Police and Technology:
Historical Review and Current Status

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Summary

This report is part of a larger study on technology currently used by police departments in North America. The purpose of this report is to show the extent to which police technological developments affect day-to-day law enforcement, the police organization as a whole and its relationship with the community.

The various technologies available today to the police and to society as a whole can sometimes be intimidating. Therefore, it is important that the technology currently used by law enforcement be considered within the framework of a long-term technological development process. Part I provides a history of technological developments in North American police departments and Part II contains a review of the current situation.

In Part I we briefly discuss the various technological advances made by law enforcement during three stages from the end of the nineteenth century to the end of the 1970s. An overall factual data analysis is provided in the conclusion.

The First Stage (1881-1945)

During this first stage of technological development, law enforcement gained mobility through the use of motor vehicles, the ability to communicate over distances with the telephone and with radios in patrol cars, and access to information from forensic laboratory experts. These three major developments impacted police work and police organizations in at least seven different ways.

1) Creation of criminal laws leading to an increase in the number of tasks, especially as it related to the automobile, which became widespread fairly quickly.

2) A greater number of tasks led to the creation of specialized sections within law enforcement: for example, traffic, radio communications and forensic labs, at least in large departments. The organizational structure was thus modified.

3) Technology provided law enforcement with indispensable tools.

4) An expanded territory: the automobile covered a larger area more quickly; communications made it possible to transmit and receive information over long distances; technologies used in labs provided access to information that was previously unavailable, due to the stage of development of biology, chemistry and physics in the past.

5) Technology related to transportation, communications and forensic labs was designed by experts who made constant advances in research and development in their fields. These advances were shared with law enforcement.

6) The use of motor vehicles and communications increased the safety of police officers.

7) All these developments, including an increase in the number of tasks and the creation of specialized sections, led to a more complex police organization. In the late 50s, as the organization was becoming more complex, file management was centralized and the organization was restructured. Centralization was a consequence of these technological developments, but it became a requirement in order to use these new developments effectively. Automatic data processing occurred during the next stage.

The Second Stage (1946-1959)

Police bureaucratization emerged during the second stage but it could have started earlier.

This stage also saw the advent of the 911 emergency response system in North America. This system was implemented by all departments over time, although it came much later, i.e. in the 1970s, 80s and even 90s,

for most of them. Closer relationships started to be formed between the various community groups, and service delivery improved.

Also, the traffic police acquired its first instruments designed to measure the speed of a motor vehicle and to evaluate the condition of the driver. These ?scientific? instruments enhanced the credibility of the traffic police.

They became everyday tools. They improved over time and they were used more or less systematically. They were used by the traffic police for law enforcement purposes.

The Third Stage (1960- 1979)

Police technology truly emerged during the third stage. This was the start of the computer age and most of the technological advances made during the following decades were based on computers.

Call distribution centres, computerized databanks and computer sections, in large departments, emerged during this stage. There was an increase in police staffing levels and the first civilian specialists in administration, automatic data processing and various fields related to forensic technology were hired. Bureaucratization and management in general kept expanding.

The safety of police officers kept improving. It became possible to make queries on suspects from the field using databanks such as the Quebec Police Information Centre (QPIC) and the Canadian Police Information Centre (CPIC).

Police technology became more complex. Research and development on technology specifically designed for law enforcement was really structured for the first time. For example, in the United States, the National Institute of Justice (NIJ) was created in 1968. This organization is responsible for the quality of technologies used by the police and also for research, development and equipment standardization.

The Fourth Stage

Part II covers the fourth stage of technological development, specifically the relationship between law enforcement and technology, technologies currently used by the police and those being developed. Technological developments are identified based on their capacity to provide the police with a greater amount of information, to provide such information more quickly and/or to give access to data which would have been unavailable without these technological tools. This part briefly discusses each known technology used by law enforcement to gain access to more information, i.e. telecommunications, mobile data computers, expert systems, imaging, lab and biometric technologies. At least one implementation location is mentioned. We also identify a few technologies currently in development, in production or in use in private institutions. Finally, we look at police research centres around the world and international conferences on police technology.

Telecommunications

Police departments around the world use various network communication systems at the national or international levels. These communication networks are helpful to police officers in their management, investigation and decision-making activities.

This technological field is particularly complex. It is perhaps the most complex used by law enforcement. Its stated purpose is to provide police officers with the most secure communication system possible as well as a more direct and quicker access to databanks containing various information files. Effectiveness in terms of call distribution and communication standardization is the objective. These communication systems are by definition interconnected.

The trend seems to be toward the proliferation and integration of communication systems whether it be for the police or government agencies.

Mobile Data Computer

Mobile data computers are used by police officers to conduct research in databanks. They can send messages and reports, find numbers in a databank and change status from their vehicle. They can also communicate with other patrol cars without using radio communications. Calls from citizens can be sent directly to the cruiser. Police officers can download, update and close files without going to the police station. In addition, the system identifies missing information. This system should now be available to RCMP members nationwide (*Pony Express*, December 1997).

Mobile data computers are also used by managers to tighten their control over patrol officers. Patrolmen feel they are being watched (Ericson and Haggerty, 1996) and they devise various means to elude this supervision.

Communication technologies help solve problems while at the same time creating others. For example, vehicle communication systems are sometimes used by patrolmen ?as toys to communicate?. They may, for instance, use the system to set up informal meetings or to conduct random checks.

The Internet

The Internet has been operating as a telecommunications network since 1993. It is used by police agencies all over the world, in the Americas, Europe and Asia. The Home Office, the Federal Bureau of Investigation (FBI), Scotland Yard, Interpol and the French National Police as well as the Royal Canadian Mounted Police (RCMP), the Quebec Provincial Police (Sûreté du Québec), the Montreal Urban Community Police Department and the Ontario Provincial Police (OPP) all have a Website. Several other Canadian and American police departments are also on the Web (a few sites are shown in the References). The Internet helps police departments, particularly those involved in community policing, work more closely with community members. This network can be used by citizens to provide anonymous tips to the police. Also, the Internet is one of the tools available to police officers for distance learning.

As with motor vehicles and computers, new work areas are being created for law enforcement on the Internet and there is now a cyberpolice. The Internet is a communications network that is also widely used by the public.
In fact, the Internet has opened up new crime opportunities by providing new means to commit conventional crimes (child pornography, fraud, money laundering, child prostitution, hate propaganda, etc.). Already, police units are assigned exclusively to technological crime, including Internet crime, i.e., in Canada, the Computer Crime Section of the RCMP (RCMP Website under Technological Crime) and in the U.S. the FBI=s Computer Squad (FBI Website). Concepts such as Internet police, cyberpolice, electronic investigation, etc. are used within the RCMP. Encryption is thus becoming a concern for law enforcement.

Finally, in the U.S., more specifically in Ohio, a databank on inmates has been posted on the Internet.

Expert Systems

Computer systems help the police obtain quickly various information on individuals who committed specific offenses such as fraud, violent crimes, rape, serial murders, etc. These systems with their software are capable of matching up and analyzing a large amount of data.

Imaging Technology

Technological advances also affected still and animated photography. Photography has been part of the police environment for a long time. Witnesses had to go through large photo collections to identify suspects. Fingerprinting involved unpleasant inking sessions. These police tasks were made easier by technology. We provide a short description of electronic and computer-related advances that led to the development of the following systems: photo radar, night vision, electronic imaging, hyperspectral cameras, video surveillance cameras, wireless video cameras, nooklooker cameras, digitization of photos, fingerprints, footprints, earprints and composite sketches.

Forensic Laboratories

Chemistry, biology, physics as well as robotics and even entomology are part of everyday operations in a forensic lab. The processes used are highly complex and specialized. They are performed by civilian experts. Finally, it should be pointed out that the equipment used in forensic labs is very costly ($600,000 for a tandem spectrometer).

