

A Paper-Centred Information System: Effectiveness and Quality Implications in UK Police Intelligence Units

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Abstract

This paper investigates the quality of information and intelligence in the United Kingdom's (UK) police intelligence units with a particular emphasis on the role of paper-based artefacts as they are used and created in the cycle of information and intelligence management. This is with the aim to analyse the role of paper-based artefacts in the coordination between human and technical resources adopted in the police intelligence units and to investigate whether they support the intelligence units' work practices in compliance to the guidelines prescribed by the National Intelligence Model (NIM). The cognitive approach of Distributed Cognition (DCog) is applied to analyse the role and impact of paper-based artefacts used to represent information and intelligence during the cycle of information and intelligence management and case studies were conducted with 15 police intelligence units to observe their work practices. Findings offer a diagnosis and suggestion for the re-design of parts of the cycle of information and intelligence management where paper-based artefacts hinder the quality of information and intelligence.

1. Introduction

In the United Kingdom (UK) there are 53 police forces. Each force has an intelligence unit that tackles crime in line with the government and force priorities, such as drug and vehicle crimes (Centrex, 2006; 2005). The activities of an intelligence unit are to collect, collate and disseminate information and intelligence for a policing purpose such as targeting an offender, preventing the occurrence of a crime or ensuring an offender is brought to justice for the crime committed (Centrex, 2006).

An intelligence unit operates in accordance to three levels prescribed by the NIM, which is a policing model introduced by the Home Office in 2000. The NIM employs a robust management of intelligence to create a clear picture of all policing issues at local, regional and national level enabling managers to make informed decisions about what their strategic priorities are, manage identified risks and allocate resources effectively where they can make most impact. The NIM is segmented into three levels: level one is an intelligence unit housed in a local police station within a force, for example Luton police station has an intelligence unit within Bedfordshire police force. The activities at this level are concerned with issues, crimes and criminals at a local level; level two is an intelligence unit for the force, which may also work in collaboration with other UK forces to tackle crime. For example, Bedfordshire police force's intelligence unit may work in collaboration with Hertfordshire and Staffordshire police forces. Level three is an intelligence unit for serious and organised crime on a national or international level. For example, a UK police force such as the Metropolitan police may work in collaboration with America's New York police force in relation to drug trafficking (Centrex, 2005). A national intelligence unit is operationally driven for specific crimes such as drug or human trafficking on a national and international scale, often in an ad hoc manner. This can lead to studies which can be difficult to generalise. This paper instead focuses on intelligence units at levels one (local) and two (regional) as the context of study due to the frequency and relative standardisation of the operational processes, information flows and artefacts usage that occur in units at levels one and two.

This paper begins with a discussion of the cognitive approach of Distributed Cognition (DCog) which is here adopted to analyse paper-based artefacts as external representations of information and intelligence during the cycle of information and intelligence management. This leads to the extended definitions of

the concepts of information and intelligence and their quality dimensions: accessibility, timeliness and trust in section 3. The methodological approach applied to this study is illustrated in section 4 together with an account of the activity under observation in section 5. The findings are presented in section 6 and the contribution of this paper is highlighted in section 7.

2. Distributed Cognition

In traditional cognitive science, a cognitive unit is located inside the human skull with no participation of external factors, whereas DCog looks for cognitive processes wherever they may occur (Hollan et al., 2000). Hence, DCog looks at social and technical aspects of cognition where information is processed by a system of agents of social and technological nature (Rogers and Scaife, 1997). Thus, DCog expands the traditional cognitive approach of studying the mind or artefacts since neither are able to perform cognitive work in isolation (Sutton, 2006) rather in coordination and collaboration with one another. DCog provide the flexibility to analyse an individual or a group of people in interaction with their socio-technical environment and attribute equal representational power to human agents and artefacts. The latter can be internal (cognitive artefacts) or external representations (technical artefacts). Although there is a proliferation of terminology in the literature, c.f. representation in Zhang and Norman (1994), Hutchins (1995), Zhang (1997a) and Hollan et al., (2000); information representation in Doherty (2000), and artefact in Rogers and Ellis (1994), Rogers and Scaife (1997) and Hutchins (1999). This paper uses the DCog term artefact to identify any entity that enables information and intelligence to be represented, accessed and communicated.

