is also an important finding for mobile knowledge sharing. Overall, the results discussed here demonstrate that mobile technologies have increased the access to corporate information and knowledge within the policing and utility service contexts.

In addition to inputting and accessing information, pre-trial and wider focus group participants broadly agreed that information could be shared with their colleagues whilst on duty via email rather than relying on the two-way radio (section 6.2.3). This was also shown in the wider evaluation questionnaire, with a significant number of respondents making use of email on a regular basis (section 7.3.3 – ‘impact of mobile technology on information sources used’). In terms of knowledge sharing, this could represent dangers or losses to salient information that is passed onto all officers: as discussed in section 6.2.3, officers in the neighbourhood will get/send any salient information in response to incidents reported via the radio. Officers are always listening to the radio so that they can share their related information on the radio, such as related history or warming markers. Despite the evidence from this study suggesting that the use of email was more effective than the radio, because information was recorded in front of the officer rather than relying on the radio, it is important to recognise the risk this may contain. In contrast to acquiring salient information through the radio on a relatively widespread scale, it may be more difficult to share information widely through email. Senders must have an understanding of whom to share information with / send emails to and be selective in doing so without excluding key colleagues, though at the same time avoiding an overload of information (as examined in section 2.2.1). In addition, users of mobile technologies must constantly be checking their email inbox to obtain relevant information in a timely fashion whilst completing operational duties. For example, to obtain any relevant history or warning markers via an email at the same time as driving to an incident would be impractical and compromise safety. Striking a balance between these competing demands may prove more difficult than obtaining information passively from the two-way radio, and consequently compromise the quality of information shared. In reflection of this notion, the post-trial questionnaire determined that zero respondents made use of email and a considerable number made use of the radio or force information systems, with a small proportion (17 per cent) making use of face-to-face communication, for acquiring

\(^59\) Brown & Brudney, ref. 11, p. 32.
information. This perhaps demonstrates that in reality, the use of email may offer some benefits but is impractical due to the reasons advocated in this paragraph.

As outlined in section 9.2 and detailed in sections 5.2.1 to 5.2.4, section 6.2.3 and 8.2.4, this study established that mobile technologies also carry some disadvantages to knowledge sharing. Evidence throughout the pilot study and wider evaluation within the Constabulary and research with utility services organisations (including the RAC, Yorkshire Water, BT and British Gas) demonstrated that operating remotely can increase solo working and levels of isolation. Unless managed effectively, this can present risks to face-to-face knowledge sharing, for example identifying links between individual items of information through informal conversation with colleagues. For example, as found in section 5.2.1, pre and post-pilot participants and those engaging in the wider evaluation study expressed key concerns that the level of opportunities to share information face-to-face had decreased; and that this had reduced the perceived usefulness of MDTs. Similarly, both phases of research (pilot and wider evaluation) concur that management decisions, such as encouragement to make fewer return trips to the local policing unit, an increase in the level of single-crewed police vehicles and changes to shift start times, had taken a negative effect on the existing shift culture (sections 6.2.3 and 5.2.4). The key lesson discussed in section 9.4.1, to not push the full mobility element too far in order to simply promote visibility levels, links to the findings here. Mechanisms to promote face-to-face knowledge sharing must remain in place, and may include those considered in section 9.4.1, along with those contained within the recommendations of Chapter ten.

9.4.3. Impact of mobile technologies on roles of employees

In addition to evaluating the impact of mobile technologies on existing information and knowledge processes, this research aimed evaluate the impact on employees. A reoccurring theme throughout this research was the impact of mobile information technologies on existing roles and responsibilities of employees. It emerged consistently in each of the five individual chapter discussions that mobile technologies caused a shift from tasks being performed in the core administrative functions ('back office' – such as the call management centre and the crime input bureau) to the police officer or user of a MDT.

For example, as displayed in sections 4.2.1 and 6.2.2, officers in the pilot widely agreed that there was a reduced reliance on the call management centre to update information, which removed intermediaries from the communication chain. This allowed more direct information with employees at higher and lower levels of the organisation. At the same time, this enabled personnel within the call management centre to concentrate on handling calls of a higher priority rather than several small incidents. In this sense, it can be argued that mobile technology enhanced the existing roles and responsibilities. This finding can be paralleled with research by Agrawal\textsuperscript{61} and Norman and Allen\textsuperscript{62} into the impacts of mobile computing within a US and UK police department respectively. Both studies


\textsuperscript{62} Norman & Allen, ref. 4, p. 217.
identified a strong relationship between the level of communication and time available for officers due to a reduced need for the assistance of a dispatch team.

However, this also implies that the onus is now on the police officer to update information within information systems, rather than relying on personnel within the call management centre and the crime input bureau to do so. An interesting finding from this research was the conflict between police officers and administrative and managerial staff over the perceived quality of information input directly into information systems via MDTs (refer to section 7.2.4). Officers participating in post-trial and wider evaluation focus groups widely considered that the quality of information had improved: as discussed in section 9.4.2, information could be input without delay. Similarly, in section 5.2.1, it was found that MDTs bypassed the previous three-day delay to input information. In contrast, call management centre and crime input bureau respondents and management participants concurred that the accuracy of data on the intelligence systems might be reduced in the long-term as a result of input error by officers. This may allude to a possible fear amongst administrative workers of a loss of control due to a change in their role. In the same way, call management centre staff expressed concern over job losses, as mobile technologies had the potential to reduce the role of the control unit (section 5.2.4). For other organisations, this is an important lesson with regard to managing expectations amongst employees. As found in section 5.4.2, organisations should keep all stakeholders informed about the purpose of mobile technologies and how they affect their role. In parallel, Collerette et al\textsuperscript{63} highlight the importance of communicating across all levels of the organisation. Especially in the current age of austerity in public spending in the UK, where police forces are making spending cuts by reducing the number of civilian workers\textsuperscript{64}, a reduced reliance on the call centre and crime input bureau may reflect the notion of a reduction in the level of control or in the number of administrative positions available.

Moreover, the wider evaluation study exposed dangers over police officers taking control of decision-making from the call management centre. For example, there were several instances whereby officers assigned themselves to an incident via the remote incident management information system (as exemplified in sections 6.2.6, 6.3.2 and 8.2.2). Again, personnel from the call management centre were concerned about a loss of control within their roles and furthermore fears for the safety of officers. Nevertheless, it was observed that police officers have a desire for greater autonomy and see mobile working as a way to achieve this (see sections 6.2.6 and 8.2.2). This again highlights the importance of managing expectations and establishing clear functions of each stakeholder involved with mobile information technologies.

9.5. Appropriate ness of methods adopted

It must be noted that without the opportunity to be immersed in the organisation under study, that is, the Leicestershire Constabulary, a significant part of the research could not have been undertaken. Access to such a wealth of data within an organisation that has a strict authorisation procedure would

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\textsuperscript{63} Collerette et al, ref. 20, p. 164.
have not been possible. As it was, the Constabulary sought an independent body to work alongside the mobile information project team and conduct a series of evaluation research studies. The opportunity to do so from the initial introduction of mobile technology allowed the prospect to carry out research from the initial selection process to making recommendations to assist with the cultural change. The action research and ethnographic research strategy afforded a greater understanding of the culture and workings of a complex and dynamic information environment within a single organisation, rather than across a wider range of policing organisations. Without such an understanding, the multifaceted, intangible cultural and management issues affecting change in policing organisations may not have arisen.

A qualitative mixed methods approach taken in the research granted an in-depth understanding of the opportunities and risks afforded by the introduction of mobile technology into a UK police force, and have led to the development of a toolkit for application across UK police forces, which has not been a feature in related studies. This study has highlighted its usefulness as a means to addressing the cultural change as well as adding to the body of academic knowledge on the evaluation process.

The consistency between the results found at the different phases of the study (between Leicestershire and the other UK police forces sampled), and in the various methodological components of the study (focus groups, interviews, questionnaires, observational work shadowing), suggests that the triangulation process has been useful to confirm the validity and reliability of the range of findings. The combination of methods above compared with the findings of interviews with other UK police forces was instrumental in highlighting the consistent key factors to acceptance of mobile information technologies.

The use of semi-structured face-to-face interviews and focus groups appeared to be an appropriate method, allowing an element of adherence to the main research objectives whilst also granting flexibility for participants to express the main themes that they felt had been important in the implementation and change process of mobile information technologies. The inductive nature of the research approach facilitated exploration of the impact of mobile technologies on the existing information environment, rather than subjecting the study to closed research hypotheses. The use of a questionnaire allowed wider sampling of data to corroborate the existing focus group and interview data. However, the volume of surveys in circulation at the time of the research may have limited the level of responses. The observational work shadowing data added a new dimension to the findings by identifying the use of mobile information technologies in context, which may be more objective than the data collected via the other methods.

However, it must be noted that participating in the data collection may have influenced the results by participants possibly wishing to be viewed in a positive light: for example by reducing the number of return trips to the station during periods of work-shadowing.

In a similar notion, in hindsight it would have been useful to supplement the largely qualitative data with additional quantitative data, for example benchmarking figures. Such benchmarking figures could include usage figures of MDTs compared with that of desktop computers in police stations. This may further understanding of user acceptance and the cultural change entailed. Benchmarking figures could also include comparison of data quality levels before and after the introduction of direct crime recording, in order to determine its impact on a wider scale. In addition, it may have been useful to expand the qualitative findings regarding user acceptance by statistically testing existing theoretical
models and the validity of external factors through a survey instrument. As discussed in Chapter five, this was not possible due to Governmental drivers to implement mobile technology within a limited timeframe, which placed significant pressure for the evaluation research to go ahead.

Furthermore, the reflection of the results from the different elements of the research highlight a limitation in the design of the research. As discussed throughout section 9.4 of this chapter, whilst the inclusion of more enthusiastic officers within the pilot phase of the research was appropriate for the ‘action’ element of the research (in terms of promoting the technology initially to less resistant users), it was less than ideal for the academic element of the research. The results show variations between the impact of mobile technologies amongst the pilot participants and the wider evaluation participants. Although this issue has been recognised and discussed within this Chapter, it is nevertheless an important consideration towards the implications for the overall results and the design of similar future studies.

It should be recognised that the specific organisational context of policing means that the results are not necessarily generalisable to other environments but they still provide some practical implications and theoretical lessons learned that could be applied by UK police forces and possibly public sector organisations, particularly those within the domain of the emergency services.

9.6. Summary

The discussion of the findings of the study has suggested that the introduction of mobile information technologies into UK police forces carries significant benefits for policing organisations, but for this to be possible the radical organisational and cultural change that it brings must be managed effectively. A number of complex issues are entailed in the change process, and cannot be resolved through simplistic solutions and quick fixes that the UK Government originally intended but a long-term programme of change management. In response to the research findings, the study developed an implementation toolkit for application across UK police forces to manage the radical technological change. An evaluation framework and an adapted, holistic user acceptance model (H-TAM) are the main components of this toolkit. Whilst other related studies have addressed the main factors to acceptance of technologies, they do not provide an integrated framework that can be applied in such a practical manner.

The exploration of the impact of mobile information technologies on the existing information environment of a policing organisation has enhanced theoretical understanding of the key challenges and risks afforded by such technology. The study has shown that it can improve visibility levels, facilitate mobile knowledge sharing and increase access to real-time information; for society this may mean improved safety and protection. However, to facilitate this police forces need to focus their energies on managing the impact on existing roles and responsibilities and further training packages to provide the necessary skills to access such information; alongside addressing the cultural and managerial barriers to acceptance via the toolkit discussed above.

The factors identified in the study show that existing theoretical models, such as Davis’ Technology Acceptance Model, must be extended to include elements that are not intrinsic to the
technology in order to suit a policing environment. Instead of factors that related to the perceived usability or usefulness of mobile information technologies, newly emerging external factors, such as organisational cultures and values, as well as the actions of senior management, were crucial in determining the success of the implementation of a new technology. Consequently, the incorporation of these factors into H-TAM has contributed to current academic knowledge. Rather, the study has validated the notion that the introduction of technology must go beyond the technology and cover the people and processes associated with the technology.
Chapter Ten: Conclusion and Recommendations

Chapter Preface

This concluding Chapter considers how the findings of the research study contribute to the achievement of the aim and objectives set out in Chapter One, and outlines the conclusions reached in response to the overall research question. It also suggests some recommendations to overcome barriers to the implementation and use of mobile technology by the Leicestershire Constabulary and/or other related parties. Areas for future research are also identified in this Chapter.