Biometric Technologies

All biometric technologies share one common feature: they use the human body, most often a part of the body, for purposes of identification. Fingerprints and dental impressions have been used for a long time. In recent years, other identification techniques were added. Also, biometric technologies designed for identification were complemented with biometric technologies designed for detection and control.

DNA Identification

Convictions were obtained in hundreds of violent offense cases ranging from assault to murder through DNA identification. This type of evidence is used to exonerate suspects and to release inmates wrongly convicted. DNA testing for forensic purposes is practiced all over the world: in the United States, United Kingdom, France, Germany, Australia and New Zealand, (Solicitor General of Canada, January 1996, Creation of a national DNA databank, Consultation paper).

In Canada, the DNA Identification Act, providing for the establishment of a national DNA databank, was passed by Parliament on Dec 8, 1998.

This national DNA or genetic databank raises some real questions. The list of identified offenses contains assault, assault against a peace officer and indecent acts. A study of ?mentally ill? offenders conducted at the Montreal Municipal Court in 1991-1992 shows that a large number of individuals suffering from a ?mental illness? or perceived as such are charged with this type of offense on a regular basis. Demonstrators can also be charged with assaulting a peace officer.

Other Biometric Identification Procedures

Other biometric procedures, including voice identification and eyescan, help identify an individual=s unique features. The human ear is also used. For the first time in Great Britain a mould of a suspect=s ear was made and a facial mapping expert was able to match the mould with the suspect=s ear. Also in Great Britain, the West Midland Police Department is developing a computerized shoe print database.

Police Research Centres in North America

The Canadian Police Research Centre is one of three functional services provided by the RCMP=s Science and Technology Branch. The Centre is responsible for ensuring that police departments across Canada have access to the best equipment and that Canadian companies have the opportunity to develop an expertise in this specialized field. Its main partners include the Canadian Association of Chiefs of Police, the Royal Canadian Mounted Police and the National Research Council of Canada.

In the United States, the National Institute of Justice (NIJ) sponsors all police research conducted under the aegis of the National Law Enforcement and Correction Technology Center (NLECTC). The work is performed through a partnership involving the Justice Department and the Department of Defense.

Police Research Centres in Europe

In Great Britain, the Police Scientific Development Branch (PSDB) is responsible for providing scientific research and technical support to police departments and other clients. Its objectives include giving technical advice to police divisions, cabinet ministers, police departments and corrections facilities, enhancing operational efficiency and helping improve police policies in specific ministries (such as Transportation and also the Home Office, to fight terrorism and cooperate on the international level).

In Germany, in 1957, a permanent committee under the Federal and Länder Ministries of the Interior set up a subcommittee named *Technische Kommission* responsible for standardizing police equipment in the Federal Republic of Germany, coordinating the approach to all technical problems and developing unique instructions for police operation and management.

International Conferences

Conferences on law enforcement technology developments have been held in the United States every year since 1994 under the sponsorship of the National Institute of Justice. In Europe, the *Salon Milipol Paris* has been held in France every two years since 1984 by the French Ministry of the Interior.

These conferences provide police officers with information on new technologies and on how to use them legally and as efficiently as possible.

Conclusion

This historical review outlines the technological advances made by North American police departments over a century. It puts into perspective the current technological development process.

The Technological Development Process is Irreversible

Once the technological developments are introduced, their use seems to be based on need. It is true for motor vehicles, as police departments initially acquired two or three, then progressively set up fleets of vehicles, helicopters, boats, etc. It is equally true for forensic laboratories and computers where, for instance, the amount of computerized data related to the management of the organization as well as to ?clients? has now become so large (new databanks are regularly added) that the police requires new processing and analysis software, enhanced computers and more computer specialists. Technology begets more technology.

Building Up the Organization

Police technological developments help build up the organization. Indeed, new technologies were instrumental in structuring the organization, modifying its area of responsibility, improving its effectiveness in obtaining information on citizens, and changing its image. Its as if the police were adapting and evolving based on available and, above all, acquired technology.

In fact, technologies used by the police build on technologies implemented by other institutions to inform, monitor, control and respond. Information and surveillance technologies are now widespread in education, medical and corrections facilities, private corporations and the retail industry.

A Massive Amount of Data

The literature shows that the police have access to a massive amount of data through a whole range of technologies such as information, telecommunications, surveillance, expert systems and biotechnologies. This increased access brought about by technology raises, among others, the problem of managing this information. How can the police manage effectively such a large amount of data?

Interfacing with other institutions is another problem. If the police can be connected to the databank of a government agency, is the opposite true?

It also raises the problem of the legality of acquiring these data. The use of random checks seems to suggest that the informal is taking precedence over the legal, as current control mechanisms are unable to check all potential uses of databanks by law enforcement.

It is also appropriate to ask whether the relationship the police have (and will have) with technology will bring law enforcement closer to the community or drive it further apart.

Counter Measures

Information technology is used to commit a whole range of offenses including fraud, pornography, pedophilia and hate propaganda. Also, some highly respected institutions see the integrity of their data threatened by ?hackers?.

Police officers are requesting new technological tools or a greater access to existing ones and an increase in the number of specialists. We are involved in a virtual technological arms race as Nogala (1993) clearly suggests.

Encryption is becoming a major issue for law enforcement all over the world, but will this ultimately be such a beneficial move or will it give those who travel on the information superhighway to commit offenses or to protest more opportunities to be creative?

If police data are vulnerable to outside aggressions, they are also threatened by technology. The Y2K bug has generated numerous reports in police organizations around the world and the work required to make computers Y2K-compliant has been costly, but no one can be absolutely sure at this time that all computers will pass muster when the day comes.

Biometric Technologies

It seems that biometric technologies are becoming more and more prevalent not only in society as a whole but also in law enforcement. The human body is now a major source of information and ?biosurveillance? has its own implications and issues. This topic should be discussed further.

The impact of these technologies on the criminalization of individuals that are ?mentally ill" (or perceived as such) and protesters in a demonstration could be an interesting research topic. Knowing that the people in the first group are often charged with assaulting a peace officer or committing indecent acts and that the second group can easily be charged with assaulting a peace officer, may suggest that genetic information from these individuals is likely to be included in the national DNA databank.

Let=s suppose that a well-intentioned researcher decides to use the data contained in the national DNA databank to identify genes common to all ?criminals?.

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The First Three Stages of Technological Development

This report is part of a larger study on technology currently used by North American police departments. The purpose of this study is to show the extent to which police technological developments affect day-to-day law enforcement, the police organization as a whole and its relationship with the community.

The development of police technology seems to be closely linked to the evolution of basic science, engineering and administration. It is also reflects the social and economic environment in which it occurs. The police is not isolated from social realities. Therefore, as suggested by Nogala (1993), technological advances are dependent on motivational forces within the organization as well as stimulating and opposing forces from the outside. Police departments must also take into account what is available at any given time, what they actually need and whether they can afford it.

It emerged fairly quickly that the current technological drive within law enforcement started in the late 1960s and early 70s. The technological explosion of the 1960s and 70s was ushered in by major social changes and through administrative and organizational restructuring efforts. The means to implement existing technologies from other fields were then acquired by large police departments, a least in the United States and Germany. These technologies were adapted to police work. Police research centers were set up to meet the needs of police officers in the field. From then on, police departments started to hire more and more civilian professionals. Technological developments are continuing today at an increasing pace.

These technologies are analyzed in terms of their various, numerous and complex relationships with society in general and with justice and law enforcement in particular. For example, some people look at their impact on privacy (1997 Convention *Vie privée sans frontières*), the increasing prevalence of surveillance and the fixation on safety, amplified by information, communication and surveillance technologies (Marx, 1988; Bogard, 1996; Lyon, 1992; Manning, 1992; Ericson & Haggerty, 1996). Others focus on their connection to the law (Brodeur, 1988; Cadoux, 1993), on devising legal guidelines (Trudel, 1997) and on the application of some technologies by the justice system, eg. for house arrests (Landreville, 1987) and video testimony. For some, the rationale for using technology is its ability to improve public safety (NIJ, 1996) and reduce drug trafficking (NIJ, 1996) or control youth gangs (NIJ, 1998). Although technology may be viewed as helping social control agencies (Marx, 1989) and expanding police power (Nogala, 1993), it is also considered to be a threat by the very people who hold power (Marx, 1992).