When information and intelligence is represented on an artefact it facilitates accessibility and interpretation for an individual or organisation, enabling judgement about the relevancy and adequacy of the information to the task at hand (Norman, 1993). Furthermore, the effectiveness of an artefact for the representation of information is determined by the awareness that each human agent in the socio-technical system has of the activity performed at the system level. Shared awareness of an activity is particularly beneficial in saving time and possible errors by reducing the number of information manipulation required to present the information content of an artefact in a representational format that is suitable and effective for the system as a whole. An example from the field that illustrates the above point is provided in

the ‘prisoner release’ activity that involves the collaboration between both the prison and the police services. The prison service may send the police force information on prisoner releases on an excel spreadsheet. Such representation of information format is not suitable to the police service that needs to store this information in their force intelligence system since there does not exist a protocol on how to transform this type of artefact. That is, whether the information should remain in its original representation, be stored in the force intelligence system or be passed out via email until ‘someone’ can find a use for it. In this instance, the prisoner release can remain as an excel representation with guidelines for its transformation by an intelligence unit or provide an interface (linked to the force intelligence system) whereby the prison service can enter this information directly, thus removing ambiguity in its transformation and use. This artefact creates additional work for the police force who will manipulate the information such that it can be stored in their force intelligence system. The prison service lacks an awareness of the police force task and therefore will represent the information on an artefact most appropriate for them but not their recipient, the police force.

Other studies which employed DCog have investigated the role of artefacts in several contexts such as distributed work (Alterman et al., 2001) where, in absence of face-to-face communication, electronic artefacts were used to support collaboration; in critical systems such as underground transport systems (Garbis, 2000), where immediate response to critical events has to be managed through artefacts; in problem solving (Zhang, 1997b; Zhang and Norman, 1994) where it was noted that artefacts can represent more effectively the problem domains and rules affording more structured cognitive behaviour and quicker decision making.

For this paper, DCog has been applied to understand the role of paper-based artefacts at individual and team level. The emphasis on the analysis of paper-based artefacts is two folded; firstly the use of paper-based artefacts seems to be pervasive in all police intelligence units involved in this study but with a large degree of discretion among forces. This accounts for very diverse work practices which involve paper-based artefacts and can result in either effective or cumbersome processes. Secondly a relative recent emphasis has been put on intelligence-led policing by the NIM (Centrex, 2005) and by the technological support offered to the police services in sustaining their informational and operational needs (Cabinet Office, 2005); however work practices in police intelligence units are still fundamentally centred

on paper-based artefacts. The focus of the study of paper-based artefacts at individual and team levels is justified by the highly collaborative nature of the activity performed in intelligence units; however it is worth noticing that all the human agents involved in the activity have very defined competences and responsibilities they perform individually in order to conform to the security and confidentiality issues that the activity of information and intelligence management requires. 28)

3. Information and Intelligence Quality and Dimensions

The quality of information and intelligence is a crucial factor informing the decision making process of police operations. This includes knowing where and when to allocate police resources to tackle and prevent crime. This represents the context in which paper-based artefacts are investigated in this paper. The cycle of information and intelligence management is a process where the transformation and transition of the entities information and intelligence occurs. The transformation process is where one entity (information) is changed into another (intelligence) through linking, verification and analysis, and the transition process is the dissemination of this created entity to its recipient(s).

In order to identify the implication of paper-based artefacts on the quality of the information and intelligence managed and produced in police intelligence units it is necessary to provide a clear definition of these entities since in the literature they are ill-defined, used interchangeably (Myburgh, 2000) and context-dependant in cognitive domains (Myburgh, 2000; Stenmark, 2002) or in technological areas (Galliers and Newell, 2001) or used as synonyms (Myburgh, 2000) or distinguished as separate entities (Stenmark, 2002). To establish a consistent terminology that facilitates the reader the definitions and origination process of information and intelligence adopted in this paper are presented below.