10.1. Optimising the information and knowledge environment

The major finding of this research is that mobile information technologies can have a positive impact on the existing information and knowledge environment. Information and knowledge can now be accessed more readily by police officers within the field and core policing processes can be completed with fewer delays, thus contributing to the arena of mobile knowledge management. However, evaluation from various elements of the research showed consistently that the extent of this impact on existing bureaucracy is limited by the cultural change that the technology entails. For many years, the police service has become reliant on fixed computers within police premises to complete its core activities. The advantages afforded by mobile technology may have not been embraced due to this traditional mindset engrained within the police service. As a result, a toolkit and methodology was developed in the research for practical application across UK police forces to assist with the cultural change, in terms of promoting the selection process and user acceptance of mobile information technologies.

The study has demonstrated that it is possible to use an evaluative, qualitative approach to minimise any issues that can arise from introducing mobile technology into a hierarchical organisation, such as policing. The largely action research approach used in the research has proved to be beneficial in applying existing theoretical models to increase understanding of how to implement mobile technologies successfully within a policing context. This has proved to be beneficial in overcoming practical barriers during the implementation process, and advancing existing theoretical knowledge (detailed in the subsequent paragraph). The researcher has also benefited from the approach by participating in a multifaceted, hierarchical organisation, such as the Leicestershire Constabulary, which has further understanding of how such an organisation operates and the complexities it brings.

Table 10.1.1 (overleaf) demonstrates the extent to which the aim and objectives have been met.
### Table 10.1.1: Evaluation of aim and objectives

<table>
<thead>
<tr>
<th>No.</th>
<th>Aim</th>
<th>Met</th>
<th>Justification</th>
<th>Chapter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To evaluate the impact of mobile technology on employees and information and knowledge intensive business processes within the Leicestershire Constabulary. In doing so, it aimed to gain a theoretical understanding of technology acceptance and knowledge management within a policing context.</td>
<td>✔</td>
<td>This was achieved by completing objectives one to nine. However, the research carries some limitations which are discussed within this Table and subsequent sections.</td>
<td>Chapters one to ten</td>
</tr>
<tr>
<td>2</td>
<td>To conduct a critical review of existing literature to understand the extent of research on mobilising information and knowledge processes.</td>
<td>✔</td>
<td>A critical literature review was undertaken into various evaluation frameworks available, existing theories on knowledge sharing and knowledge management, perspectives on data quality and information literacy, and various theoretical models that can be applied to increase understanding of user acceptance of mobile information technologies. This is evident in Chapter Two of the thesis.</td>
<td>Chapter Two</td>
</tr>
<tr>
<td>3</td>
<td>To understand the organisational context of policing and specifically the Leicestershire Constabulary</td>
<td>✔</td>
<td>An initial two-week period of induction was undertaken prior to commencing the research, where the researcher adopted an ethnographic approach within operational activities and non-operational administrative functions (such as the call management centre) to learn about the various elements of policing, from the existing paper-based crime recording processes to the use of operational systems. This context was kept up to date during the course of the study by playing an active role within the mobile information project team within the Corporate Development Department of the Constabulary, which plays a central role within key organisational developments.</td>
<td>Chapter One</td>
</tr>
<tr>
<td>4</td>
<td>To produce an evaluation framework to enable police forces to select the solution that best matches their information and knowledge needs and user requirements.</td>
<td>✔</td>
<td>An evaluation framework was developed consisting of a focus group to identify user requirements, a stakeholder analysis to balance competing needs, a feature analysis to evaluate objectively a range of solutions in the marketplace against prioritised user requirements.</td>
<td>Chapter Four</td>
</tr>
</tbody>
</table>
requirements, and interview and observation to verify the framework internally with senior management and externally with three ‘experts’ in other UK police forces. However, further data may have been collected to identify any additional user requirements not arising within the methods above. The framework was presented at the third European Conference of Information Management and Evaluation.

<table>
<thead>
<tr>
<th>4</th>
<th>To evaluate police acceptance of mobile technology</th>
<th>✓</th>
<th>A mixed methods approach of focus groups, interviews, questionnaires and observational work shadowing was undertaken to investigate the factors affecting officer acceptance of MDTs and to apply theoretical models in the literature retrospectively to test their applicability within a policing context. Further data was collected via focus groups and a wider scale questionnaire following a two-week pilot study. However, it may have been useful to supplement the largely qualitative data with quantitative data e.g. benchmarking figures (as discussed in section 9.4). It may have also been constructive to statistically test existing theoretical models and the validity of external factors, perhaps via a survey instrument.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>To test the adapted user acceptance model</td>
<td>✓</td>
<td>Semi-structured interviews were conducted with managers of mobile information technology projects within five other police forces; namely Cheshire, Essex, Humberside, Lancashire and Wiltshire. Data was also collected at an action research workshop run by facilitators from the NPIA branch of the UK Home Office, where representatives from all UK police forces involved in the implementation of mobile technology were present.</td>
</tr>
<tr>
<td>6</td>
<td>To investigate the impact of mobile technology on existing information and knowledge sharing practices within the Constabulary</td>
<td>✓</td>
<td>A mixed methods approach of focus groups, interviews, questionnaires, observational work shadowing during a two-week pilot study was used to investigate the impact of mobile information technologies on existing knowledge sharing practices. Further focus groups and a wider scale questionnaire were</td>
</tr>
</tbody>
</table>
Chapter Ten: Conclusion and Recommendations

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Objective</th>
<th>Methodology</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>To investigate the implications of mobile access to information systems for data quality and information literacy</td>
<td>A questionnaire, semi-structured interviews and focus groups were conducted to allow triangulation of results in order to develop a coherent picture of how police officers search for information within a mobile information environment, the level of training provided in searching for information, and the current level of data quality and the implications of this within a mobile environment.</td>
<td>Seven</td>
</tr>
<tr>
<td>8</td>
<td>To determine the impact that the implementation of mobile technology has had on information and knowledge intensive business processes within the Constabulary</td>
<td>A questionnaire and interviews were conducted with operational police officers, and interviews were conducted with personnel within the control room, crime input bureau as well as officers of more senior rank. This allowed an in-depth understanding of the perceived impact of mobile technology on existing business processes across the Constabulary.</td>
<td>Eight</td>
</tr>
<tr>
<td>9</td>
<td>Produce a set of recommendations for interventions for any other similar organisations looking to mobilise their information and knowledge processes, based on findings from the previous objectives. This may help organisations in avoiding the issues by applying the lessons learned from the study without having to go through the complete mobilisation process and learn lessons themselves.</td>
<td>An evaluation framework, H-TAM, and set of guidelines for managing the impact on knowledge sharing, data quality and information literacy were produced based on findings from the previous objectives.</td>
<td>Four to Ten</td>
</tr>
</tbody>
</table>

Various Chapters within this thesis have set about trying to achieve these objectives, as highlighted in Table 10.1.1. The next few sections will conclude the key findings for each objective. Some of the questions raised as a result of accomplishment of the research objectives remain unanswered and form the basis of the future research section of this Chapter.
10.1.1. Development of an evaluation framework

An evaluation framework was developed in the research and applied within the Constabulary (Chapter four). The framework builds on existing approaches in the literature, which stress the importance of managing stakeholders but do not facilitate practical management of stakeholder needs. The framework was applied to the selection of a mobile information solution within the Leicestershire Constabulary. It led to a chosen solution that meets a range of user requirements, rather than the preferences of senior management, which may promote acceptance of a new technology. However, further data could have been collected from potential users when identifying user requirements, rather than relying on a small sample of ‘experts’ within the Constabulary who had experience of implementing mobile technology on a smaller scale.

The solution implemented within the Constabulary allows anytime anyplace crime recording, rather than relying on paper based records, and this may possibly change the future of policing within the UK. This was recognised in a national IT industry award. Few similar frameworks are available within the literature for practical application within UK police forces to provide a structured and objective approach to their decision-making exercises.

10.1.2. Evaluation of police acceptance of mobile information technologies

The research into the factors affecting officer acceptance of mobile information technologies has found that officer performance, security/ reliability/ usability, management style and cognitive factors affected the level of adoption (Chapter five). Few previous studies have been conducted within the UK to promote understanding in this area. It was validated that external factors relating to management style and cognitive factors were found to have a key influence on the usage of mobile solutions throughout several UK police forces, due to the hierarchical and task culture apparent within policing organisations. These external factors do not fit within existing theoretical models, such as the Technology Acceptance Model. An adapted H-TAM was developed in response to these findings, for practical application across UK police forces in order to overcome the barriers to usage and the cultural change entailed with the introduction of mobile technology. However, as identified in section 9.4 it may have been useful to supplement the largely qualitative findings with more objective data. Specifically, the validity of external factors emanating from this study may have been statistically tested, perhaps via a survey instrument.

10.1.3. Impact on knowledge sharing practices

A pilot study was conducted, along with a further period of evaluation, to examine the impact of mobile information technologies on knowledge sharing practices. This involved the use of a more effective method of observational ‘work-shadowing’ to identify the use of the technology in context, rather than through more subjective methods such as interviews. The ethnographic approach to this research allowed a more intimate understanding of the knowledge sharing practices than other research studies.

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This research brought together practical findings with a theoretical underpinning and to address findings in a specific context (see Chapter six). It was found that overall, mobile technology can have a positive impact on UK policing and knowledge sharing. The benefits to the Constabulary included a reduction in the amount of time to perform routine tasks resulting in fewer returns to the station, better time management and increased visibility; during the pilot officers were visible to the public for 97 per cent of the time shadowed. Overall this may be seen as an improvement to the policing performance provided. Benefits to knowledge sharing were apparent from the findings. Firstly there was an improvement in the timeliness and accuracy of information meaning greater availability of information for decision-making purposes. It took officers eleven minutes to input information using mobile technology rather than the previous three days with the paper-based crime recording system. In addition, the delivery of knowledge to officers regardless of geographical restrictions meant that officers could make decisions with greater confidence. This may contribute to the concept of a learning organisation and support the upcoming concept of mobile knowledge management. Secondly, officers had better control over information and knowledge available to them as a result of mobile technology, rather than receiving too much or less critical information from the call management centre. Thirdly, it was found that since mobile technology has a lower level of latency than audio information (e.g. radio) officers could share information with other officers in the field more quickly and locate specific expertise more easily. Finally, officers in the pilot believed that knowledge sharing had improved because mobile technology provided a new avenue for keeping each other up to date with events e.g. completing checks for other colleagues and sharing warning and history markers with non mobile technology users whilst on patrol. However, it was found that mobile technology may reduce opportunities informal exchange of intelligence, as officers are expected to spend more time policing the streets. Therefore it was recommended that the Constabulary introduce mechanisms to promote face-to-face knowledge sharing, and are discussed further in Section 10.3.

10.1.4. Implications of mobile access to information technologies for data quality and information literacy

The ability to input information directly into police systems within a mobile environment creates ramifications for data quality. As far as the author is aware, previous research has not addressed this issue. In Chapter seven, it was found that the Leicestershire Constabulary only measure the completeness of data and accuracy of data is not considered. Since police officers can now input information directly via MDTs, this may cause vital links between items of data to be missed to the detriment of the vulnerable. It was also found that inputting information into law enforcement systems is currently difficult due to the ineffective design of crime input-form interfaces, which does not take into account the limitations of entering data whilst attending compromising and dangerous situations. As a result, the interface needs to be developed and recommendations for future research are made within Section 10.6. The knowledge acquired within Chapter seven can be applied by other law enforcement organisations looking to provide mobile access to their information and knowledge environment without reducing the level of data quality as a result of direct input of information. In addition to these findings, it
may have been useful to collect benchmark data in order to assess objectively data quality levels before and after the introduction of direct input.