In a general sense, technology shapes society. In recent years, technological advances were instrumental in changing our society from an industrial to a post-industrial paradigm. Some suggest that power no longer rests solely on wealth, but also on knowledge (greatly increased by information technology) and above all on knowledge about knowledge (Toffler, 1990). Ericson and Haggerty (1996) suggest that police officers have become ?knowledge workers?. They compile data and provide them to institutions now known as risk management institutions.
In the area of management, the impact of information technology on organizations, including police organizations, is also studied (Orlinowski, 1993): for instance, some try to evaluate how computerized police files have affected police work and the organization itself (Akrich and Maedel, 1996).

Finally, technologies under development should also be considered, for example, nanotechnology[1], which in the near future could radically change social life in general, employment and organizations, even the way wars are fought, which has already been modified by information technology (Toffler, 1993; Fontaine, 1997).

The various technologies available today to the police and to society as a whole can sometimes be intimidating. Therefore, it is important that the technology currently used by law enforcement be considered

[1] Nanotechnology deals with very small things. Research work involves chemistry, physics and computers, and a lot of it is done in universities. For their part, military planners have already realized the potential offered by this new science. This field includes microscopic robots and objects assembled one molecule at a time by machines invisible to the naked eye. It=s called the world of the extremely small and the extraordinarily efficient (Fontaine, 1997). These tiny robots will be used for biomedical work as well as in the military. They could also replace people for dangerous work and a wide range of daily activities.

within the framework of a long-term technological development process. Part I provides a history of technological developments in North American police departments.

We do not claim that this history of police technology in North America is complete. We have tried to identify technological developments in police organizations from the end of the nineteenth century to the 1970s, and understand to what extent each development affected both the work of police officers and the police organization itself.

This process should help put in perspective the technology currently used by the police, which will be discussed in Part II of this report. This is our central objective and we intend to meet it by highlighting the main technological developments during the stages being studied as well as the impact of these advances on police work and police organizations.

The First Stage (end of 19th century to 1945)

During the 19th century, police officers worked in nearly complete isolation. Their means of transportation were limited to horse-drawn carriages and bicycles, and communication systems were nonexistent except for the telegraph, used occasionally.

The invention of the telephone, the development of motorized transportation and early communication systems, the creation of the first forensic laboratories and the gradual computerization of services slowly modified police work and the overall police organization. Table A shows the first stage of technological development.0.0.0.1

Early Communication Systems

The first communication system was the telegraph. Reviewed police department histories make no mention of its significance or its impact on police work.

The advent of the ?call box?[2] is considered to be the first technological development that actually changed policing. It put an end to police isolation. At first, police officers reacted negatively to this new technology. The Chicago Police Department history states: ?There was much initial opposition to this method because officers feared that they could now be held accountable for their time on duty? (Chicago Police Headquarters Website, historical section, p. 3). These call boxes were improved over time[3] and some of them survived the technological advances of the twentieth century and are still in use in Chicago.

In a letter sent to the police chief in 1885, the mayor of Philadelphia used the following argument to support the installation of call boxes in the city: ? ...Electricity is the one thing that criminals dread. It circumvents all their skill and cunning? (Metro Toronto Police Website, historical section, p. 11). At that time, police management already put a lot of faith in technology.

Impact of these First Communications on Police Work

The main impact of these first communications was breaking the traditional isolation of police officers and increasing their safety level. Also, police officers started to be accountable. This led to the first centralization in its most basic form. The mayor of Philadelphia at the time suggested in his writings that the authorities should anticipate how technology could support police work.

[2] The call box is made up of a cabin containing a telephone, a shelf and a pencil. They were installed throughout the city. Police officers and citizens could access them with a key. Police patrols (horse-drawn carriages called ?paddy wagons?) remained at the station ready to respond to incoming calls. Call boxes were installed in Chicago in 1881 and in Toronto in 1888.

[3] It is interesting to note that Winnipeg was the first city in North America, in 1913, to deploy a slightly more sophisticated communication system. It was called the ?Siemens System? and it enabled the officer not only to communicate regularly with the station, but also to receive calls.

Motor Vehicles

Before 1900, most police departments conducted their patrols on foot. Only a few lucky officers patrolled around the city on bicycles or motorcycles. For example, the Dallas Police Department owned a motorcycle as early as 1890 (Dallas Police Department Website).

The first motor vehicles came into use early in this century.
In Canada, the Winnipeg Police Department acquired a vehicle in 1906, the RCMP purchased its first two vehicles in 1917[4] and the London Police Department did so in 1913. The Toronto Police Department had at least one vehicle in 1914, whereas the Kingston Police Department had no vehicle, no bicycle and no telephone in 1919.

In the United States, the Indianapolis and Chicago Police Departments were the first to acquire a motor vehicle in 1904 and 1906 respectively (IPD and CPH Websites).

Remarkably, the Ontario and Quebec Provincial Police set up their first fleet of patrol vehicles in 1941 and 1945 respectively. These two agencies had been conducting motorcycle patrols since the 1920s. The motorcycles were gradually replaced by vehicles (S.Q., 1995: Highley, 1984).

Impact of Motor Vehicles on Police Work

The advent of the motor vehicle impacted police work as well as the organization as a whole in several ways in both the short and long term. Motor vehicles created new tasks for police officers. They quickly became an indispensable policing tool. However, the automobile soon became a very popular consumer good[5] and some people started using it to break the law. Overall, the automobile had a major impact on law enforcement. First, right from the beginning of this century police officers had to enforce laws dealing with motor vehicles and impaired driving[6], vehicle theft and burglarized vehicles. They also had to respond when motor vehicles were used to commit offenses not directly related to the vehicle itself, such as bank robberies and driving across the border to flee from justice (Chicago Police Headquarters Website).
The automobile gave greater mobility to the police. They could cover a larger area more quickly. As road traffic increased in North America, specialized traffic enforcement units were established. We therefore suggest that the automobile contributed to the development of the existing police organizational structure.

Forensic Laboratories

According to an on-line document published by the Quebec Department of Public Security, the first known forensic labs were created in Paris in 1868, in Lyon in 1910 and in Montreal in 1914. Their objective was to help the police track down offenders. At the start of the century, the managers of these labs had a basic knowledge in forensic medicine, chemistry and physics. This knowledge was used to develop scientific evidence.

However, these labs truly emerged a little later, during the 1930s. It is during this period that large police departments around the world created their first forensic labs. Between 1932 and 1939, forensic labs were established by the FBI, the New Scotland Yard, New York State Patrol, the RCMP as well as the Chicago and San Diego Police Departments (see the Websites for these agencies).

Over time and as the knowledge expanded, the staff became more diversified and new specialties were created: biology, toxicology, physical and organic chemistry, ballistics and counterfeit documentation. In recent

[4] They were used to patrol the border between Manitoba and the United States.

[5] When the Ford manufacturing plant was created early in this century, the objective was to build a car for each American family (Lacey, 1987).

[6] Starting early in this century, laws dealing with motor vehicles and impaired driving were passed both in Canada and the United States. For example, the *Motor Vehicle Act* was promulgated in Quebec in 1904 (Quebec Statutes, 1904, c. 30). No vehicles were registered in the province at that time. In Ontario, the legislation was passed in 1903 and 178 vehicles were registered that year. Impaired driving legislation soon followed in Ontario, in 1906, and in Quebec in 1907. All the other provinces did the same, except New Brunswick (Soullière, 1989).

years experts in genetics (DNA testing), electronics, computer engineering, odontology, radiology, even anthropology and forensic entomology joined these laboratories.