- *Information*: Data become information when relations between data sets are discovered and established such that contextual meaning is generated (Myburgh, 2000; Sensky, 2002). At this stage, information is often used to answer questions such as who, what, where and when (Sensky, 2002) in relation to the entities Person (e.g. Joe Bloggs), Object (e.g. vehicles, buildings), Location (e.g. London Bridge) or Event (e.g. human right's protest) (P.O.L.E). In the context of the UK police

service, such a definition is somehow mirrored (Centrex, 2006); information is intended as the outcome of a process where relational links among data sets are recognised and established by personnel within the UK police intelligence unit (Centrex, 2006). This is also the definition that this paper applies;

- *Intelligence*: Can be internally and externally represented (Albus, 1991; Sternberg, 1999); however only externally represented intelligence serves an operational purpose. This paper is concerned with externally represented intelligence that is developed from data and information, which leads to its representation on an artefact for an operational purpose (Centrex, 2006). The development of intelligence is seen as either an overt process (Cope, 2004) such as an intelligence product developed from an intelligence cycle (information and intelligence gathering, collation, analysis and planning phases) of all available sources for an identified priority or as a covert process (OFRI, 2006) of acquiring information for an intelligence gap. This paper defines intelligence as information obtained from external sources (e.g. covert and overt surveillances, partner agencies, etc) and internal sources (e.g. force systems, intelligence products, etc) that has been evaluated (assessed and analysed). This type of intelligence informs the tasking and coordination of resources for government and police priorities, and information and intelligence gaps within a police force.

A police intelligence unit relies on information and intelligence being of good quality to perform their activities effectively. Quality is defined according to its context of application and its fitness for purpose and research has highlighted the importance of shared awareness of the tasks for which information is created such that individuals can generate information representations that are suitable for the task at hand (Miller, 1996; Strong *et al.*, 1997b).

In England and Wales, the police are assessed for their performance against crime type priorities (e.g. class A drugs, anti-social behaviour, etc) known as government priorities. Furthermore, a police force may have additional crimes to the ones outlined in the government priorities that impact their performance. In this instance, the police force will tackle these crimes locally, which is known as control strategies (Centrex, 2006). For this paper, information quality is the fitness of information to meet a national (government) and/or local (police force) priority, while intelligence quality is the appropriateness of intelligence to identify issues

and gaps with regards to entities that are relevant to investigative and operational police needs such as people, objects, locations and events (P.O.L.E.)

In the literature, there are several quality dimensions used to determine whether an entity is of good or poor quality (Wang and Strong, 1996; Strong *et al.*, 1997a; Lee *et al.*, 2002); however on the basis of the context of study this paper has selected three quality dimensions for the assessment of good or poor information and intelligence: accessibility, timeliness, and trust. These quality dimensions are presented and illustrated with examples for intelligence and information.

- *Accessibility* considers the ease with which one is able to collect or retrieve information and intelligence when it is needed regardless of the type of artefact it is represented on (paper, computer system) (Miller, 1996; Kahn *et al.*, 2002; Lee and Strong, 2003; Lee *et al.*, 2002; Kim *et al.*, 2005). Poor accessibility can impinge on decision making if information held by the organisation is not known to exist, it is difficult or expensive to access in terms of time and resources. Artefact integration (and lack of) can also create barriers to effective storage and access, impacting the quality of information and intelligence that drive decision making. (Redman, 1996; 1998);
- *Timeliness* applies to the creation and dissemination of intelligence within satisfactory timescales to avoid a missed opportunity. It also applies to the retrieval of current information and intelligence such that it can be applied to the task at hand (Miller, 1996; Wand and Wang, 1996; Lee and Strong, 2003; Centrex, 2006). For example, the creation of a fortnightly document (an intelligence product presented in section 5) supports resource management and awareness of short term issues affecting a police force;
- *Trust* relates to the information and intelligence source and content (Centrex, 2006). For example, validating that Joe Bloggs is a trustworthy source which will then determine whether the information provided (e.g. Tom will smuggle in cocaine on flight BA1234 on Wednesday) by Joe Bloggs is also trustworthy;

In a police intelligence unit, the management of information and intelligence often employs multiple artefacts such as paper documents, email, computer systems, databases, fax machines and telephones. Artefacts externally represent and coordinate the

information and intelligence gathered and created in the cycle of information and intelligence management (fig. 1); hence affecting their degree of quality.