Chapter seven also investigated the impact of mobile information seeking behaviour on the effectiveness of the use of mobile technology. Domains other than policing have similar problems, but these are exacerbated in law enforcement due to the need to make decisions in a time scale of seconds, yet to be reliable and accurate. The evidence from this study supports the notion that police officers have sufficient information-based capabilities to take advantage of the use of MDTs. There was a perception that an increase in appropriate retrieval and precision of the content improved decision-making as a result of using the devices. This allowed police officers to spend more time on policing in the community than in dealing with paperwork, even though on occasions some police officers spent more time than usual on information retrieval. Although the findings indicate that the use of MDTs has increased the level of successful and timely decision-making, most police officers felt that the training to underpin this technology is too short and somewhat inadequate in terms of content. Further recommendations to address this issue are provided in Section 10.3.

10.1.5. Impact on existing policing processes

Despite significant pressures from external bodies to streamline existing processes and bureaucracy levels through the use of mobile technology, the policing domain has received little attention in this area. The evidence from this study (Chapter eight) does not fully support the expectation of the UK Government to decrease inefficiencies within core paper-based policing processes via mobile technologies. For example, the adoption of direct crime recording via a mobile data terminal remained relatively low, with many users reverting to the old technique of recording crime details on paper and inputting it either in a police vehicle or returning to a local policing unit; rather than at the scene of a crime. The most frequent use of mobile technology proved to be for completing quick intelligence checks prior to attending incidents, rather than for carrying out lengthy administrative tasks. It was suggested that due to reliability technical issues and cultural matters, this limited the impact of mobile technology on existing bureaucracy levels. Evidence from the study shows that visibility marginally increased, with many continuing to make return journeys to their home station to complete time-consuming paperwork. Reliable connectivity, ergonomics and interface design remain open questions. In the meantime, provision of desktop computers in the community may help to increase presence in neighbourhoods. The advantages afforded by mobile technology may have not been embraced due to this traditional mindset engrained within the police service, also hindered by short implementation timescales imposed by external funding bodies. It is suggested that the gap between usage and anticipated reductions in bureaucracy can be addressed by continued training, communication and a clear vision of the mobile information project. Usage is being promoted (successfully) through the establishment of dedicated working user and continuous improvement groups, alongside mechanisms to monitor and address usage levels; a result of the action research approach taken in this study.
10.1.6. Summary

The research in this thesis has significantly contributed to four areas of research. Firstly, it has developed an evaluation framework that can be applied by other UK police forces and public sector organisations during the selection process of a new technology, which can help organisations ensure that the technology meets user requirements. Secondly, it has determined the impact of mobile technologies on existing knowledge sharing practices and produced a set of recommendations to ensure that valuable knowledge that is shared informally is not lost as a result of the use of newly introduced mobile information technologies. This contributes to the new trend in the literature of mobile knowledge management. Thirdly it has produced a holistic model that can be applied by UK police forces and other public sector organisations in order to address the barriers to user acceptance of mobile information technologies and the cultural change it brings, including a change in policing practices. This has bridged the gap in the understanding of factors affecting officer acceptance of technology and extended existing theoretical models. Finally it has addressed a gap in the literature by increasing understanding of the opportunities and risks posed by mobile information technologies on existing business processes and how these can be managed via the tools developed in the research. Overall this has contributed to the research aim by evaluating the overall impact that mobile technology has on employees and existing information and knowledge intensive business processes through application of the toolkit developed in the study.

10.2. Recommendations for the Leicestershire Constabulary

The research has highlighted a number of areas where the Leicestershire Constabulary could improve the impact and usage of mobile information technologies and manage the overall cultural change this entails. It is recommended that the organisation addresses the barriers to user acceptance of the mobile data terminal solution and incorporate elements of the H-TAM set out in Chapter five. To do this, particular attention should be given to continuous involvement of the operational officers in developing the technologies. Specifically, the Constabulary should maintain widespread, ongoing, effective communication of information to promote the benefits and changes of the technology, alongside user demonstrations. As found in the study, it is recommended that the Constabulary tailors the device functionality to particular roles and tasks, rather than adopting a ‘one size fits all’ approach. User acceptance may also be promoted through the publication of usage statistics between different shifts, which may promote an element of competitiveness and highlight ‘non-users’. Local supervision should also be encouraged to place pressure on their officers to make greater use of the technology and spend less time inside their local policing unit for administrative duties. Further focus should be on the users through development of further training packages; findings suggest that these should be scenario based to allow officers to understand how the use of the device fits with their operational role and to familiarise themselves with the devices without the pressured and demanding environment of policing. In addition, the Constabulary should seek to address the technical limitations of their mobile solution, including the provision of an electronic signature, a more reliable network connection, a wireless and illuminated keyboard and a more flexible docking station that can be pivoted towards the driver. Overcoming these
issues may help to move towards a set of more streamlined policing processes. The Constabulary should allow a longer time period for the change in policing processes to occur.

Once the H-TAM has been put into place the Leicestershire Constabulary can focus on managing the impact of mobile technology on knowledge sharing. It is recommended that the Constabulary ensures continued opportunities for face-to-face interaction between officers, through guidelines defined in Chapter six, so that reductions in time spent in stations does not lead to a loss of team spirit and morale, or a reduction in formal and informal exchange of knowledge and intelligence. This might be achieved through the continued use of face-to-face briefings and informal meetings, such as refreshment breaks, and regular use of double-crewing to minimise officer isolation.

Finally, it is recommended that the Constabulary promote data quality and information literacy through a number of measures outlined in Chapter seven. These include the development of controlled vocabularies to aid the entry of data at source and searching of particular information within a mobile and demanding environment. In the research, the screen shots demonstrating the use of controlled vocabularies were well-received amongst police officers. A one-key system should be developed to allow officers to input information into a single system and update all relevant systems in the background, and is discussed further in Section 10.5. The Constabulary should also develop metadata and other data and information standards to provide a common format for recording information and thus promoting data quality levels. Data quality levels within a mobile information environment should be further promoted through agreement of a definition of data quality and introducing metrics, to eliminate the current level of subjectivity regarding accuracy. Metrics could include those outlined in Chapter seven, such data reconciliation cost savings (e.g. labour costs) and performance (e.g. volume of errors). Furthermore, it is recommended that the Constabulary continue with their corporate approach to delivering messages about the importance of data quality in relation to decision-making, and develop a wider marketing campaign to deliver such messages. This might help to resolve conflict between the administrative functions of the Call Management Centre and the Crime Input Bureau, who were resistant in the study towards officers inputting data directly.

All of the recommendations mentioned above could enable the Leicestershire Constabulary to undergo a technological change effectively to allow mobile technology to have an optimal effect of its existing information and knowledge processes.

10.3. Recommendations for the wider policing community

The research within this thesis has largely been specific to the Leicestershire Constabulary; however, recommendations can still be made to other UK police forces and other organisations within the public sector. These organisations may benefit from the practical implications and lessons learned of the findings in this study, in order to manage the cultural change of introducing new information technologies and to improve their information and knowledge environments. It is recommended that UK policing organisations take advantage of the toolkit developed in this study and in particular that they make use of the initial evaluation framework set out in Chapter four. This may work towards ensuring that their chosen solution involves the user in the design and selection process to guarantee that their chosen solution meets user requirements.
UK police forces should then integrate the H-TAM demonstrated in Chapter five in order to promote usage of their implemented mobile solution. In light of the recent significant investment in UK taxpayer revenue into mobile information technologies, promoting user acceptance of the technologies across all UK police forces is important to ensure return on investment. In particular, UK police forces may wish to consider development of scenario-based training, maintaining widespread communication across all levels of their organisation in relation to changes of the technology, encouraging local supervision to enforce usage of the devices, and implementing the project over a longer period of time for the change to occur (as outlined in the previous Section). In addition, they could also take into account leveraging external, social influences including the strong influence of peers via project champions, as found in this study, which may prove beneficial in promoting the benefits of technology via word of mouth to more resistant ‘technophobes’ in their organisation.

In line with the recommendations for the Leicestershire Constabulary, it is also recommended that the wider policing community ensure opportunities for face-to-face informal knowledge sharing, so that a reduction in time spent in a local policing unit as a result of the use of mobile technologies does not lead to a loss of motivation or the valuable exchange of tacit knowledge and intelligence. These could be achieved through measures outlined in Section 10.3.

It is imperative that other police forces provide the facilities to allow effective data entry and information retrieval within a mobile information environment. As outlined in the previous section, to do so it is recommended that other police forces pursue the development of controlled vocabularies and a one-key system. If all of the above recommendations are followed police forces should find improvements in the adoption of new information technologies and a more efficient information and knowledge environment.

10.4. Recommendations for future research

The research has provided a valuable toolkit for practical use within UK police forces, and has been tested within a number of other UK police forces besides the Leicestershire Constabulary. The research offers a significant contribution to the small number of studies exploring the impact of mobile information technologies on an existing policing environment, but there remains the need for further such in-depth studies. The application of the toolkit developed in this study to other UK policing contexts could offer a powerful means of exploring the data obtained from future studies. This could also offer an opportunity to further test the validity of the toolkit within a range of policing contexts.

Alongside the implementation of mobile data terminals within the Leicestershire Constabulary, the next step in the development of the mobile information technologies initiative is the extended implementation of handheld devices to its foot patrol officers. Together with the ability for police officers to access and input crime details from the scene, there will be a new capability for members of the public to report crimes electronically as part of a separate project being undertaken by Loughborough University called SNIPPET (Social Network Initiative for Public/Police EngagementT). Members of the public will be able to report low level crime via the Internet using their mobile phones and a specially adapted Google Map. This may allow operational police officers with more efficient access to incident related information and shorter response times. However, for this project to be a success there needs to be a significant
adoption level of handheld devices. Future research should subsequently apply the findings from the PhD study, in particular with regard to the H-TAM, in order to overcome the barriers to the implementation of handheld devices.

In light of the recommendations made in relation to objective seven of this study to assist with information literacy and data quality within a mobile information environment, future research may wish to develop a controlled vocabulary that can be used within policing information systems. The cost effectiveness of such a technique may then be tested through the use of non-invasive measures, such as the monitoring of levels of data quality with controlled vocabularies compared without the use of such techniques. In addition, future research may also work towards producing an integrated single entry system for use within a mobile information environment. Similar current developments include COPLINK in the US and GENIE in the UK; but these systems do not permit single data entry – rather only information retrieval. Taking into account the introduction of the Police National Database in the UK, this future research is important.

Future studies may also extend the evaluation impact of mobile information technologies on knowledge sharing, as via objective six of this study, by conducting a social network analysis within the Leicestershire Constabulary or other UK police forces. This may assess how informal knowledge networks have changed as a result of the use of mobile information technologies. This is a body of research that has been covered in other sectors but is currently under-researched within the policing sector.

10.5. Conclusions

10.5.1. Contribution of the Research

Research has been slow to identify the opportunities and threats posed by the introduction of mobile information technologies into a complex and dynamic information environment such as policing. Policing organisations can gain from this understanding by addressing the barriers to the effective use of mobile technologies. As the demand for continued improvements in the level of service provided to the public increases, the need to change the face of twenty-first century policing by removing the apparent high levels of bureaucracy will become increasingly important. This has been recognised previously by external bodies, where specific recommendations were made to adopt a leaner approach to policing via the use of mobile technologies in order to free up police time. The 80 million pounds invested into a mobile technology initiative by the UK Government places a responsibility on police forces within England and Wales to realise the benefits of such technologies.

Overall this thesis has managed to develop an implementation toolkit and methodology for practical application across the UK police forces. The results show that the introduction of mobile information technologies is one of the largest changes in UK policing since the introduction of the two-way radio, and the toolkit and methodology can be applied to manage the change upon policing employees and its business processes. The results have led to a much greater understanding of the impact of mobile technologies on existing policing practices and processes. It has also been possible to
build on this understanding in a practical sense by identifying how usage of mobile devices can be improved.