Using the RCMP Forensic Labs as an Example
When the first RCMP forensic lab was opened in 1937, it was staffed by only one person, a physician, working in a small room in Regina, Saskatchewan. In 1942, a second lab was created in cooperation with the National Research Council of Canada in a location now occupied by the Canadian Police College, in Ottawa. By 1969, the RCMP had five labs. Today, over 300 forensic experts work in six RCMP forensic laboratories (*Pony Express*, Dec. 1997).

Impact of Forensic Labs on Police Work[7]
The knowledge acquired by forensic lab workers became a policing tool and it gave law enforcement access to information previously unavailable due to the stage of development of chemistry, biology and physics at the time. In addition, whenever the science involved in the development of forensic technology made advances, it benefited the police as it created new allies in the search for evidence.

The First Radio Communications from a Patrol Car

The reviewed literature suggests that radio communications were very important. The first systems were installed at the end of the 1920s. Indianapolis was, according to its history, the second department in North America to put radio communications in its patrol cars, in 1929. Chicago was probably the first, also in 1929.

The first communication system used a one-way radio. With this system, patrolmen could receive calls from the station but they were unable to communicate with the station. In many cases, these communications were routed through a local AM radio station.

Two-way radios were introduced only at the end of the 1930s. All patrol cars in the Chicago Police Department were equipped with a transmitter-receiver system starting in 1942. San Diego began to use this technology in 1936. Patrol officers could receive and transmit messages to the station. The Winnipeg Police Department, in Manitoba, staffed by the RCMP, was the first in Canada to use this system, in 1939, followed by Kingston, Ontario, the same year.

At the end of the 1940s, the advent of the walkie-talkie provided patrol officers with car-to-car communications. Then, in the early 1950s, a new telephone system called ?point-to-point telephone? enabled patrol officers to communicate with fixed stations in the suburbs as well as with the county and state police (Chicago Police Headquarters Website)[8].

Using the Ontario Provincial Police as an Example
The best known and best documented example in Canada is the Ontario Provincial Police. A few facts on the installation of the new radio communication system are provided below.

It is during a miner=s strike in Kirkland Lake, in 1941, that police officers used for the first time a two-way communication system mounted in patrol cars, also acquired in 1941. This transmitter-receiver system enabled the officers to communicate with the Kirkland Lake Police Station from their cars.

In 1945[9], the Canadian Radio Technical Planning Board (Ottawa) awarded radio frequencies to the OPP. In 1946, a budget of $500,000 was voted for the installation of the new system. The system was inaugurated on Nov 27, 1947 and the Radio Communication Branch was formed by the OPP. When the installations were completed in late 1948, there were 41 stations and 300 vehicles equipped with the new radio communication system (Higley, 1984).

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[7] Forensic labs are discussed in greater detail in Part II.

[8] It should be emphasized here that the ?war effort? produced several technological advances, especially in communications (New York State Patrol Website).

[9] A large number of municipal police departments were already using this modern communication system at the time (Higley, 1948).

This system provided communications between fixed stations such as the headquarters and a district, between a district and a detachment, between a station and a patrol car and also between patrol cars over a distance ranging from 7 to 20 miles.

In his annual report in 1948 entitled *Report of the Commissioner of the Ontario Provincial Police* (1948), the OPP Commissioner gave an account of the members= comments. The radio communication system newly installed in patrol cars received a lot of praise. The comments below are excerpts from this report:

...I have also pleasure to report that our radio system, since its inauguration in November 1947, has proven its worth on many occasions...We made rapid captures, solely trough the medium of radio, of fifty different criminals... During the past year, our radio system also handled many compassionate messages and errands of mercy... it has further proved of great assistance in locating missing persons. ...Radio has also had a tendency to knit the Ontario Provincial Police Force more closely together in the past year by making it possible to keep in constant touch with our many detachments and mobile unit.(Report of the Commissioner of the Ontario Provincial Police, 1948, p.9).

Impact of Radio Communication on Police Work

As radio communications improved over time, police officers were able to respond more quickly, track down suspects more rapidly, even outside their territory, and communicate information concerning an incident from the station or from the patrol car, thus making it possible for the people nearest to the scene to respond without delay.

The officers could also set up road blocks, provide assistance, improve relations with members of other police departments and increase their safety level as they were able to call for help.

Police management was thus able to increase centralization. The creation of a specialized radio communication section in police departments supported centralization and enabled managers to monitor more closely the whereabouts of their patrol officers and to organize their work more efficiently.

Stage Summary

The first stage was marked by two world wars. The technological advances generated by the ?war effort? undoubtedly speeded up the development of radio communications.

During this stage, the police acquired greater mobility with the advent of motor vehicles, an ability to communicate over distances with the telephone and vehicle-mounted radios, and access to more information through forensic lab experts. These three major developments impacted police work and police organization in at least seven different ways.

1) Creation of criminal laws which increased the number of tasks, especially as it related to the automobile, which became widespread fairly quickly.

2) A larger number of tasks led to the creation of specialized sections within law enforcement: for example, traffic, radio communications and forensic labs, at least in large departments. The organizational structure was thus modified.

3) Technology provided law enforcement with indispensable tools.

4) An expanded territory: the automobile covered a larger area more quickly; communications made it possible to transmit and receive information over long distances; technologies used in labs provided access to information previously unavailable due to the stage of development of biology, chemistry and physics in the past.

5) These three technologies were designed by experts who made constant advances in research and development in their fields. These advances were shared with law enforcement.

6) The use of motor vehicles and communications increased the safety of police officers.

7) All these developments plus an increase in the number of tasks and the creation of specialized sections led to a more complex police organization. In the late 50s, as the organization was becoming more complex, file management was centralized and the organization was restructured. Centralization was a consequence of technological development, but it became a requirement in order to use more effectively these new developments. Data computerization occurred during the next stage.

The Second Stage (1946-1959)

Reviewed police department histories placed little emphasis on this stage, as if this period of stabilization and assimilation of new tools were a pause before the great turmoil of the 1960s and 70s.

Communications

From 1946 to 1959, communications were improved somewhat with the advent of the generator-operated portable walkie-talkie. Also, the Chicago Police Department started sending suspect photos with a teleprinter. Finally, the first 911 emergency response service (999 at the time) in North America was set up in Winnipeg, Manitoba. The 911 line being first installed in Winnipeg put this city once again among the pioneers.[10]

Impact of these Technologies

The portable walkie-talkie improved the safety of police officers outside the cruisers, at short range. Documents started to be transmitted more quickly and securely. The 911 emergency line connected together the various city emergency services, such as the police, fire department, hospitals.

Two Technological Advances for the Traffic Police

During the second stage, several departments reorganized their traffic section. Two technological advances designed for the traffic police stand out, i.e. a speed detector and an alcohol testing device in their most basic form.

These two instruments were used directly for law enforcement. The first was called a *drunkometer* and it was used to enforce the legislation on impaired driving. The second was designed to check vehicle speed. The traffic police was equipped for the first time to enforce the law in these specific cases.

Impact of these Technological Advances

These instruments were considered to be ?scientific? devices used to measure drunkenness and vehicle speed. With these devices, the police could enhance the quality of their evidence, reduce challenges and validate arrests and prosecutions.

Centralization of Files

During the 1950s, some departments reorganized their files and created a central registry. These actions by the police only mirrored what was happening in other public and private institutions at the time.

Impact of the Centralization of Files

The police continued to forge ahead and eventually joined the reorganization and computerization movement of the 1960s and 70s.