4. A Case Study of UK Police Intelligence Units

Since 2000, much emphasis has been placed on an intelligence-led approach to policing with the introduction of the NIM. The traditional reactive model of policing became unable to cope with changing crime trends, so rather than reacting to new situations or relying on traditional notions of crime and criminal behaviour, intelligence-led policing was introduced to possibly prevent crime before it occurs, or at least minimise its effects, and to act upon crime drivers (Ratcliffe, 2003). This changing phase for the UK police service served as the initial reason for pursuing the methodological approach of case studies to understand how many and to what extent police forces had accepted and adopted the guidelines prescribed by the NIM. At the time of this study the quality of intelligence managed by the police services was also raising public concerns due to major criminal investigations that highlighted the crucial role of effective intelligence management.

The case study approach taken by this research selected 15 UK police intelligence units as sites of data collection. The forces were selected taking into account the size and geographical location of the forces as well as the socio-economical contexts of the jurisdictional area covered. An additional factor influencing the choice of sites was the forces' consent to participate in the study and the provision made to access documentations and staff within the intelligence unit. The data collection spanned for nine months and included three methods, namely: observations, interviews and document analysis. Triangulation was achieved by comparing the findings from the 15 sites as well as including two researchers in the data analysis.

Initially, the case study approach employed the techniques of complete observer, where no provision is made for a social interaction with the informants (Gold, 1958), and unstructured interviews to first gain an insight into how technical and social agents coordinate their tasks in the intelligence unit. 75 interviews were conducted with intelligence officers, intelligence analysts, and administrative personnel situated in the police intelligence unit. Once familiarity with the research site was achieved and the necessary security checks were completed, a confidential relation with the visited police forces was established. This

allowed the employment of a more participative observation technique, observer-as-participant with formal interactions with informants (Gold, 1958). This helped in focusing down the area of investigation to two stages of the cycle of information and intelligence management, namely: information and intelligence gathering, and collation. It was observed that the quality of information and intelligence was at large affected in these two stages and that paper-based artefacts played a dominant role in such a process. These observations provided a final research focus that has led the remaining part of the data collection. Semi-structured interviews were introduced at this stage of the research to ensure a preliminary validation of the observation notes with the relevant staff such that that no misunderstandings had occurred, and to further explore and select the dimensions relevant to the definition of information and intelligence quality. Data collected from each research site were documented textually in note-taking forms which were then transformed into a report to outline the people, processes and artefacts (technological and paper) that participate in the cycle of information and intelligence management. Thematic analysis was applied to identify the most frequently occurring themes in the collected data and structure the account of the findings such that they could include data from the 15 forces (Boyatzis, 1998).

5. The Cycle of Information and Intelligence Management

Within a police intelligence unit, intelligence constitutes information that has undergone evaluation, assessment and grading to validate a source, the information provided and the people within the organisation who can read it based on rank and role access. Intelligence drives the tasking and coordination of police resources to deal with national and local crime priorities and information and intelligence gaps.