As this study has highlighted factors that have not been addressed elsewhere in the current body of literature in the policing domain, it is believed that the findings make a significant contribution to the understanding of mobile information technologies within the law enforcement arena and possibly the wider public sector context. As explained in this Chapter, the four main contributions of this thesis have been:

- Development of an evaluation framework to select the most appropriate mobile solution;
- Facilitating management of the risks and leveraging the benefits of mobile technology for knowledge sharing;
- Production and validation of a holistic technology acceptance model (H-TAM) across UK police forces;
- Extending the understanding of the opportunities and risks posed by mobile information technologies.

The research in this thesis has made contributions to both academia and the policing arena. From the research findings, two journal papers and two conference papers have been produced, which are detailed at the beginning of this thesis.

Figure 10.6.1 shows the research design, making it possible to see how the PhD all fits together and to identify where the contributions lie (indicated by ‘C’).
Figure 10.6.1: The Research Design and Contributions
10.5.2. Impact of the Research

Whilst the research has been undertaken, it has received interest from the policing community including members of the National Policing Improvement Agency (NPIA) of the UK Home Office. The author was invited by the NPIA to speak about the practical elements of the findings at a policing conference. In addition, the research has also received attention from a number of other UK police forces, which have become interested in applying the implementation toolkit during their development of mobile technology projects. The research has also been highly commended for its value and usefulness by the main collaborator within the Leicestershire Constabulary.

The research outlined in this thesis can help policing organisations similar to the one studied to implement new technologies, particularly mobile information technologies, successfully. The four main research contributions can help policing organisations manage the cultural change that the technology brings and help to address the main barriers, as identified in this study. The use of the toolkit developed in this study can help policing organisations move towards the 21st century of policing, with access to real-time information available within a dynamic information and knowledge environment and ultimately increased visibility and protection to the public.


Arnott, S. Police need more mobile IT. <http://www.computing.co.uk/computing/news/2198497/police-mobile>, 12.09.2007, [accessed 08.11.07].


Bacon, F. Religious meditations of heresies, 1597.


<http://www.bbc.co.uk/leicester/content/articles/2008/08/07/more_bobbies_on_the_beat_feature.shtml>, 08.08.08, [accessed 12.09.08].

BBC News. *Officers take laptops on the beat.*  
<http://news.bbc.co.uk/1/hi/england/leicestershire/7547040.stm>, 07.08.08, [accessed 12.09.08].

BBC News. *Technology has police on the beat.*  
<http://news.bbc.co.uk/1/hi/england/leicestershire/7804847.stm>, 30.12.08, [accessed 06.01.08].


Carvel, J. *What was new in Gordon Brown’s speech?* <http://www.guardian.co.uk/society/2007/sep/24/conferences.uknews>, 24.09.07, [accessed 08.04.08].


Connors, T. Putting the ‘L’ into intelligence-led policing: how police leaders can leverage intelligence capability. *International Journal of Intelligence and Counter-Intelligence*, 2009, 22(2), 237-245.


Enderby Eye. *Police mobile data to deliver 30 per cent more time on the streets.* <http://www.enderbyeye.co.uk/news/news08_130.html>, 10.08.08, [accessed 12.09.08].


Howe, K. R. Against the quantitative-qualitative incompatibility thesis or dogmas die hard. <http://dirwww.colorado.edu/education/faculty/kennethhowe/Docs/Howe_Against_the_Quant_Qual_Incompatibility_Thesis.pdf>, 1988, [accessed 30.10.08].


Leicestershire Constabulary – our purpose. <http://www.leics.police.uk/about/1_our_purpose>, [2007], [accessed 31.01.07].


Nelson, M. R. We have the information you want, but getting it will cost you: being held hostage by information overload. <http://www.acm.org/crossroads/xrds1-1/mnelson.html>, 2004, [accessed 14.02.08].


<http://www.hig.se/~lbn/Kurser/IndorgC/Nonaka_etal_2000_SECI.pdf>, [accessed 29.11.06].


<http://weatherhead.case.edu/pervasive/participants_one.htm>, 01.02.05, [accessed 11.06.08].


Public Technology. *Police get 50 million funding for handheld computers.*  
<http://www.publictechnology.net/modules.php?op=modload&name=News&file=article&sid=15900>, 28.05.08, [accessed 11.06.08].

Public Technology. *Cheshire Police gets mobile data technology to improve front-line policing.*  
<http://www.publictechnology.net/modules.php?op=modload&name=News&file=article&sid=11825>, 03.10.07, [accessed 09.06.08].


RAC. *Breakdown cover, rescue service and roadside assistance by RAC.*  
<http://www.rac.co.uk/web/breakdowncover/>, 2009, [accessed 17.02.09].


Reuters. *Lee County, Florida adopts active warrant alert system to increase justice information sharing.*  
<http://www.reuters.com/article/idUS136792+09-Dec-2008+MW20081209>, 09.12.08, [accessed 07.01.08].


Spiers, G. The psychological contract and the Blackberry wireless communication device: Blackberry – friend or foe? MBA dissertation, Nottingham Trent University, United Kingdom, 2008.


Syson, H. *Knowledge sharing in the UK police service – a research study*, MSc dissertation, Loughborough University, United Kingdom, 2007.


*The Bichard Inquiry*. <http://www.bichardinquery.org.uk/>, [22.06.04], [accessed 16.01.08].


The online TV channel for public service modernisation GBTV. *Mobile tasking system increases productivity for Beds Police.* <http://www.localgov.tv/cgi-bin/details.pl?action=prog&id=248>, n.d., [accessed 08.01.09].

Thomas, J. & Harden, A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 2008, 8(45). Available at: <http://www.biomedcentral.com/1471-2288/8/45>, [accessed 31.10.08].


Yang, K. H., et al. Adoption of information and communication technology: impact of technology types, organisational resources and management style. *Industrial Management and Data Systems*, 2007, 107(9), 1257-1275.


Appendices

Appendix 1 - Literature search strategy and results for cost-benefit analysis of structuring techniques

Aim of search:
- To identify previous research and/or experiments to evaluate the cost-effectiveness of a taxonomy.

Search strategy results:

<table>
<thead>
<tr>
<th>Search term (entered into TITLE field)</th>
<th>Recall (no. of results)</th>
<th>Precision (no. of results)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost effectiveness AND taxonomy</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cost effectiveness AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Value AND taxonomy</td>
<td>54</td>
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</tr>
<tr>
<td>Evaluate AND taxonomy</td>
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<td>0</td>
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<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Evaluating AND use of taxonomy</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Evaluating AND taxonomies</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Evaluate AND taxonomies</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Value AND taxonomies</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Measuring value AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Evaluating value AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cost effectiveness AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cost benefit AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Benefit AND taxonomies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Experiment AND taxonomies</td>
<td>1</td>
<td>0</td>
</tr>
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<td>Effectiveness AND taxonomies</td>
<td>2</td>
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</tr>
<tr>
<td>Effectiveness AND taxonomy</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Assessment AND taxonomy</td>
<td>111</td>
<td>0</td>
</tr>
<tr>
<td>Assessment AND taxonomies</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Performance AND taxonomies</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Measuring AND taxonomies</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cost of taxonomies OR ontologies</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendices

Appendix 2 – Data collection Instruments

Appendix 2a – Focus group questions to identify user requirements for development of an evaluation framework

Leicestershire Constabulary

Mobile Data Project

Focus Group 3.12.07

10:00 Opening by workshop chair [Tom]
   Explain objectives and introduce participants
   Duration: 10 mins

10:10 Session One. Crime Recording Process Mapping
   Duration: 30 mins
   Session leader(s): Rachael & Tom
   Method: Draw process map on flipchart

Begin with showing our understanding of what happens – crime flow chart. Officers draw out their perception of the current crime recording process on a flipchart to assist discussion of how mobile data supports the process.

a. Describe the process that you currently undertake when called out to respond to a crime incident report. Prompts:
   - How do you make a record of the incident?
   - What are the specific steps involved?
   - What paperwork has to be completed?
   - To whom is this record reported?
   - What information systems are involved?
   - How is it entered into your database systems?
   - Who will access this information?
   - How will it be used?
   - How are officers trained in the current crime recording process?
   - What are the key strengths of the current process?
   - Are there perceived problems with the current processes?
   - If so, what – and how widely agreed?
   - How do you determine what other incidents might have taken place that are of relevance?
10:40 Information and knowledge sharing
Duration: 30 mins
Session leader(s): Louise & Remko
Method: Discussion and post-its* to identify difficulties

a. After attending an incident, who do you share information and knowledge with about the incident (either formally or informally)?
b. What kind of information and knowledge do you share, i.e. on which topics?
c. How does this sharing take place (e.g. verbally or by written report), i.e. which channels do you use and in which order?
d. With what frequency do you share this knowledge?
e. How quickly do colleagues respond to knowledge requests, i.e. questions for help/support.
f. What difficulties do you encounter in gaining information and knowledge on relevant incidents?*
g. Would you describe the current culture of the Force as being one that encourages officers to share information and knowledge with each other?*
h. If not, what would need to change to encourage this sharing to take place more often?*
i. Are there already some kind of communities that have formed around these topics?
j. Do you expect that the mobile data technologies will impact – either positively or negatively - on the importance of personal contacts to get the required knowledge?

11:10 Session Two. Current experience with mobile data technologies
Duration: 30 mins
Session leader(s): Rachael & Tom
Method: Discussion and post-its* to identify experiences

a. What mobile technologies are you currently using?
b. For what purpose and in what circumstances are they used?
c. How often do you use these mobile technologies?
d. What problems have you encountered in using such equipment (e.g. performance/reliability)?*
e. What do you think of the relevance, quality and reliability of data in these systems?*
f. What advantages have you found from their use?*
g. What would make their use more effective or more user-friendly?*
h. Has there been an impact on the data capture process?
   • If so, what: - positives/ negatives?
i. What would you do differently or would you change when initiating the use of mobile data technology in future?
11:40 Future roll-out

Duration: 30 mins
Session leader(s): Wendy
Method: Discussion and post-its to identify potential barriers

a. What other processes do you think could benefit from their use?
b. What are general attitudes to new technology?
   • Is there much variation (i.e. is there a particular ‘culture’ or is it down to individuals?)
c. How receptive do you think other personnel are to the use of mobile data technologies to assist them in their work?
d. What expectations are/were there about the mobile devices?
e. How are officers to be made aware of mobile data changes?
f. What training has been provided for current mobile data units and what was the duration of this training?
g. What problems would you anticipate in rolling out these technologies to crime investigation personnel across the Force?
h. How would you suggest that these problems could best be minimised or overcome?
i. What changes to current crime investigation and reporting processes and procedures would you anticipate being necessary in order for mobile data to be used effectively in these areas?
Appendix 2b - Questionnaire used within two-week pilot study

Mobile Information Technologies Pilot Evaluation Study
Post-Trial Questionnaire

Please complete the following questions. The questions are to determine your perception of using a mobile data terminal so please be open and honest.

1. Please record your name:

2. What is your collar number?

3. What is your gender?
   - [ ] Male
   - [ ] Female

4. What is your age? (Please select from one of the following categories):
   - [ ] 18-24
   - [ ] 25-34
   - [ ] 35-44
   - [ ] 45-54
   - [ ] 55-64
   - [ ] 65+
<table>
<thead>
<tr>
<th>5. What is your job position?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Police officer</td>
</tr>
<tr>
<td>□ Sergeant</td>
</tr>
<tr>
<td>□ Inspector</td>
</tr>
<tr>
<td>□ Chief Inspector</td>
</tr>
<tr>
<td>□ Superintendent</td>
</tr>
<tr>
<td>□ Chief Superintendent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Approximately how many years of policing experience do you hold?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ 0-1 year</td>
</tr>
<tr>
<td>□ 2-5 years</td>
</tr>
<tr>
<td>□ 6-10 years</td>
</tr>
<tr>
<td>□ 11-15 years</td>
</tr>
<tr>
<td>□ 16-20 years</td>
</tr>
<tr>
<td>□ 21-25 years</td>
</tr>
<tr>
<td>□ 26+ years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. From the following options, how would you describe your overall computer competence?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Very proficient (I can use a computer well and could teach my peers)</td>
</tr>
<tr>
<td>□ Proficient (I use a computer all the time and know most of its features)</td>
</tr>
<tr>
<td>□ Average (I use a computer sometimes, but only for basic tasks)</td>
</tr>
<tr>
<td>□ Below average (I have little knowledge of how to use a computer)</td>
</tr>
<tr>
<td>□ Non-user (I do not know how to use a computer)</td>
</tr>
</tbody>
</table>
Please rate your agreement with the following statements...