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[10] The development of the Winnipeg Police Department is not the subject of this paper, but we could not resist mentioning a few facts concerning this department. The Winnipeg Police Department acquired a motor vehicle as early as 1904 (the same year as Indianapolis and two years before Chicago). Winnipeg installed the Siemens System in 1913, the first communication system of its kind in North America. In 1917, the first two motor vehicles purchased by the RCMP were used to patrol the border between Manitoba and the US. The Winnipeg Police Department started using a two-way communication system in 1939, a Canadian first. Finally, the first 911 emergency response service in North America was set up in Winnipeg in 1959 (the number was 999 at the time).

Stage Summary

This second stage of technological development was marked by the emergence of a bureaucratic police. However, this may have started earlier[11].

This stage was also marked by the advent of the 911 emergency response line in North America. It was eventually implemented by all police departments, although in most cases this only occurred much later, in the 1970s, 80s and even 90s. Emergency services started to work more closely together, thus delivering better services to the community.

During this stage, the traffic police acquired its first instruments designed to measure vehicle speed and the state of drunkenness of the driver. These instruments were directly related to law enforcement and they were used by a specific type of police officer, i.e. the traffic officer. These ?scientific? instruments increased the credibility of the traffic police.

The Third Stage(1960-1979)

During the 1960s, modern management and reorganization were emphasized. This new approach was reinforced by the advent of the computer during this decade. The computerization of police files started at that time and it has continued ever since.

Communications were improved, mainly due to the computer, and during the 1970s, telephone exchanges saw major improvements with the advent of the call distribution system and the Computer Aid Dispatch (CAD). In addition, the first computerized databanks were created during the 1960s and 70s.

Let=s use the Quebec Provincial Police (Sûreté du Québec) as an example. The QPP underwent a first reorganization in 1961[12]. In 1969, it went through a second reorganization, based on modern management principles, and it created a computer unit. In 1974, the Quebec Police Information Centre (QPIC) became operational and it was linked to the Canadian Police Information Centre (CPIC), which had been launched in 1972.
During this stage, police managers as well as members began to see that technological developments were beneficial to them and that such advances could be enhanced through a partnership with other government agencies.

Communications and Databank Networks

Two items stood out. First, the enhancement of vehicle-mounted communication systems with the installation of two-way radios , the improvement of telephone exchanges and the advent of the Computer Aid Dispatch (CAD) system[13]. These go hand in hand with the improvement of radio communications and the introduction of the 911 emergency response line

In addition, computerized databank networks were one of the main technological developments in police communication during this stage.

Using the RCMP=s Canadian Police Information Centre as an Example

The CPIC creates links with police departments[14] and also government agencies. It was launched in 1972. It expanded during the last 26 years and it has now attained the following status:

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[11] In fact, management emerged early in this century (*Sciences Humaines,* April-May 1998).

[12] After the death of Maurice Duplessis, Quebec society as a whole, including the police, was reorganized and transformed.

[13] The 911 emergency response line continued to be installed in the departments.

[14] Databank network: in 1965 the London (Ont.) Department was linked to the Ontario Police Forces Network. In 1969, the Orlando Police Department was linked to the Florida Crime Information Center (FCIC). The CPIC was launched in 1972 and it was linked to the QPIC in 1974. In 1972, the New York State Patrol was linked to the New York State Criminal Justice. In 1973, the New York State Patrol was linked to the New York State Department of Motor Vehicles.

This integrated computer-based system provides information to police departments across Canada on offenses and offenders, by allowing direct access to operational data. Access to the main computer is through telecommunication lines connected to computer terminals strategically located all over Canada. It contains the following files: vehicles (registration in each province, stolen vehicles, abandoned vehicles), persons, property, navigation, summarized police records, dental features, inmates, vagrants, wanted persons, paroled persons, indicted persons, persons under prohibition (such as alcohol, firearms, driving a vehicle) and persons under the control of the Correctional Services. The CPIC is linked to the National Crime Information Center (NCIC) in the US and to various state databanks through an interface called the Automated Canadian United States Police Information Exchange System (ACUPIES). This interface is managed by the RCMP=s Interpol Section in Ottawa. The FBI/NCIC computer system can also be used to search for individuals, vehicles, property and police records, or to check ownership certificates and driver=s licences in all 50 states (RCMP Website).

Impact of Communications and Databank Networks on Police Work
The creation of databank networks made it possible for police officers to obtain information more quickly from a variety of sources such as government agencies and police organizations in Canada and abroad. This enhanced police safety.

Improved communications led to greater centralization and bureaucratization.

Management, Reorganization, Computerization

Several police departments underwent a reorganization in the 1960s and 70s based on the modern management philosophy. This marked the beginning of the bureaucratization process in police departments. Sections were dismantled and new ones were created. Police training increasingly became a priority for managers and training institutions were established.

Around the mid-1960s, computer technology began to emerge and computer sections were gradually created in police departments, starting with the larger ones[15]. The computerization process was certainly not linear.

Impact of the Reorganization and Computerization Movements
The computerization of police activities led to the creation of computer sections. With the advent of computers, staffing levels had to be increased both for police officers and civilians specialized in computer science and administration.

Improved communications increased officer safety and led to greater centralization. On the other hand, police reorganization gave rise to regionalization, delegation and control (management from the 1960s and 70s).

Research and Development

This stage was marked by an increasing commitment to computer technology and applications by police organizations. The police started to see how technology could help them in law enforcement, decision making, investigation, modernization and management of the organization. Let=s use as an example what was done in the United States and Germany at the time. This seemed to reflect what the concerns of the time were, or at least what they would soon be, in the western world.

In 1966, a presidential commission on law enforcement and justice had to deal with an increase in the number and sophistication of crimes in the United States. One of the nine areas discussed by the Commisson was the *Task Force*. One of the conclusions of the *Task Force Report on Science and Technology* reads as follows:

[15] For example, New York State Patrol in 1965, the Quebec Provincial Police in 1969 and the London (Ont.) Police Department in 1975.

...although the science and technology have long been used to help police solve specific crimes, the professionals in those fields - the scientists and engineers - have had little impact on the operations of the criminal justice system (NIJ, 1994, p.32).[16]

The Commission report mentions that several devices aleady existed either as prototypes or on the market. In other cases, the feasibility had been demonstrated and future research could produce good results. However, even the devices and equipment already available could only be absorbed slowly by law enforcement. The reasons given to explain this situation were: limited funding, lack of motivation by the industry to conduct research and develop products for a highly fragmented market, and finally, few employees within the criminal justice system were trained and skilled in the area of technology.

The National Institute of Justice (NIJ) was created in 1968 to respond to the expectations of the criminal justice system in the area of technology. Its responsibility was to focus on the development of new technology for law enforcement. As early as 1968, the NIJ started distributing grants and held its first discussions with other federal agencies, including the Department of Defense. Today the NIJ is more active than ever.

The first discussions with the Department of Defense concerning technological equipment[17] covered two-way radios for law enforcement, crowd control agents, night vision equipment and non-lethal bullets. The NIJ started to attend, as an observer, the regular meetings of the Federal Council on Science and Technology, and was formally involved with the Department of Defense in a study conducted by this agency. The Transportation Department, the Department of Housing and Urban Development and the National Aeronautics and Space Administration (NASA) also took part in the study (NIJ, 1994, p. 33).

The first NIJ grant was given to the police department in Newton, Massachusetts, for testing six models of night vision equipment. This positive experience is directly responsible for the widespread use of night vision equipment by law enforcement in the United States today.

The NIJ produced many innovations in the 1970s. With a 250% increase in its budget (it had a budget of five million dollars in 1972) it got involved in developing air patrol mobility. However, weapons were its main focus. The International Association of Chiefs of Police (IACP) launched a police practice evaluation program dealing with firearms, to assess the equipment available, such as rifles, water cannons, protective masks and bullet-proof vests.

In 1971, the NIJ set up the National Law Enforcement Standards Laboratory (NLESL). It was responsible for developing the basic scientific criteria that were to be met before commercial equipment could be recognized by the police. This enabled the police to select high quality equipent at low cost. The NLESL also certified laboratories where this equipment was to be evaluated against the standards set by the NLESL.