In some organisations, information and intelligence gathering is the driving force for critical decision making during operations. This process is facilitated by an intelligence cycle, which this paper refers to and analyses as the cycle of information and intelligence management (fig. 1). This cycle is a dynamic and continuous process (Gulflink, 2006) that starts with the gathering of information and intelligence (stage 1). Information can be collected from external and internal sources but intelligence can only be retrieved from internal sources since it has undergone an evaluation process where it has been previously transformed from information to intelligence. The cycle then proceeds to

the collation stage (stage 2), a proactive activity of coordinating information and intelligence (linking, converting and entering) that have been collected from external and/or internal sources. Information and intelligence (assessed intelligence report stored in the force intelligence system) can be represented on an intelligence product that is stored on the force electronic repository. An intelligence report comprises information collected from external sources that have an intelligence purpose while an intelligence product comprises the retrieval and integration of external information sources and internal information and intelligence sources to highlight links between the entities P.O.L.E. There are four types of intelligence product: problem profile, target profile, tactical assessment and strategic assessment, which are discussed in section 5.2.

Although in Figure 1 the stages are represented as sequential, the information and intelligence gathering, and collation stages can be performed in parallel in order to swiftly identify and fill information gaps. For example, Joe Bloggs owns a grey Nissan Micra car but the car registration is not known. Therefore, this information will need to be obtained from the Driving and Vehicle Licensing Agency (DVLA) database (collection from an external source) such that it can be entered onto the force system record for Joe Bloggs (collation)

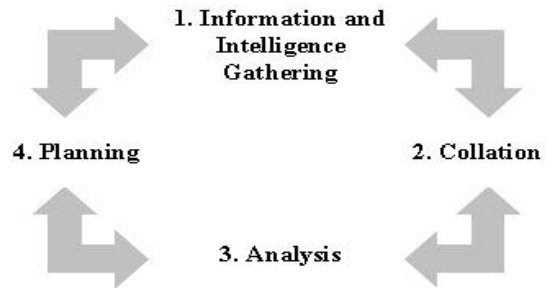


Figure 1. Cycle of Information and Intelligence Management as observed in UK Police Intelligence Units

Following these two stages, the cycle proceeds to the analysis stage (stage 3) where information is transformed into intelligence through evaluation and assessment of the reliability of the source provider and the information provided. An intelligence product is then disseminated in the planning stage (stage 4) where resources are tasked and coordinated in order to bridge the information and/or intelligence gaps for the government and police priorities. Once again the analysis and planning stages are not sequential as there

may be a need to further research and develop an intelligence product before resources can be allocated to deal with the issue. The planning stage will inform the type of police resources to be used during the collection of data and information from external sources in the information and intelligence gathering stage.

The next two sections illustrate the stages of information and intelligence gathering, and collation within the cycle of information and intelligence management as performed in the UK police intelligence units. Both these stages are of particular interest to this paper since they employ paper-based artefacts to collect and collate information and intelligence, which can help to assess their impact on subsequent stages of the cycle as well as the quality of information and intelligence during and after each cycle iteration. Information and intelligence are treated as distinguished entities and undergo transformation and transition processes specific to them in each stage of the cycle of information and intelligence management.

5.1 Information and Intelligence Gathering Stage

Within most law enforcement and homeland security organisations that manage information and intelligence, the information and intelligence gathering stage is triggered by knowledge gaps known as information and/or intelligence requirements (Miller, 1997; CSIS, 2004; Centrex, 2006; 2005; Gulflink, 2006; OFRI, 2006; USA Army, 2006).

For many organisations' intelligence cycle, the information and intelligence gathering stage occurs from external and internal sources (Cope *et al.*, 2001; Cope, 2004; CSIS, 2004; OFRI, 2006; USA Army, 2006) or just external sources (Miller, 1997; Centrex, 2006; 2005; Gulflink, 2006). This paper considers the information and intelligence gathering stage to encompass two tasks: retrieval and collection that can occur simultaneously by the same agent or separately by different agents. In the first task, retrieval, information and intelligence are retrieved from internal sources (police force repositories) and in the second task, collection, information is collected from external sources (from other agencies). The task of retrieval is performed by applying query based searches on databases, accessing electronic file repositories for intelligence products, manual searches of paper copies or casual/informal conversations. The information and/or intelligence collection is achieved by communicating directly with other agencies. In this instance, law enforcement agencies (e.g. courts) and partner agencies (e.g. council) form the external

agencies. The swift access to the information held by external sources is critical to ensure appropriate decision making and timely planning. Collection and retrieval are driven by the government priorities and control strategies, also called focus desks (e.g. burglary), or are performed for each geographical area within a police force (e.g. Fulham) or according to the current workload (e.g. ongoing events and investigations).