<table>
<thead>
<tr>
<th>Q</th>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>A mobile data terminal enhanced my job satisfaction.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A mobile data terminal helped me to be more productive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>A mobile data terminal was easy to use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I learnt to use a mobile data terminal quickly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Options</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 12. I found using a mobile data terminal was enjoyable                  | □ Strongly agree  
□ Agree  
□ Disagree  
□ Strongly disagree |
| 13. A mobile data terminal was easy to use in houses, properties, etc.  | □ Strongly agree  
□ Agree  
□ Disagree  
□ Strongly disagree |
| 14. I used a mobile data terminal...                                   | □ For the majority of the shift  
□ A few times per shift  
□ Once per shift  
□ Never |
| 15. The perception of the attitude amongst my colleagues towards       | □ Mostly positive  
□ Mostly neutral  
□ Mostly negative |
| mobile data terminals was...                                           |                                                                         |
16. I used the following applications on the mobile data terminals frequently: (Please select all that apply)

- [ ] CIS
- [ ] OIS
- [ ] Intranet
- [ ] Email
- [ ] Other: (Please specify)

17. Having a mobile data terminal caused the number of crime reports I complete per shift to...

- [ ] Increase
- [ ] Stay the same
- [ ] Decrease

18. A mobile data terminal allowed me to submit reports in a timely manner.

- [ ] Strongly agree
- [ ] Agree
- [ ] Disagree
- [ ] Strongly disagree

19. A mobile data terminal is provided information I needed when I responded to calls for service.

- [ ] Strongly agree
- [ ] Agree
- [ ] Disagree
- [ ] Strongly disagree
20. Having a mobile data terminal caused the amount of time I spend using the radio to:

- [ ] Increase
- [ ] Stay the same
- [ ] Decrease

21. During the pilot, I mostly communicated information to other officers via: (Please select one option)

- [ ] Face-to-face
- [ ] Radio
- [ ] Email
- [ ] Force information systems

22. In what situations was a mobile data terminal most useful? (Please write your thoughts in the space provided)

23. I am likely to adopt a mobile data terminal for conducting my daily tasks.

- [ ] Strongly agree
- [ ] Agree
- [ ] Disagree
- [ ] Strongly disagree
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. I would mind if the organisation took away my mobile data terminal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. I think a mobile data terminal should be rolled out across the Force.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for your feedback and kind cooperation.
Appendix 2c - Focus group questions used in the Pilot Evaluation Study

Aims of Focus Group
- Identify risks and potential benefits
- Determine Impact of MDTs
- Prepare for the trial

Question 1: Impact on Work Practice
What situations and processes might MDTs enhance current work practices?

Question 2: Organisational Support
a) What do you think of existing support and training for MDTs?

b) What would you consider an appropriate level support and training during the trial?

c) Do you have any concerns about training?

Question 3: Usage and System Requirements
a) What applications do you expect to use with the MDT?

b) How confident would you feel about using the applications in a variety of situations?

Question 4
Perceived benefits and risks
Appendix 2d - Interview questions used in the Pilot Evaluation Study

**Aim of interview:** To assess the impact of MDTs on operational and business processes.

**Interview participants:** Staff including section sergeants, Inspectors, and staff from the Control Unit.

**Questions:**

1. How has the pilot enhanced or hindered your existing work practices?

2. In what situations and for what processes have mobile data terminals enhanced or hindered current work practices?

3. What do you perceive to be the risks of mobile data terminals?

4. What do you perceive to be the benefits of mobile data terminals?

5. Would you like to see any changes in the way MDTs are being used?

6. Are there any specific issues or lessons learnt that you feel should be captured for the wider MDT roll-out?
## Mobile Data Terminals: Work shadowing Exercise

### Observations Data Collection Sheet

For each incident please record the following:

<table>
<thead>
<tr>
<th>Officer collar number</th>
<th>Incident start time</th>
<th>Shift</th>
<th>Start mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call-sign: 41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incident finish time</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Type of incident:

**Duration**

**Comments**

### MDT Usage

<table>
<thead>
<tr>
<th>Officer collar number</th>
<th>Incident start time</th>
<th>Shift</th>
<th>Start mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call-sign: 41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incident finish time</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### a. What is the predominant location of officer for the incident?

- In car
- On foot
- In premises
- In station
- Other

Please specify: ____________________________

#### b. How is the MDT used for this incident?

(e.g. recording incident details from victim)

#### c. Which communication and recording instruments were used for this incident? What was the purpose of using these instruments?

- Radio
- Laptop
- Notebook
- Forms

Please specify: ____________________________

**Purpose:**

#### d. If the radio was used for this incident, what was the purpose of using the radio?*

*Enter duration of radio usage in 'Duration' column.*

- To request additional info
- To request to update details
- To request third party to input info
- To communicate with dispatcher

Other: ____________________________

*Please specify:* ____________________________

---

---
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. Did the officer have to return to the station for this incident?</td>
<td></td>
</tr>
<tr>
<td>(If yes please record duration* officer was in station and answer question f)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N ☐ Y ☐ (Record duration in ‘Duration’ column)</td>
</tr>
<tr>
<td>f. Purpose of returning to station?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arrest ☐ Break ☐ Administrative ☐ Failed Equipment ☐ Other ☐ <strong>Please specify:</strong></td>
</tr>
<tr>
<td></td>
<td>………………………………………………………………………………………..</td>
</tr>
<tr>
<td>g. Was the officer interrupted?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N ☐ Y ☐ Why Officer was Interrupted:</td>
</tr>
<tr>
<td></td>
<td>………………………………………………………………………………………..</td>
</tr>
<tr>
<td><strong>IT Systems</strong></td>
<td></td>
</tr>
<tr>
<td>a. How were the incident details recorded?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manually ☐ Electronically ☐ Both ☐</td>
</tr>
<tr>
<td>b. Which IT systems used for this incident? <strong>Please record OIS/CIS number</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CIS ☐ OIS ☐ Intranet ☐ Other ☐ <strong>Please specify:</strong></td>
</tr>
<tr>
<td></td>
<td>OIS number: ………………………. CIS number: ……………………….</td>
</tr>
<tr>
<td>c. How long did it take to record incident information onto systems?*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any issues arising with recording information electronically:</td>
</tr>
<tr>
<td>d. Location of where details recorded?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With victim/ witness/ suspect ☐ In car ☐ At station ☐ Other ☐ <strong>Please specify:</strong></td>
</tr>
<tr>
<td></td>
<td>If with victim/ witness/ suspect did they appear to be: Positive about the use of the technology ☐ Neutral/ unable to gauge ☐ Hostile/ critical of the use of the technology ☐</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td></td>
</tr>
<tr>
<td>a. Were there any issues arising with the technical reliability of the equipment?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N ☐ Y ☐ (Please describe the issue arising)</td>
</tr>
<tr>
<td>b. Were there any issues arising with the retrieval of information or access to relevant systems?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N ☐ Y ☐ (Please describe the issue arising)</td>
</tr>
<tr>
<td>c. Were there any issues regarding Security (e.g. safety of device, unauthorised viewing of data etc)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N ☐ Y ☐ (Please describe the issue arising)</td>
</tr>
<tr>
<td>Section</td>
<td>Response</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>e. Were there any issues regarding the overall usability of the device?</td>
<td>N  □  Y  □ (Please describe the issue arising)</td>
</tr>
<tr>
<td><strong>At the END of the incident:</strong></td>
<td></td>
</tr>
<tr>
<td>a. The device made the Officer's task easier</td>
<td>Please rate agreement with the statement in relation to the incident:</td>
</tr>
<tr>
<td></td>
<td>Strongly agree  □  Agree  □  Disagree  □  Strongly disagree  □</td>
</tr>
<tr>
<td>b. The device made the officer's work more effective</td>
<td>Please rate agreement with the statement in relation to the incident:</td>
</tr>
<tr>
<td></td>
<td>Strongly agree  □  Agree  □  Disagree  □  Strongly disagree  □</td>
</tr>
<tr>
<td>c. The device caused the time spent on data access and to input to...</td>
<td>Increase  □  Stay the same  □  Decrease  □</td>
</tr>
<tr>
<td>d. The device increased the Officer's overall job satisfaction during the course of the incident</td>
<td>Please rate agreement with the statement in relation to the incident:</td>
</tr>
<tr>
<td></td>
<td>Strongly agree  □  Agree  □  Disagree  □  Strongly disagree  □</td>
</tr>
<tr>
<td>e. What problems (if any) did the Officer experience as a result of using the device during this incident?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>f. What would you change/ do differently (if any)?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>g. What else would have helped?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>h. Any additional observations/comments</td>
<td>Record comments here:</td>
</tr>
<tr>
<td><strong>At the END of the shift:</strong></td>
<td></td>
</tr>
<tr>
<td>a. Recorded vehicle mileage per shift (recorded in Vehicle logbook)</td>
<td>Start mileage:</td>
</tr>
<tr>
<td></td>
<td>Finish mileage:</td>
</tr>
<tr>
<td>b. The device made the Officer's task easier</td>
<td>Please rate agreement with the statement in relation to the shift: Strongly agree □ Agree □ Disagree □ Strongly disagree □</td>
</tr>
<tr>
<td>c. The device made the officer's work more effective</td>
<td>Please rate agreement with the statement in relation to the shift: Strongly agree □ Agree □ Disagree □ Strongly disagree □</td>
</tr>
<tr>
<td>d. The device caused the time spent on data access and to input to...</td>
<td>Increase □ Stay the same □ Decrease □</td>
</tr>
<tr>
<td>e. The device increased the Officer's overall job satisfaction during the course of the incident</td>
<td>Please rate agreement with the statement in relation to the shift: Strongly agree □ Agree □ Disagree □ Strongly disagree □</td>
</tr>
<tr>
<td>f. The Officer feels satisfied with the use of the device</td>
<td>Please rate agreement with the statement in relation to the shift: Strongly agree □ Agree □ Disagree □ Strongly disagree □</td>
</tr>
<tr>
<td>g. What problems (if any) did the Officer experience as a result of using the device during the shift?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>h. With regards to the device what would you change/ do differently (if any)?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>i. How else could this technology be used?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>j. What else would have helped?</td>
<td>Record comments here:</td>
</tr>
<tr>
<td>k. Any additional observations/ comments</td>
<td>Record comments here:</td>
</tr>
</tbody>
</table>
Appendices

Appendix 2f - Questionnaire used for later evaluation into the impact of mobile technology on information literacy and knowledge sharing

Objectives of research:
1. To determine the different strategies used for data input
2. To investigate search strategies employed by police officers
3. To establish the perceived level of information literacy amongst police officers
4. To make recommendations to improve and assist with information literacy issues amongst operational police officers
5. To recognise the implications of mobile technology on perceived information literacy skills of police officers

MDT Questionnaire: The Impact of Mobile Technology

Structured Questions

Please complete the questionnaire by filling in the bubbles like this □ (don’t tick, dash or make a cross) – the data is to be captured via scanner, so your kind co-operation will guarantee accurate data for the analysis of results.

Section 1: General experience: Information searching
1. On average, how often per day do you search for general information using a computer? (Objective 2)

□ 0-5 times per day □ 21-25 times per day
□ 6-10 times per day □ 26-30 times per day
□ 11-15 times per day □ 30+ times per day
□ 16-20 times per day

This question allows comparison with further answers from those who use search engines all the time against those who are rare users. The question also establishes whether police officers are more or less prolific in searching for information than the average user. The Telegraph reports that the average person searches Google 68 times per day.
2. How often do you use the following search engines? (Mark one option per search engine)  
(Objective 2)

<table>
<thead>
<tr>
<th>Search Engine</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Six-monthly</th>
<th>Yearly</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altavista</td>
<td>☐</td>
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<td>☐</td>
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<td>Ask Jeeves</td>
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<tr>
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<tr>
<td>Kartoo</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
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<td>☐</td>
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<tr>
<td>Answers</td>
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<td>☐</td>
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</tbody>
</table>

Other (please state): ☐ ☐ ☐ ☐ ☐ ☐

This question provides useful data showing not only how often users use the major search engines, but also if they have ever used the less known alternative engines such as Kartoo and Answers. The most frequently used search engine may indicate the preferred way of searching e.g. Kartoo displays information in a visual format whereas Google displays information in a text format.