Also, as early as 1957 in Germany, a permanent committee under the Federal and Länder Ministries of the Interior created a subcommittee[18] to ...*standardize police equipment in the Federal Republic of Germany, coordinate the approach to all technical problems and develop unique instructions for police operation and management* (Rebscher, 1993). The Police Procedures Research and Development Centre[19] was created in 1975. Rebscher (1993) mentions that *the Centre must apply its results directly to police practices while taking into account operational, organizational, personnel, budget and legislative requirements*.

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[16] A report from the Cleveland Bar Association published in 1912 says more or less the same thing: *The Foundation-s findings criticized the police for not keeping pace with modern demands and not developing effective techniques to address advanced social and industrial conditions* (NIJ,1994 p.51).

[17] It should be noted that these discussions did not cover only technology but also such topics as giving offenders a second chance at enrolment, and rehabilitation methods used by the military (NIJ, 1994, p. 32).

[18] Called *Technische Komission*.

[19] Forschungsund Entwicklungsstelle für Polizeitechnick (FESTPT).

Other police research centres exist and are very active around the world today, including the Police Scientific Development Branch, in Great Britain, and the Canadian Police Research Centre, in Canada.

Impact of Police Research Centres on Police Work

These research centres implemented various programs and financed technological acquisitions by police departments. Their mandate was to provide greater safety both to the police and the public. To achieve this they took into account the needs expressed by officers in the field and they standardized the equipment based on police standards. The research centres were indirectly responsible for making police equipment more affordable and more efficient, while controlling all the equipment used by the various police departments in the country. They also made it possible for police organizations to be gradually recognized as major and serious customers by the private sector.

Stage Summary

Police technology truly emerged during the 1960s and 70s. This was the start of computerization, and most of the technologies that evolved during the following decades were based on computers.

Call distribution centres, computerized databanks and computer sections, in large departments, emerged during this stage. The overall capacity of police officers to access and collate information in databank networks with the use of a computer was increased. Also, police staffing levels rose and the first civilian specialists were hired. Bureaucratization and management in general kept expanding.

Police safety increased: officers could make queries on suspects from the field using databanks such as QPIC and CPIC.

Police technology became more complex. Research and development on technology specifically designed for law enforcement was truly structured for the first time.

Technological developments implemented since the beginning of this century have helped law enforcement in the areas of mobility, communications, management and identification. During the 1960s and 70s, which were very productive years in terms of technological developments, police organizations reached a point of no return with respect to the financial burden resulting from the purchase of new technologies, the replacement of obsolete technologies and maintenance of the equipment in use. In addition, the responsible ministries started to invest in research and development on new technology specifically designed for law enforcement.

The Fourth Stage of Technological Development (1980-1999): Current Status

Introduction

The book *War and Anti-War* (Toffler, 1993) was the starting point for our research on police technology. When we read this book we realized that despite working very extensively on the topic of social order and disorder (LeBeuf & Soullière, 1996a) over a two-year period, some of the facts were overlooked, including infrasonic testing conducted by the police in France and the US during demonstrations (Marx, 1993; Toffler, 1993). Infrasound could be used to disperse crowds of protesters. It can cause nausea, dizziness and diarrhea, thus forcing the protesters to leave. This technology may have been feasible but, on a more practical level, we decided to look at existing technologies used by the police.

Police organizations have become dependent on technology and this technology generates recurring costs. However, they cannot go back. They must stay on course in order keep up with the technology available to criminals, maintain their professional and scientific reputation and retain their legitimacy. In addition, the historical review shows that technology, instead of being a support to the police, is instrumental in structuring the organization. These two elements, i.e. the irreversibility of the process and the fact that technology helps build up the organization, are critical to understanding current technological developments in law enforcement.

The historical review on police technology shows that since the end of the nineteenth century, law enforcement has benefited from technology developed by scientists. This relationship between science and the police did not have the same intensity throughout the twentieth century. Indeed, since the 1960s and 70s, the pace of technological change has greatly increased. It is now so fast that it is very difficult to keep up. This acceleration is due mostly to the incredible advances made in computer science.

Part II deals specifically with the relationship between technology and the police, technological advances made by law enforcement since the 1980s and the technology currently used or under development. This is the fourth stage of technological development. Technologies are identified based on their ability to provide the police with a greater amount of information, to provide such information more quickly and/or give access to data which would have been unavailable without these technological tools. Part II briefly discusses each known technology used by law enforcement to gain a wider access to information, i.e. telecommunications, mobile data computers, expert systems, imaging, labs and biometric technology. At least one implementation location is mentioned. A few technologies currently under development, production or use in private institutions are also identified. We also look at police research centres around the world and international conferences on police technology. Clandestine technology, technological weapons, non-lethal weapons and less-than-lethal weapons are not discussed here.

Three main objectives were identified: review the technologies currently used, specify the issues related to their use and identify research options.

To conclude, we describe the main points of the review, the major issues related to the use of technology and the most exciting research options.

Telecommunications

> *Police cars have become mobile offices and technological laboratories. They are ›wired‹ with voice radios, cellular telephones, computer-assisted dispatch terminals, laptop computers, radar, video cameras, remote microphones, breathalyser equipment, fax machines, printers and vehicle locators...The wired nature of the police car is evident when one looks at the vehicle›s exterior, which, because a separate antenna is required for each electronic device, takes on the appearance of an ›antenna farm‹* (Ericson,1996, p.135).

Police departments around the world use various telecommunication networks at the local, national and international levels. These networks help police officers in their management, investigation and decision-making activities.

Communication technology is particularly complex, perhaps the most complex technology used by law enforcement. Its stated purpose is to provide police officers with the most secure communications possible as well as a more direct and quicker access to data banks containing various information files. Effectiveness in terms of call distribution and standardization of communications is the objective. These communication systems are by definition interconnected; they do not stand alone.

Some communication systems, such as the Integrated Police Telecommunications Network used by the Sûreté du Québec*[20], are mainly used for call management. Automated dispatch systems allow operational transmission stations to capture relevant information on incidents, for file management or patrol dispatch (CAD)[21] (Sûreté du Québec Website).

Other systems can be used during police operations for investigative or decision-making purposes, for example the Canadian Police Information Centre (CPIC)* and the Quebec Police Information Centre (QPIC)*, connected to the CPIC (Sûreté du Québec and RCMP Websites).

When mobility, security and flexibility are critical factors, some police departments, including the RCMP, have access to a portable encrypted satellite telecommunication system. This system prevents line overload during emergency or disaster situations.

Also the satellite-based Global Positioning System[22] is used by some police departments responsible for large areas, such as the des Collines Regional County Municipality Police Department. This system also increases the safety of patrol officers in large departments. For that reason, the Montreal Urban Community Police Department plans to use such a system.

In Germany, the INPOL-NEU* electronic police information system has been available to all police officers in that country for over 20 years (Inpol at the time). BKA provides the central system (Rebscher, 1993). In France, RUBIS supports the *Gendarmerie nationale* and ACROPOLE* from the Ministry of the Interior is available to all units of the *Police nationale*. The ACROPOLE communication system gives police officers access to databanks on wanted persons, stolen vehicles and verbal description of suspects (French Ministry of the Interior Website).

Great Britain=s Telecommunications Group (TG) is responsible to the Home Office for emergency communications through the Emergency Communications Network (ECN), which is connected to the central government. This network is protected against nuclear electromagnetic radiation as it can affect communications and the operation of electronic equipment. The TG system also handles government communications considered unsuitable for transmission via commercial means. It is also responsible for the NATO Civil Communications Planning Committee as well as for providing technical advice to the Home Office (and other government agencies) on issues related to emergency communications (Home Office Website under Telecommunications).