5.2 Collation Stage

Information and intelligence gathered from external and internal sources are evaluated during the collation stage, which comprises three tasks: the compilation of an intelligence report; the creation of an intelligence record, known as an intelligence log in the force intelligence system; and the compilation of one or more of the four National Intelligence Model (NIM) intelligence products (problem profile, target profile, tactical assessment and strategic assessment).

1. *Compilation of an intelligence report:* An intelligence report is known as a 5x5x5 in the UK police service. A 5x5x5 is completed by a member of staff in the police force who is reporting the information for intelligence purposes. A 5x5x5 denotes an intelligence grading process used to determine the reliability of the source and the information provided, and the rank and role access to this 5x5x5. The reporting member of staff grades the reliability of the source and of the information, which is assessed based on the information content provided. If there is a risk linked to the submitted 5x5x5, a risk assessment form is also required. A government protective marking scheme (GPMS) marker is applied to the 5x5x5 before being submitted to the intelligence unit classifying the 5x5x5 as restricted, confidential or secret. A 5x5x5 has to be documented accurately such that it is interpretable and within timescales set by a police force to avoid it being obsolete. A 5x5x5 can be submitted to an intelligence unit:

- Electronically via email, which requires no signature since the email is authenticated by automatic identifiers;
- By being entered directly into the force intelligence system by the reporting member of staff. An email will be sent to the intelligence officer located in the intelligence unit with the 5x5x5 unique reference number (URN) that is generated by the intelligence system in order to access it;

- As a paper-based 5x5x5 that is signed before being personally handed over to an intelligence officer.

Once submitted, the role of the intelligence unit is to assess (including risk assessment) and disseminate the 5x5x5. Regardless of whether the submitted 5x5x5 is a paper or an electronic artefact, the intelligence officer will carry out the 5x5x5 assessment electronically: directly in the force intelligence system; by updating an electronic 5x5x5 in the body of an email; in a new electronic 5x5x5 template. Assessment of a 5x5x5 involves quality assurance for completeness and accuracy, re-evaluation of the reliability of the source and information and sanitisation of the 5x5x5 if there is an indication of the source. If a risk assessment form is needed but not included, then it is compiled and attached to the submitted 5x5x5. Dissemination of a 5x5x5 comprises a handling grade for rank and role access.

2. *Creation of an intelligence log:* If an electronic 5x5x5 has been assessed directly in the force intelligence system (since it was submitted directly into the force intelligence system) then an intelligence log has already been created. Otherwise, an electronic 5x5x5 assessed in the body of an email or in a new 5x5x5 template will be printed out and this assessed paper-based 5x5x5 is personally handed over to an inputter situated within the intelligence unit to be transformed into an electronic artefact by means of data entry and stored into the force intelligence system. In this instance, the intelligence officer will save his electronically assessed 5x5x5 on his local repository. Data entry of the paper-based 5x5x5 is a straightforward process performed by an inputter and poor timeliness of its data entry delays prompt accessibility of newly collected intelligence. This task outputs an intelligence log which is an electronic copy of the assessed 5x5x5 stored in the intelligence system that can be retrieved based on rank and role access.
3. *Compilation of an intelligence product:* The information and intelligence gathered undergoes a transformation process to become intelligence which will be compiled in the necessary intelligence product. Once the intelligence product is completed, it is posted electronically on the force storage repository for rank and role access and disseminated via email to the management team within the intelligence unit. This intelligence

product is used for the tasking and coordination of resources in the identification of information and/or intelligence requirements and to support and perform police operations (e.g. surveillance on Joe Bloggs business premises for drug smuggling). An intelligence product needs to be developed within its designated deadline (e.g. a tactical assessment every fortnight) and the contents need to be accurate, interpretable, reliable and accessible since it drives decision making on resource management. There are four types of intelligence product:

- A problem profile outlines an established/emerging crime or incident series with problem locations and may be created in line with the tactical assessment fortnightly timescale;
- A target profile provides an analysis of a person (suspect or victim) or group of people being targeted in line with the force or local control strategies. A target profile and may be created in line with the tactical assessment fortnightly timescale;
- A tactical assessment identifies the short term issues for local, force and/or regional control strategies and is created on a fortnightly basis;
- A strategic assessment is a long term perspective that identifies both current priorities as well as evaluating and reporting on emerging trends and is created twice a year on a six month basis.

6. Findings

The findings are discussed in relation to the two stages of information and intelligence management cycle selected for this research, respectively gathering, and collation. These findings only refer to those tasks that create, make use or manipulate paper-based artefacts and analyse the role of artefacts and the impediments or affordance they generate to the creation of good quality information and intelligence.

6.1 Information and Intelligence Gathering

Driven by national, regional or geographical priorities, agents in the intelligence unit consult several force information systems (e.g. crime, custody, incident, and intelligence), databases (e.g. forensics DNA and fingerprints, firearms, and drugs) and repositories (e.g. global drive) for the retrieval of information and intelligence that can inform police operations.

The use of paper-based artefacts is mainly prompted by two specific circumstances. The first case occurs when database queries are performed. The retrieved results are printed out on paper when i) members of staff are not fully trained, ii) do not have privileges to access relevant databases, and iii) the results are extensive and from disparate information systems. In all the above scenarios agents with training and access print out the retrieved results and if necessary, pass them on to the agent who has requested the query but does not have training or access. The relevant information and intelligence is then manually entered in an intelligence product. Paper-based artefacts in the form of notes are also used in forces where only operational staff has access to specialised information systems (e.g. drugs and firearms). Intelligence unit agents, in this case, depend on the availability of operational staff that can perform the queries and read out loud the results over the phone, when agents can take written notes.

Although the use of paper-based artefacts in information and intelligence retrieval represents an easier alternative to implement when compared to other critical issues encountered by the intelligence unit (lack of training and nature of the information processed), it certainly has repercussions. Retrieval and entry of query results are (at times) out of synch with the demands of the operational services which require a swift contribution from the intelligence unit in order to perform operations within an appropriate time scale. Although the information and intelligence are available and accessible, inevitable bottlenecks are represented by the constraints and dependency that agents have on more senior colleagues to perform database queries on their behalf. In addition the creation of redundant paper-based artefacts (prints out of digital records or transcripts of phone conversations) must be manually typed, providing dangerous opportunities for spelling mistakes and misunderstandings. These paper documents also need to be appropriately discharged for data protection purposes at the end of the task at hand; however a higher risk of disclosure is faced when information and intelligence is represented on paper in working space that share resources and are open-structured. It is also worth noticing that all agents in the police intelligence units are monitored and audits are conducted on systems accessed to ensure that no improper use of information and intelligence occurs or is detected at its earliest occurrence. However, the nature of paper-based artefacts makes it difficult to implement such an audit trail that can assert the nature and the purpose of the held information and intelligence and its distribution.

Although protocols of data sharing between the police services and external agencies have been under proposal, exchange and communication are usually the result of local arrangements. In forces where data exchange protocols are in place, intelligence unit agents can receive information in diverse formats, namely: through *ad hoc* information systems, email attachments, phone conversations and fax transmissions. When an information system is used to collect information from external sources, no paper-based artefacts are generated since the information can be cut and pasted into an intelligence product. In this respect accessibility is high since there is a protocol to share information between the agency and police force but timeliness can be compromised by the external agency's lack of awareness of the police force's needs. In all other scenarios, observations have revealed that paper-based documents were created to facilitate the manipulation and distribution of the information and intelligence to the relevant recipients. This finding partially highlights the inappropriate support that available technological resources provide in the intelligence units especially in cases where large amount of data are manipulated. Paper-based artefacts are then employed to bridge the computational needs that agents cannot perform in interaction with technology. Even in those circumstances where data from an external agency was received in electronic format, the information was printed out to allow for a geographical structuring of the information and for a swift distribution, still not breaching information disclosure (each command unit only received information relevant to its geographical area).