3. Roughly what percentage of the time do you find what you are looking for on the first search you run? (Objective 2)

☐ 0%
☐ 25%
☐ 50%
☐ 75%
☐ 100%

This question coupled with the previous question can give an idea of how successful a user finds a particular style of search engine. For example, if a user always used Google and had a 100 per cent success rate then that is a style of searching that works well for that type of user.
4. On average how many keywords do you use to search? A keyword is a word entered into a search engine in an effort to get the search engine to return matching and relevant results. (Objective 2)

- 1
- 2
- 3
- 4
- 5+

5. Do you make use of advanced search tools when searching for information? This screenshot gives an example of an advanced search tool within the Google search engine. (Objective 2)

- Yes
- No
- Sometimes

Research indicates that the majority of users enter three or less keywords and often only two (Jansen, B. J., et al 2000 'real life, real users, and real needs: a study and analyses of user queries on
Appendices

the web’, Information Processing & Management, 36(2), 207-227) and fewer than ten per cent of queries use Boolean operators to optimise their search (Nancy, C. M, n.d. ‘end user searching on the Internet: an analysis of term pair topics submitted to the Exite search engine). This makes it harder for search engines to narrow down results. This question allows an indication of respondents’ information literacy, and may provide added value over existing research into information literacy within policing which generally asks officers to rate their abilities (e.g. Al-Daihani, 2007).

Section 2: Workplace experience: Information input and searching

6. Do you find that writing free text is a problem when inputting information into information systems?

☐ All of the time
☐ Some of the time
☐ Never

This question may provide insight into difficulties encountered when entering information. If officers find it difficult to input information, this may also make it difficult to retrieve that information (data quality issues etc). This question precedes the following question.

7. Would you prefer to have a more automated approach to searching and input? (e.g. a predictive text mechanism, such as that used for texting, which provides possible selections relevant to your search and input?) (Objective 4)

☐ Yes
☐ No
☐ Unsure

A taxonomy or subject thesaurus can assist with data input and information searching. This question will see how users feel about this, which may lead towards recommendations.

8. On average, how often are the results accurate from a single search? (Objectives 2 & 3)

☐ All of the time
☐ Some of the time
☐ Never

This question indicates the level of information overload evident in policing and whether an officer has to dig through pages of links that came out of their initial search, which suggests their approach to searching is not optimal. If an officer has a high number of irrelevant search results, this could be at the detriment of the quality of policing when mobile technology is introduced and the responsibility for retrieving relevant information is taken away from the call management centre and given to officers.
9. If you are going to a new address and unfamiliar with the area would you prefer to: (Objective 2)

- [ ] Ask a colleague for directions
- [ ] Ask a member of the public for directions
- [ ] Look at a paper map
- [ ] Look at a computer generated map

This question may provide indication as to how officers prefer to search for information i.e. whether they prefer to use people as the main source of information or written sources; with mobile technology possibly removing communication intermediaries this question may address officer preference and concerns about becoming more reliant on technology than people (less tacit knowledge exchange). The question also, according to psychology papers, will establish if the officer is left or right-brain oriented. There is research that demonstrates the way left brain and right brain people search for information. The outcomes may answer the second objective of the paper and lead towards recommendations for creating an optimal search engine for police officers.

10. Do you find you get a large number of irrelevant results when you search? (Objectives 2 & 3)

- [ ] All of the time
- [ ] Some of the time
- [ ] Never

This question indicates the level of information overload evident in policing and whether an officer has to dig through pages of links that came out of their initial search, which suggests their approach to searching is not optimal. If an officer has a high number of irrelevant search results, this could be at the detriment of the quality of policing when mobile technology is introduced and the responsibility for retrieving relevant information is taken away from the call management centre and given to officers.

11. On average, when you need a single piece of information, how long did you spend looking for this information before turning to mobile technology? (Objective 5)

- [ ] 1 to 5 minutes
- [ ] 6 to 15 minutes
- [ ] 16 to 30 minutes
- [ ] 31 to 45 minutes
- [ ] 46 to 60 minutes
- [ ] Over an hour
- [ ] Other (please state)
12. On average, when you need a single piece of information, how long do you spend looking for information using mobile technology? (Objective 5).

- ☐ 1 to 5 minutes  ☐ 46 to 60 minutes
- ☐ 6 to 15 minutes  ☐ Over an hour
- ☐ 16 to 30 minutes  ☐ Other (please state)
- ☐ 31 to 45 minutes

Comparison of answers from these two questions may indicate the actual or perceived impact of information literacy on the quality of policing; the advent of mobile technology may mean that officers have to depend more on their own ability to retrieve information and if they spend more time looking for information this could leave less time to provide a service to the public.

13. Mobile technology has improved the quantity of information available. (Objectives 3 & 5)

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

This question may provide indication of any apparent information overload evident within policing, which may have implications on the quality of policing. Findings of this question can be compared with that of Allen & Shoard (2005).

14. My ability to employ an effective search strategy is

- ☐ Excellent
- ☐ Good
- ☐ Average
- ☐ Poor
- ☐ Very poor

This question is taken from Al-Daihani (2007) and provides indication of subjective information literacy amongst officers.
15. Mobile technology has improved the quality of information available? (i.e. all necessary information is available, all necessary fields have been completed, details entered correctly). (Objectives 3 & 5)

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

This question may indicate whether mobile technology is allowing officers to access better information than before CMC used to provide information to officers.

16. How has mobile technology made the task of searching for information? (Objectives 3 & 5)

☐ Easier
☐ The same
☐ More difficult

This question indicates how mobile technology may be magnifying the need for information literacy skills within policing

17. I can adequately find the information I need when using an information system or database (Objectives 2 & 3)

☐ All of the time
☐ Most of the time
☐ Half of the time
☐ A small amount of the time
☐ Never

This question indicates the average level of information literacy amongst East Midlands police officers.
18. The Constabulary’s computer technology and databases allows officers to easily and effectively sort, select and count records. (Objectives 3, 4 & 5)

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

This question is adapted from Brown and Brudney (2003) and intends to indicate whether the design of systems are user friendly in retrieving information, with regard to systems being used via mobile technology in intense and pressuring situations.

19. I usually consult a colleague before searching (Objectives 2 & 5)

☐ All of the time
☐ Most of the time
☐ Half of the time
☐ A small amount of the time
☐ Never

This question may suggest whether an officer needs help to find information.

20. There is a manageable amount of information which I have to deal with on a daily basis (Objective 3)

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree
21. Did you have any training into how to input information into the following electronic sources? Please mark the appropriate number for EACH ANSWER to the following (Objective 4)

<table>
<thead>
<tr>
<th>Electronic source</th>
<th>Training provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No training</td>
</tr>
<tr>
<td>Databases &amp; information systems</td>
<td>1</td>
</tr>
<tr>
<td>Internet websites</td>
<td>1</td>
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<tr>
<td>Intranet</td>
<td>1</td>
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<tr>
<td>Intelligence reports</td>
<td>1</td>
</tr>
</tbody>
</table>

22. Did you have any training into how to effectively search for information within the following electronic sources? Please mark the appropriate number for EACH ANSWER to the following (Objective 4) (These two questions are adapted from Al-Daihani, 'Information Behaviour of Kuwaiti legal professionals, PhD thesis, 2003, p. 269).

<table>
<thead>
<tr>
<th>Electronic source</th>
<th>Training provided</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No training</td>
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<tr>
<td>Databases &amp; information systems</td>
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<tr>
<td>Internet websites</td>
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<tr>
<td>Intranet</td>
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</tr>
<tr>
<td>Intelligence reports</td>
<td>1</td>
</tr>
</tbody>
</table>

23. If you have received training, how long was the total duration of this training? (Objective 4)

- 0-1 hours
- 2-5 hours
- 6-10 hours
- 11-15 hours
- 16-20 hours
- Over 20 hours
- N/A
24. What do you think about the quality of training provided in searching for information? (Objective 4)

☐ Excellent ☐ Poor
☐ Good ☐ Very poor
☐ Average ☐ N/A

25. If you did receive training, how recent was this training?

<table>
<thead>
<tr>
<th>Electronic source</th>
<th>Training provided</th>
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<tbody>
<tr>
<td></td>
<td>Less than a year ago</td>
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<tr>
<td>Databases &amp; information systems</td>
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<td>Internet websites</td>
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<td>Intranet</td>
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<tr>
<td>Intelligence reports</td>
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</tbody>
</table>

*These questions will provide an indication towards the training given in searching for information and whether UK police forces are providing adequate training with the light of mobile technology placing greater emphasis on officers’ ability to retrieve records.*
26. With mobile technology, I utilise the following media to access information:

<table>
<thead>
<tr>
<th>Communication medium</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Six-monthly</th>
<th>Yearly</th>
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<tr>
<td>Official circulars and memos</td>
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<td>Mass media (newspapers, TV etc)</td>
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<td>Face to face meetings</td>
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<td>Training activities</td>
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<td>Departmental files and guidelines</td>
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<td>Internet websites</td>
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</tbody>
</table>
27. **Before** mobile technology, I utilised the following media to access information: (Objectives 3 & 5)

<table>
<thead>
<tr>
<th>Communication medium</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Six-monthly</th>
<th>Yearly</th>
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<td>Official circulars and memos</td>
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<tr>
<td>Mass media (newspapers, TV etc)</td>
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Comparison of answers from these two questions may indicate the significance of face-to-face knowledge sharing and why opportunities for tacit knowledge sharing should not be removed, especially if information literacy is low, and safety issues as officers may not capture salient information over radio whilst performing duties.
28. Of all the communication mediums listed in the previous two questions, what are the **three** most important source of information that you cannot do without? (Objectives 2 & 5)

Please select the three most important options by marking one option from each column.

<table>
<thead>
<tr>
<th>Sources of information</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official circulars and memos</td>
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<td>Mass media (newspapers, TV etc)</td>
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<td>Telephone</td>
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<tr>
<td>Colleagues</td>
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</tbody>
</table>
Questions 29 to 32 are adapted from Glomseth et al (2007) to provide an assessment of the organisational culture and barriers to knowledge sharing within policing for a separate paper but felt that a single questionnaire should be sent to officers to prevent them from becoming intolerant of being surveyed.

Section 3: Demographic Information

33. What is your gender?
   □ Male
   □ Female

34. What is your job position?
   □ Police officer  □ Sergeant
   □ Inspector      □ Chief Inspector
   □ Superintendent □ Chief superintendent

35. Approximately how many years of policing experience do you hold?
   □ 0-1 year  □ 16-20 years
   □ 2-5 years  □ 21-25 years
   □ 6-10 years □ 26+ years
   □ 11-15 years
36. Are you currently using mobile technology?

☐ Yes  
☐ No

37. If yes, what type of mobile technology are you using?

☐ Mobile data terminal (MDT)  
☐ Handheld device (e.g. Blackberry or PDA)  
☐ Other (please state):

Thank you for completing this questionnaire – your input is valuable to the outcome of this research!

Sources of questions

Questions 1 – 5 & 8-10: adapted from Pegram, J. final year project – ‘researching and developing an optimised search tool for the world wide web’, 2006.

Questions 6-7 & 11-13 & 15-17: From question brainstorm session

Question 14: From Al-Daihani (2007) paper


Question 20: from Hugh Syson MSc dissertation (2007)


Questions 19 & 28: Adapted from Tedmori (2007) paper

Questions 29–32: Adapted from Glomseth et al. (2007) paper


Questions 23-25: From question brainstorm session

Questions 33-37: From question brainstorm session
Appendix 2g - Expert verbal reasoning exercise

Data collection instrument
- Researching how officers search for information and their thought processes when you search for information on the police information systems.
- When you search for a particular piece of information, please can you think aloud constantly and not censor your thoughts.
- May have done something similar in advanced driving
- Do not worry about grammar or talking in complete sentences or swearing etc.
- Not evaluating the officer

The research is for recommendations that will help improve searching, especially since MDTs have removed the CMC to provide relevant info.