In the United States, the National Institute of Justice (1998) published the results of a study entitled ?Wireless Communications and Interoperability among State and Local Law Enforcement Agencies?. This somewhat technical document discussing low UHF, Mhz and radio wave spectra led to the creation of the National Public

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[21] CAD: Computer Aid Dispatch.

[22] GPS satellites can locate a vehicle anywhere in the world. Signals sent by these satellites are picked up by a GPS receiver in the vehicle. These signals are processed and transmitted via radio to a dispatch centre where vehicle positions can be displayed on a map. Generally, these positions are fed to a management system used by the dispatcher for decision-making purposes (Mobilair-Integration Website).

Safety Telecommunications Council (NPSTC). Interpol and its ICPO* telecommunications network must also be taken into account.

The multiplication and integration of communication systems, whether for law enforcement or other government agencies, seem to be the prevailing trend.

Communication Systems in Patrol Cars

At the present time, two systems can be mounted in patrol cars: a Mobile Data Terminal and a Mobile Data Computer.

Mobile Data Terminal [23]

All Canadian police officers have access to this terminal. It is used for searches in the Canadian Police Information Centre (CPIC) and the Police Information Retrieval System (PIRS). In Quebec, the police can query the Quebec Police Information Centre (QPIC). With these systems, police officers can access data directly and they can obtain it more quickly. These systems are said to be secure as journalists and scanner users[24] are unable to intercept their communications.

The various levels of government in the United States have invested heavily to provide this equipment to police departments, whatever their size. In 1997, 1.29 billion dollars were spent on the MDT and CAD (Computer Aid Dispatch) systems. In 2002, $2.59 billion will be budgeted for that purpose (Washington Technology, vol. 13, no. 7, p. 20, July 2, 1998, on the NLECTC Website). Canada has no such programs and police departments must provide their own funds for that equipment in their budgets.

Mobile Data Computer[25]

The Mobile Data Computer is used by police officers to conduct searches in databanks from their patrol cars. They can send reports and messages, search for numbers in databanks and change their status while sitting in the car. They can also communicate with other patrol cars without going through the station. When a call comes in, the information is sent directly to the officer on the Mobile Data Computer. Files can be downloaded, updated and closed without going to the office. In addition, the system gives a warning when important information is missing. The need for a report supervisor is thus called into question (Ericson & Haggerty, 1996).

In Canada, several police departments use Mobile Data Computers, i.e. in Ontario: Toronto, Hamilton-Wentworth and London; in Quebec: Terrebonne, Drumondville, Lévis, Québec, Laval, Brossard, St-Jérôme, Sherbrooke, Hull[26], Des Collines and Haute St-Charles RCM. The Calgary Police Department, in Alberta, and the Vancouver Police Department, in British Columbia, are also equipped with Mobile Data Computers. The RCMP Burnaby Detachment, in British Columbia, has been using portable computers in 45 of its patrol cars since February 1996 (*Pony Express*, December 1997).

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[23] Bike patrols in Alexandria, Virginia (USA) are now equipped with a terminal (the Unwired Cop). It is mounted on the back of the bike(Law and Order, vol. 46, no. 4, April 8, 1998).

[24] However, a Website on Mobile Data Terminals is now posted. It describes the equipment (available from Radio Shack) and provides decryption codes giving access to data contained on the MDT: **http://www.people.qualcomm.com/crypto/MDT.html**.

[25] Foot patrols in Great Britain will soon have a microcomputer just like vehicle patrols. Whatever their location, officers on foot will have access to the same information as officers in patrol cars. This system has an emergency button that can be pressed by the officer to ask for help. The officer=s location can be pinpointed by the Global Positioning System. The first department to use this system was Hartlepool, Cleveland. This device is small and light and it costs ,1000 (July 9, 1998: BBC News).

[26] The Hull Police Department is currently involved in an equipment replacement process. The first computers were mounted in their patrol cars in 1992.

On the other hand, large agencies such as the Sûreté du Québec, the Ontario Provincial Police, the Montreal Urban Community Police Department and the Royal Canadian Mounted Police as a whole are not equipped with this system. This is due to the fact that computer installation costs are linked to radio coverage costs, which are themselves related to the size of the area covered, hence an easier access for mid-size departments.

Comments

An article published in the RCMP=s *Pony Express* (December 1997) reports that police officers who have access to a mobile computer already consider it a must item. Also, police managers are discovering that these computers not only save time, but contain less mistakes and are more accurate. Therefore, both managers and employees are satisfied. Does the current (or future) relationship between law enforcement and technology make police officers better able to respond to the community or to technology itself? In other words, will the performance required by computer technology take precedence over police work? What are the advantages and potential adverse effects of computer technology in patrol cars? Does this ultimately improve police work?

According to Ericson & Haggerty (1996), communication technology solves problems while creating others. For example, MDT and CAD systems are sometimes used by patrolmen ?as toys to communicate?[27], to set up informal meetings or conduct random checks[28]. Ericson & Haggerty (1996) put it this way: ?We found that up to 15% of shift time was spent on random checks of vehicles on the road or in parking lots... The only limits on such checks are the officer=s time and keyboarding speed? (p. 140).

This system is also used by managers to more closely control patrol officers. They can keep track of when the officers are in or out of the car, the number of checks done on the CPIC, the number of telephone and radio calls and the number of times the computer was used. Ericson & Haggerty state that as a result, police officers feel they are restrained and even coerced by technology. Even ticketing is controlled by this technology and it is instrumental in reducing their discretionary powers. Indeed, the officer is required to provide a justification when a courtesy ticket is issued, which is different from an actual summons.

The officers feel they are being watched (Ericson & Haggerty) and they resort to various means to elude this supervision[29]. Those who were interviewed by Ericson & Haggerty (1996) stress that their job has become ?too machine-oriented? (p. 135). This affects their work. The reality is on the screen, while the observations made outside the vehicle become twisted (p. 416).

Finally, vehicle-mounted computers supported by communication systems were supposed to produce a paperless environment. However, this is not what happened according to Ericson & Haggerty (1996). The officers seem to think that a lot of paper is evidence of their work, even though the case is not solved.

The Internet

The Internet is a telecommunications network which has been in operation in its current form since 1993. It is used by police agencies all over the world. The Home Office, the Federal Bureau of Investigation (FBI), Scotland Yard, Interpol and the French National Police as well as the Royal Canadian Mounted Police (RCMP), the Quebec Provincial Police (Sûreté du Québec), the Montreal Urban Community Police Department and the Ontario Provincial Police all have a Website. Several other Canadian and American police departments are also on the Web (a few of these sites are shown in the References).

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[27] Police managers are aware of this situation. Increasingly, police officers are required to identify themselves with a personal identification number or an access card to use the mobile computer. This procedure leaves a trail and provides for some control.

[28] A member of the RCMP stated during an informal discussion that police officers have a tendency to conduct checks more often and on more people without a serious reason for doing so.

[29] For example, before taking a break the officer should theoretically enter it on the MDT and send the message. However, some write the message without sending it. If a supervisor happens to come by, the officer shows him the message and suggests that the computer failed to send it (Ericson & Haggerty, 1996, p. 413).

The Internet helps police departments, particularly those involved in community policing, work more closely with community members. This network can also be used by citizens to provide anonymous tips to the police.

In addition, some sites such as those of the RCMP, the FBI and Interpol display the photos of their most wanted criminals. This helps track down fugitives. For example, an Australian citizen who had murdered someone in Great Britain was arrested in the United States. The police in the U.S. had seen the picture of this person on the Interpol Website. This arrest was made possible through a combination of the Internet and the ever more sophisticated communication systems, which bring together police departments from around the world: ?Scotland Yard Detective Chief Inspector said that once the police discovered their suspect had left the UK, the details were circulated throughout the United States very, very quickly. He was on America=s most wanted list within a day, DCI said, adding that these computer links would be valuable to both sides in the future? (BBC News, July 29, 1998).