In forces where data exchange protocols are absent, opportunistic contacts with external agencies are sought on the basis of personal acquaintances or previous dealings with the agency. In this instance, the collection of information becomes a long winded and often slow process (e.g. talk with colleagues to obtain source contact) and often this process may be interrupted by *ad-hoc* task requests which can break the flow of information coordination. Furthermore, the time delays in locating or distributing paper-based information and intelligence may result in the information and intelligence being obsolete when it is eventually found which creates poor situation awareness, lack of competent and informed decision making and missed opportunities to tackle crime effectively.

6.2 Collation

This collation stage aims to achieve the compilation of an intelligence product through the assessment of submitted 5x5x5 and the creation of intelligence log in the local intelligence system. This stage involves the police staffs who submit the 5x5x5, the local intelligence officer (LIO) who assesses it and the inputter who enters the assessed intelligence. A 5x5x5 can be written and submitted by a reporting member of staff in a number of ways, namely: on paper, which is then signed and personally handed to the intelligence unit, electronically in an email attachment and electronically through the force intelligence system. Independently from the submission format, the LIO assesses the submitted 5x5x5 electronically either on a new 5x5x5 template, in the body of an email or in the intelligence system. Once that the 5x5x5 is assessed electronically and all sensitive information is removed, it is passed on to the inputter on paper or electronically. In the first scenario in forces where inputters do not have email facility, the LIO prints out the assessed 5x5x5, this is then manually entered in an electronic document in the local intelligence system. When the assessed 5x5x5 is available electronically this helps maintain the original quality of the submitted 5x5x5 and supports the 'cut and paste' functionality avoiding proliferation of incorrect spellings.

The process of transforming a non-assessed and assessed paper 5x5x5 to an electronic assessed 5x5x5 is a long winded process which impinges on creating an up-to-date understanding of ongoing events and impacts decision making for resource management since shared awareness is hardly reached. Furthermore, these types of time delay can lead to information and intelligence becoming obsolete. Due to the, at times, cumbersome process, not all 5x5x5 are entered into the local intelligence systems; a necessary filtering activity takes place to prioritise those 5x5x5 reports that refer to a government priority and/or force control strategy. In other cases, paper-based 5x5x5 reports are stored in filing cabinets where search and retrieval activities are usually ineffective.

An additional problem created by non-assessed paper-based 5x5x5 reports is that they are accessible to any agent in the intelligence unit, while instead the reporting member of staff and the LIO should be the only people aware of its existence in order to protect the information and intelligence, and the source.

7. Conclusion

Led by the distributed cognition approach, this paper has focused on the role of artefacts and their ability to influence the quality of information and intelligence managed and produced in a large sample of UK police intelligence units. A 'working' definition of information and intelligence quality has been proposed and includes dimensions such as accessibility, timeliness and trust. With these dimensions in mind, the role of paper-based artefacts in police intelligence units has been analysed. Although the scope of this paper was not to assess the level of support that current technology in intelligence units provide, the proliferation of paper-based artefacts is partially explained by the lack or inadequacy of technological support. In this paper we have reported and discussed the challenge faced by police intelligence units who attempt to achieve a balance between accessible, confidential and timeliness information. The findings revealed a disjoint picture of 'local arrangements' that are sustainable and successful and of 'less effective' units. A great contribution to 'successful stories' is due to established partnerships with external agencies and the larger community as well as a proactive reorganisation of the service to enact the guidelines provided by the NIM.

The interest of the involved researchers and the collaboration with the police services is still ongoing. The current research is exploring the possibility to apply a cognitive model of human action to minimise the mismatches between the goal of the system under analysis and the available social and technical resources.

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