Number of search terms used:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
</tr>
</thead>
</table>

2. Does the officer make use of advanced search features?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Sometimes</th>
</tr>
</thead>
</table>

3. How long does it take to successfully search for a piece of information?

<table>
<thead>
<tr>
<th>0-1 minute</th>
<th>2-3 minutes</th>
<th>4-5 minutes</th>
<th>6-10 minutes</th>
<th>11-15 minutes</th>
<th>16-30 minutes</th>
</tr>
</thead>
</table>

4. Is what was retrieved what they were looking for? Yes ☐ No ☐

Record the officer’s thoughts and general observations:
Appendix 2h - Questions used in the wider evaluation focus groups

Question 1: In-property use
   a) Do you use MDTs in properties?
   b) If not, why not?

Question 2: Information and Knowledge sharing
   a) After attending an incident, what kind of information and knowledge do you share about the incident?
      e.g. lessons learned, rules of thumb, anomalies, problems, methods, tips, history
   b) In what way do you share this information?
      e.g. memos/ reports, presentation, database, meetings, mailing list, water cooler conversations, shift briefings, discussion forums, over lunch, after work
   c) Has mobile technology impacted on f2f interaction?
   d) Has mobile technology impacted on isolation? If so, how?
   e) What do you feel is the main barrier to knowledge sharing?

Question 3: Impact of MDTs on searching for information
   a) Has mobile technology impacted on your effectiveness in searching for information? If so, how?
   b) Do you have any suggestions that you would like to see to improve the searching for information within databases, both with and without the use of mobile technology?
Appendix 2i - Interview framework for mobile technology project managers of organisations recognised for their mobilisation abilities

Research into mobile technology beyond the Police Force

Rachael Lindsay, PhD student Loughborough University/ Leicestershire Constabulary (r.e.lindsay@lboro.ac.uk Rachael.lindsay@leicestershire.pnn.police.uk)

Introduction
1) Introductions and roles
2) Briefly discuss your background and research
3) Objectives of the interview:
   i  To investigate British Gas’s use of mobile technology
   ii  To investigate the associated benefits and risks of mobile technology within British Gas.
   iii To investigate the impact of mobile technology on knowledge sharing amongst field workers within British Gas
   iv  To investigate how British Gas has increased usage of mobile technology in and out of vehicles
   v  To identify best practice and lessons learnt beyond the Police Service

Questions
1. What mobile technology is in use in British Gas?
2. What tasks is mobile technology used for in British Gas?
3. What do you think are the benefits to using mobile technology?
4. What do you think are the risks to using mobile technology?
5. How is information and knowledge (e.g. customer information, information about your work) shared between field workers/ technicians?
6. What impact has mobile technology had on the sharing of knowledge and information between field workers/ service technicians?
7. What opportunities are there for field workers/ service technicians to share knowledge face to face?
8. What impact has mobile technology had on information retrieval skills of field workers/ service technicians (i.e. how they access and input information rather than relying on a control desk)?
9. How was the change process of introducing new technology managed?

10. What do you think is the most important lesson learnt from British Gas's experience with mobile technology?
Appendix 2j - Interview framework with senior officers

Research into information literacy and data quality
Chief Inspector Ops meeting
Tuesday 6th January 2009, 10am. F2F interview.

Leicestershire Constabulary personnel in attendance:
Ch. Insp. Mark Newcombe of the Operations department
Ch. Insp. Jim Hollyoak of the South area
Ch. Insp. Alastair Roe of the North area
Ch. Insp. Steve Potter of the CMC department.

Introduction
1) Introductions and roles

2) Briefly discuss your background and research
   - Have recently conducted a series of focus groups with operational officers to evaluate impact of mobile technology. I am seeking to balance views of operational officers with those of senior officers to gain a broader picture.
   - Research evidence and findings from the evaluation project highlighted the importance of knowledge sharing, information literacy skills and attention to data quality issues as the force moves towards a mobile information environment.

3) Objectives of the interview:
   i) To investigate the associated benefits and risks of mobile technology
   ii) To investigate the impact of mobile technology on knowledge sharing amongst officers
   iii) To recognise the implications of mobile technology on perceived information literacy skills of police officers
   iv) To gain a wider understanding of the implications of mobile technology on data quality in the Constabulary
   v) To relate these findings to policing performance (e.g. increased accuracy of information, more time to attend other incidents, greater public confidence due to greater accuracy and timeliness of information and increased visibility).

Questions
1. What do you think are the benefits to using mobile technology?
2. What do you think are the risks to using mobile technology? What impact has mobile technology had on the sharing of knowledge and information between officers?
3. What impact has mobile technology had on information retrieval skills of officers (i.e. how they access and input information rather than relying on a control desk)?

4. Has mobile technology increased the quantity of information available? (Strongly agree, agree, neutral, disagree, strongly disagree)

5. What do you feel is the ability of officers to employ an effective search strategy? (Excellent, good, average, poor, very poor)

6. How has mobile technology made the task of searching for information for officers? (Easier, the same, more difficult)

7. What impact do you feel mobile technology has had on data quality?

8. How have officers adjusted to the new technology?

9. What do you feel is the main barrier to knowledge sharing?
Appendix 2k – Interview framework for data quality managers

Paul Hooseman, MOPI Manager, Fri 5th June 11.30am

Sample: Members of the MOPI team (Paul Hooseman), and those responsible for managing data quality (snowball sample)

Research question:
Why is the level of data quality within the Leicestershire Constabulary different to other Forces? (NB – need evidence to back this up – does not have to be figures, can be anecdotal)

Interview objectives:
• To investigate the perceptions of data quality (may need more awareness on the importance of data quality)
• To understand why IT staff, police officers and those responsible for monitoring data quality think it is good/ poor
• To investigate the usability of information systems with regard to input and retrieval of information
• To identify the level of training provided into inputting information into systems
• To identify the nature and structure of systems
• To identify lessons learned from forces that have good data quality levels, what they do differently
• To produce recommendations to that will work towards improving the level of data quality

Aim of research:
• To map the data quality process within the Leicestershire Constabulary

Objectives of research:
• Identify the level of data quality in relation to other forces within the East Midlands
• Understand how data quality is measured within the Constabulary and what measures are used
• Identify who is responsible for maintaining different aspects of data quality
• Investigate what is done to maintain data quality levels
• Identify what processes are in place to monitor data inputted into information systems within the Constabulary

The data quality process
1. What statistics are produced to assess data quality?
2. What does the term ‘data quality’ within the Leicestershire Constabulary mean to you?
3. Can you provide any examples to illustrate how you perceive data quality?
4. What processes are in place to monitor the quality of data inputted into information systems within the Constabulary?
5. How effective do you think these processes are?
Appendices

6. What is the current level of data quality within the Constabulary compared to other East Midlands forces?
7. Why do you think it is the level it is?
8. What is the importance of monitoring data quality?
9. What measures are in place to determine the level of data quality?
10. How is data quality measured?
11. What impact has mobile technology had on the level of data quality?

System interoperability and architecture

12. How long is data stored for?
13. Who is responsible for reviewing data storage?
14. What data and information standards (e.g. metadata) are currently in place for commonly used information systems?
15. Do these standards include common architectures for the various documents used for data capture? I.e. is the crime recording form used in the Leicestershire Constabulary the same as the one used in the Kent Constabulary?
16. What data and information standards (e.g. metadata) will be in place in future for commonly used information systems?
17. How old are the commonly used information systems?
18. What is the age of data held within commonly used information systems?

Perceptions/awareness of data quality and training

19. What level of awareness about data quality amongst police officers is there?
20. What training is provided into inputting accurate information and gaining output from commonly used information systems?
21. What do you think about this level of training?
22. What would you like to be done to further the level of data quality?

Further contacts

23. Can you suggest any Forces that have a particularly good level of data quality?
24. Any other contacts to suggest to research areas further? (A group of officers to speak to re input of info and their perceptions of data quality. Snowball sample for data quality managers).
Appendix 2I – The informal open interviewing exercise used with officers

Informal open interview exercise

Introduction: My name is Rachael Lindsay and I am working as part of the mobile information team within the Leicestershire Constabulary. I am also a researcher from Loughborough University, which enables me to take an objective view towards the mobile information project. For this exercise, I am studying the use of mobile technology through the use of stories. The stories offer an opportunity for officers to voice their experiences and feedback to the project team, leading to practical recommendations to improve the use of mobile technologies. All comments will be kept anonymous, so please feel free to tell anything you feel is relevant. This is intended to be an open and informal session. There are five prompts for the exercise.

Questions:
1. Can you recall any incident that was widely discussed among yourself and your colleagues with regard to the use of mobile technology?
2. Do you have any interesting stories about the use of mobile technology?
3. Are there any other incidents or events, not necessarily involving mobile technology, that were widely discussed?
4. Do you have any interesting stories about knowledge sharing within the Constabulary?
5. Can you recall an incident regarding mobile technology and/or knowledge sharing that made you laugh/ concerned/ sad/ proud/ angry etc?
Appendix 3 – Thematic grids used for analysis of qualitative focus group data within Chapter Six
### Appendix 3a – Thematic grid for mobile information and knowledge sharing

<table>
<thead>
<tr>
<th>Theme/Case</th>
<th>Inputting information</th>
<th>Accessing information</th>
<th>Sharing information</th>
<th>Locating expertise</th>
<th>Suggestions to improve mobile knowledge sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus Group 1</strong></td>
<td>- Input intelligence there and then, more real-time information, less tendency to forget information, updating information there and then is better way of getting information shared around.</td>
<td>- Check emails and Intranet whilst out and about&lt;br&gt;- Complete checks there and then&lt;br&gt;- Do not have to wait three to four days for a crime report to be available on system&lt;br&gt;- Much more effective to search for information myself than rely on CMC to relay it back</td>
<td>- Email related information for ongoing incidents from officers that have previously dealt with incident&lt;br&gt;- Altered dynamics of where we liaise with colleagues, conducted whilst on duty or at a job&lt;br&gt;- Serves as an additional communication channel&lt;br&gt;- Extension of what we already have to share information, enhanced knowledge sharing</td>
<td>- Broadcasting information that an officer is viewing on a specific incident to other officers; new intelligence flagged to officers in the area (can only do this on radio, delays)&lt;br&gt;- CMC flag pertinent info to MDTs rather than radio so is in front of officers &amp; shared to more officers&lt;br&gt;- A way to share shortcuts for using the MDT</td>
<td></td>
</tr>
<tr>
<td><strong>Focus Group 2</strong></td>
<td>Can search for information en route to an incident</td>
<td>Mobile technology provides another communication channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Focus Group 3</strong></td>
<td>- Update intelligence system straight away, real-time intelligence, less chance of forgetting information, which is good for knowledge sharing&lt;br&gt;- Eliminates 'Chinese whispers' effect&lt;br&gt;- Diary cars update result of incident immediately</td>
<td>Do not look at Intranet on Blackberry, as has same information as briefing</td>
<td>- Can share photos in briefings via the Blackberry&lt;br&gt;- Send tasks and messages, MO's and working sheets there and then via CIS&lt;br&gt;- Share information whilst on duty via email&lt;br&gt;- Better to have information in front of you than on radio as cannot listen and attend incidents at the same time</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Focus Group 4</strong></td>
<td>Update intelligence systems there and then</td>
<td>Look at information ourselves so more likely to gain correct information than ask for it from someone else</td>
<td>Let other officers know once we have updated systems. Depends on type of incident as to who info is shared with</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Focus Group 5</th>
<th>Update Microbeats there and then</th>
<th>Can look up points of law whilst on duty Display relevant information to victim on MDT</th>
<th>Sergeant expressed need and importance of F2F contact e.g. sharing knowledge during meal breaks about incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus Group 6</td>
<td>- Enter information at the scene and free up the airwaves for high priority incidents - Complete working sheets and statements at the scene - Camera to capture evidence and mugshots</td>
<td>- View information en route to a job - View situation reports on the Intranet - Information is in front of us, less cumbersome than accessing information via radio - View briefings whilst out and about - Have evidence in front of you for identification - Gain correct information rather than rely on other sources to pass on the information and write it down</td>
<td>- Actually talking to one another now - Use ‘voice notes’ to record and share information about an article/evidence, more detailed than text information - Able to share information more as a result of mobile technology - No need to return to station to obtain a telephone number - Easier to get in contact with colleagues</td>
</tr>
<tr>
<td>Focus Group 7</td>
<td></td>
<td></td>
<td>Look up officers’ contact details via the Intranet to point-to-point them (rather than ringing around for contact details)</td>
</tr>
</tbody>
</table>
### Appendix 3b – Thematic grid for the impact of mobile technology on isolation

<table>
<thead>
<tr>
<th>Theme/case</th>
<th>Creating isolation</th>
<th>Not impacting on isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus group 1</td>
<td>- Sometimes, yes. Certainly for us I think it has. We are more self-sufficient now but this is not a bad thing as we can be more productive and not have to keep returning to the station. - As a sergeant I feel that I certainly see less of my officers, but that is the way the project is supposed to work. I have noticed there are less people in the station and I am out on the front line much more so I can speak to other staff much more whilst completing operational duties.</td>
<td></td>
</tr>
<tr>
<td>Focus group 2</td>
<td>It could isolate officers if you let it, but should be managed.</td>
<td></td>
</tr>
<tr>
<td>Focus group 3</td>
<td>- I feel I am on my own a lot more as a result of mobile technology. Now there is even less reason to go back into the station. We are expected to stay out more and now that our location is being checked on IR3/ORB I feel that there is more pressure to be out alone. - Two officers felt it has, two officers felt it had not. - No. There are still opportunities to share information F2F but it is hard to tell as we have only had the MDTs for a few weeks and they do not work properly. If they work properly then we might see less people in and around the station. At the moment it is easier to come back to the station rather than wait to log onto the MDT so I still see my colleagues. - The nature of the incidents and the fact there are so few officers within the Hinckley area mean that we are all at the same jobs, so MDTs have not had a huge impact. In the City area this might be a different case. - Sergeant allows the officers to return to the station and is not asking why the officer is in the station because he appreciates not all jobs can be completed on the MDT e.g. lengthy statements. - We still have point to point so we can share information with colleagues despite being out of the station for longer. We use point to point to contact a colleague to obtain information that they may have in their head. One good thing that we did have on Blackberry but has now been taken away was Blackberry pins where we could speak to all the other Blackberry users via text message, like an instant messaging service. This was removed within a couple of days, so I assume they do not want us talking to one another. However, I used it to talk to my colleague when I could not talk to them on the airwave due to it being busy. It is not always a good idea to be on point to point when something is happening, as you cannot hear what is going on.</td>
<td></td>
</tr>
<tr>
<td>Focus group 4</td>
<td></td>
<td>We have only had the MDTs for four to five weeks so it may be too early to say.</td>
</tr>
<tr>
<td>Focus group</td>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td></td>
</tr>
</tbody>
</table>
| Focus group 5 | - Isolation issues are likely. People talking to one another will always be necessary.  
- In the future the plan is to allow returns to the station over three shifts, which equates to around five returns per shift. At the moment an officer can return to the station 23 times per day.  
- Having meal breaks out in the community rather than back at the station would remove opportunities for sharing that bit of information in your head and identifying links.  
- In the longer term officers would be allocated a meal time and a refreshment break. Culture needs to develop over time for officers not to return to station. Eventually MDTs will reduce officers’ need to return to station.  
- No, we still brief in person and we can still contact officers via the point to point facility on the radio  
- Officers are generally happy about staying out of the station. Newer officers find returning to the station a comfort blanket e.g. to ask for help.  
- There is still a returning to the station culture due to issues of logging in and signal etc.  
- As a sergeant I am not expecting officers to stay out of the station until their meal break and feel it is acceptable for officers to return to the station for some tasks. |
| Focus group 6 | The message has been given to sergeants that they should be encouraging their officers to be out of the station. |
| Focus group 7 | |
### Appendix 3c- Thematic grid for the impact of mobile technology on productivity (benefits/ risks of mobile technology)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Positive impact on productivity</th>
<th>Negative impact on productivity</th>
</tr>
</thead>
</table>
| Focus group 1          | - We can be more productive and not have to keep returning to the station.  
- The MDT was used in a MISPHER enquiry where I was able to check COMPACT and provide the relevant information to the persons involved there and then, whilst using the laptop out of the vehicle.  
- The MDT is a brilliant idea and there is good public perception overall. The main benefit is not having to travel about 20 miles back to the station, the laptop cuts this out. There are fewer miles needed for generally accessing information.  
- Creates a professional image, can park up and ask questions, whereas before MDTs officers would sometimes forget to ask the necessary questions to the victim or suspect and have to call them back. Now MDTs mean that there is a checklist of questions in front of me so I can collect all the necessary information without having to call the person back, which looks more professional. I am out of the station a lot more and there is less need for me to come back to the station to update things. I have noticed there are less people in the station and I am out on the front line much more | - Loss of signal means that information is lost and means that we cannot use it. This is the general consensus at Melton.  
- The MDT lacks the facility to take a full statement due to the electronic signature facility not being available. If it was available we could complete the statement there and then but instead I use the paper forms so we can get the statement signed.  
- When there is good signal we can complete crime reports and checks there and then, but in more rural areas of north Leicestershire the signal is bad e.g. Melton.  
- For longer jobs the devices are not comfortable and so the officer will return to the station to complete these.  
- One officer was with a bus driver who was becoming impatient whilst all the information was input. |
| Focus group 2          | - We can deal with crime queues more quickly via the MDT                                                                                                                                                                    | - During longer periods we use computers in the station  
- When inputting crimes we have to input duplicate information e.g. the aggrieved address                                                                                                                                                       |
| Focus group 3          | - Officers are out of the station a lot more.  
- There are time savings from not having to return to the station to view incidents.  
- Mobile technology is good for identification purposes.                                                                                                                                                                                    | - I find it quicker to handwrite information. I do not use the MDT in properties due to no electronic signature. I would use the MDT if the electronic signature facility was available. |
<p>| Focus group 4          |                                                                                                                                                                                                                        | - I logged into the MDT in the car park and by the time I had got into the actual usable desktop we were already at the job. I had not been able to obtain information at all, so this was a complete waste of time. Logging in needs to be much quicker. |</p>
<table>
<thead>
<tr>
<th>Focus group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>- MDT allows sergeants to view incidents under a supervisory role</td>
</tr>
<tr>
<td>- It took 20 to 30 minutes to input a crime, which is quicker than returning to the station.</td>
</tr>
<tr>
<td>- In one case, statements were emailed to the victim, printed off at their house and signed, increasing efficiency.</td>
</tr>
<tr>
<td>- Takes a while to log in and transmit data. It takes a long time to process the log on request and to input passwords. There are too many keystrokes.</td>
</tr>
<tr>
<td>- It takes a while to get the information out, it is slow to scroll down and there are six to seven pages to scroll through, due to connection. Have to keep the suspect or victim waiting a long time until have obtained/entered all relevant information on MDT.</td>
</tr>
<tr>
<td>- I was called to a grade one incident whilst obtaining a person’s details on the MDT, so had to leave the member of public during input, causing poor customer satisfaction. A balance is needed on officer productivity.</td>
</tr>
<tr>
<td>- The control room is sometimes busy so officers have to return to the station to update information</td>
</tr>
<tr>
<td>Focus group 6</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>- When the MDT is used it is great, especially with the diary car appointments, as we can take the laptop out of the vehicle and use it as a computer and type away. When we are double crewed we can read the job and update the job there and then. If the electronic signature facility was available we would be able to live input crimes and statements in victim’s houses, which saves duplicating the work when we return to the station. When we had a missing persons incident we were able to enter the information at the scene and avoid tying up the airwaves with dribble when the CMC are wanting to dispatch officers to certain areas for high risk incidents. Mobile technology keeps us out of the station more, we are out and about a lot longer completing paperwork and catching up. Before mobile technology we would only have to attend two to three incidents and then working sheets would need updating. Now there is no rush to return to the station to hand keys over or grab a desktop machine before the next shift start; you just sit up in your car and this looks good to members of the public. Since we cover such a large area it saves us trekking back to the station to update systems. We are saving perhaps 40 minutes just sat doing some work whilst being visible to the public. Sergeants are able to do the same and check incidents that are coming in. so for two whole days the sergeant had been in the car, which was quite encouraging for officers. We can view incidents as they are coming in before they have been assigned by the CMC, which we find very satisfying to respond quicker. We can be en route to an incident before the CMC have even shouted it out. There will start to be a difference there in terms of officers’ contact with the CMC.</td>
</tr>
<tr>
<td>- Actual usage is only practical when double crewed. I personally use the MDT less when I am single crewed and when I am dealing with a person in the back it creates a few issues. I use the MDT less than when I am double crewed. I can reinforce what PC XX has just said. The MDT is a really useful tool but it is better when we are double crewed. If we are single crewed the information is received in slow time, as we have to park up before going to an incident to obtain the information and do updates. In single crewed circumstances the MDT is good for after the job to do updates rather than en route to a job. When single crewed, MDT usage is quite impractical. For example when at a road traffic incident when I return to the MDT I have been kicked out after ten minutes. When this happens I think it is easier just to leave the MDT switched off and have a look at the information once I have dealt with another job, but then this occurs again and it becomes a vicious cycle. Then I have not used the MDT for half of the day when really I could have been completing Genie checks myself when I have stopped a vehicle rather than getting the CMC to do it for me. I still hear quite a number of officers completing checks on the radio. There may be conflict with the control room, as they want officers to attend incidents as quickly as possible but officers need more time in between incidents to update the relevant information. We are obviously needing longer to deal with a job. The CMC are very keen once you have inputted a crime to get us onto the next job. We are dealing with jobs more effectively but it is taking longer to input the crime.</td>
</tr>
</tbody>
</table>

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- The MDT is a good system when officers can get on it, allows us to do all paperwork at the one job.
- MDTs are brilliant when double crewed, as the non driver can check OIS and CIS and we are able to respond to a call quicker.
- It is good to verify MISPERS on the scene via the MDT.
- I can search for the history of people en route to an address and link up pieces of information to build a picture for incidents.
- MDTs are very good for checking people on CIS, PNC checks.
- We can search for information on the Blackberry and have it in front of us, whereas waiting a while to receive information and during that time we may be called to another incident that is more important when we are in the middle of completing a stop check.
- MDTs can be used at scene preservation etc (dead time) whereas now MDTs can be used for admin tasks so it has helped out effectiveness. Can check emails as we go along or whilst waiting in custody etc.

- MDTs are not used when single crewed.
- It is slow to download information via the MDT and may as well return to the station in the time it takes to obtain the information.
- Worry over public perception that public will wonder why an officer is sat outside their house for ten minutes before going into the property and speaking with the person. May be a problem to complete all checks for grade three and four incidents.
## Appendix 4 – Survey data from Chapter 7

### Appendix 4a: Impact of mobile technology on information sources used

<table>
<thead>
<tr>
<th>Information source</th>
<th>Frequency of use</th>
<th>Change from Before</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td><strong>Official circulars/memos</strong></td>
<td>With</td>
<td>Before</td>
<td>Diff</td>
</tr>
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**Note:** The frequency of use is measured across different time frames, from daily to yearly, and the 'Diff' column indicates the change from before to after. The 'Total' column represents the sum of all frequency counts.
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- Yellow background indicates Mobile technology increased usage of source.
- Red background indicates Mobile technology reduced usage of source.
Appendix 4b: Quality of training and duration of training provided in searching for information

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<th>Total duration of training</th>
<th>Frequency</th>
<th>Percent</th>
<th>Mean score</th>
<th>Opinion on quality of training provided in searching for information</th>
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<td>2-5 hours</td>
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<td>Good</td>
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<td>6-10 hours</td>
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<td>3.36%</td>
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