The Internet is widely used by the public. As was the case with motor vehicles and computers, new tasks are being created for law enforcement. There is now a cyberpolice; law enforcement opportunities in cyberspace are being assessed by the RCMP=s Informatics Field Support Branch. In fact, the Internet has increased crime opportunities by providing new means to commit conventional crimes (child pornography, fraud, money laundering, child prostitution, hate propaganda, etc.). Already, police units are assigned exclusively to technological crime, including Internet crime, i.e., in Canada, the Computer Crime Section of the RCMP (RCMP Website under technological crime) and in the U.S., the FBI=s Computer Squad (FBI Site). Concepts such as Internet police, cyberpolice, electronic investigation, etc. are discussed within the RCMP.

Encryption[30] is thus becoming a concern for the law enforcement community. Considered to be a major issue both for governments and the police, encryption allows Internet users to protect their data from intruders, but also to avoid scrutiny by the authorities. It is a major concern on another level for Internet designers because if the authorities take this advantage away from them they could well see their creation altered[31].

Police Databanks on the Internet

In the United States, more specifically in Ohio, a database on inmates[32] is available on the Internet. The name or number of the inmate can provide access to the following data: name, offenses committed, date of incarceration, minimum and maximum sentence, date of parole board hearing and possible date of release. Already four American states operate a Website of this kind.

The Law, Law Enforcement and the Internet

If offenses can be reported to the police via E-mail, it is also possible for the police to uncover these offenses by themselves. For example, in the United States, a man was sentenced to 30 years in prison for the murder of his daughter after he confessed to the crime in a chat group. However, this confession stirred a debate as the chat group participants believed that this information should have remained private (BBC News, August 8, 1998).

The Internet and Police Training

Police training is increasingly recognized as a priority by police management. However, police managers must accommodate labour contracts and shoulder a temporary loss of expertise when officers are away on training.

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[30] Encryption is the cornerstone of all secure networks. It involves the encoding of data packets sent on the network, to make sure that only addressees holding the decoding key have access to the data (Lexique de Globetrotter.qc.ca).

[31] The FBI Director has introduced a bill that would make it illegal to use encryption technology unless the police have access to the key (*Encryption: Impact on Law Enforcement*, March 1, 1998). Also, on January 30, 1998, Joyce Queen, a British cabinet minister stated that: [Translation] ?Crime fighting in the twenty-first century cannot be done with tools from the twentieth century?. The European Union member states intend to keep a tight control over Internet encryption, i.e. to make sure that their law enforcement agencies have a guaranteed access to decryption keys (BBC News, Jan 30, 1998).

[32] Ohio Offender Database Search: **http://www.drc.state.oh.us/inmate/search.htm**

The authorities have a minimum number of hours required by the responsible state agency. Sending police officers away for training means paying travel, meal and lodging costs. Even if the training session is given locally, it still means that the employees involved will be unavailable during their training and other employees will have to be paid overtime to replace them. Therefore, distance learning is seen as a viable alternative by those responsible for police training. Distance learning tools include videotapes, teleconferencing systems and the Internet[33] (FBI Law Enforcement Bulletin, February 1998).

Comments
Encryption is becoming a national issue in every country because the police and the authorities want to keep their networks inaccessible, while at the same time considering, for security purposes, that they should have access to all communication systems, hence a real debate on Internet encryption.

This brings us to the true motive. This would undoubtedly save police officers a lot of painstaking work as the system up to now, whether encrypted or not, was essentially a coded system with an abstract barrier that could be crossed. This request reflects a commitment to use the law to easily and legally go through electronic barriers.

As cyberspace has extended the territory already covered by the police, it has led to the creation of a new field of work. We now have ?cybercops? who are responsible for tracking down Internet offenders. This new job requires new skills. Indeed, when searching for computer hackers, police officers need more than the usual police skills, which affects training. Investigations on the Internet or on any electronic transaction differ from more traditional investigations. They are governed by slightly different rules. On top of the laws dealing with specific behaviours, there are laws on how the investigation should be conducted and how the evidence should be collected. Also, access to information laws and other legislation[34] must be taken into account.

The Internet has become a public relations tool. Police department Websites can be accessed by citizens to get information from the police. However, these sites are used mainly to promote community policing.

The Internet has also become a tool for whistle blowers, thus providing a new source of information. In addition, it facilitates and supports police training.

Expert Systems

Computer systems make it possible for police officers to quickly gain access to information on individuals who committed specific offenses such as fraud, violent crime, rape, murder and serial murders. These systems are supported by software designed to match up and analyze large amounts of data.

A Few Examples

Expert systems designed for violent crimes include, in Canada, the Violent Crime Linkage Analysis System (VICLAS), which is a national system. The designers of this system were influenced by other effective systems, namely the following used in the United States: Violent Criminal Apprehension Program (VICAP), from the FBI; Sex Crimes Analyses System, in Iowa; Sex Crimes Analysis System (MINN/SCAP), in Minnesota; Homicide Investigation Tracking System (HITS), in Washington; Homicide Investigation & Lead System (HALT); in New York; Homicide Evaluation & Assessment Tracking (HEAT), in New Jersey; ATAC Program, in Pennsylvania. (RCMP Website under VICLAS).

Take the VICLAS system in Canada as an example. The researchers who developed this system studied the software packages for various existing analysis systems (listed above) and requested the cooperation of several behavioural science experts to design a questionnaire on various aspects concerning violent incidents.

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[33] For example, in the United States, training on-line is provided to police officers by Christopher Newport University, in Virginia, the host institution for two on-line training programs, i.e. CNU ONLINE and the Mid-Atlantic Police Supervisory Institute (MAPSI), since 1993 (Law Enforcement Bulletin, Feb 1998, p. 10-14).

[34] See the book by Pierre Trudel *Droit du cyberespace*, Éditions Thémis, 1997.

The questions deal with topics such as victimology, modus operandi, forensic expertise and some details about behaviour. This questionnaire is an investigative tool that takes two hours to complete.

Canada currently operates 10 VICLAS centres; seven of them are managed by the RCMP and the other three by the OPP, the Sûreté du Québec and the Montreal Urban Community Police Department. The main one is operated by the OPP in Orillia. Forty-one employees work full time for VICLAS. The system was restructured in 1997 by connecting all centres to a single database. It was designed to operate on a Quad Pentium Pro 200 with 512 megabytes of RAM and a 16-gigabyte hard disk, with the database loaded on a Microsoft SQL server. The RCMP is working in cooperation with the FBI which is in the process of restructuring its own VICAP program. This partnership will make it possible for these two organizations to exchange information.

VICLAS[35] has been in operation since 1994. In 1997, it contained over 20,000 cases with 3200 links. Belgium, Austria, Australia, the Netherlands, Great Britain and the American states of Tennessee and Indiana have all adopted the Canadian Violent Crime Linkage Analysis System.

Other Canadian expert systems include major accident reconstruction, used at least by the RCMP. Investigators can watch animated accident reconstructions.

There is also the Paint Data Query (PDQ) system used mainly by the RCMP=s forensic chemistry experts. This is the world=s most comprehensive automotive paint database. It is a powerful, searchable database. It contains samples from every manufacturer of automotive paints in North America. This system also provides information on the make, model and manufacturing year of the vehicles on which these paints have been applied since the 1960s. Over 7000 paint systems (combinations of undercoats and top coats) and more than 20,000 individual paint layers are documented. Through a partnership with international working groups, paint samples from around the world are being added, making PDQ a genuinely world-wide database (Johnson, 1997).

The RCMP, in cooperation with the FBI, is currently updating its data for all manufacturers to reflect the current production year. This system enhances the credibility of the testimony given in court by investigators and it restricts the pool of vehicles which could potentially match a given paint sample (Johnson, 1997).

Finally, two other expert systems used in Canada, i.e. CLEIMS and InvestigAID, were developed by the Canadian Police Research Centre. The first one, CLEIMS, is used by police officers to record evidence on a compact disk for purposes of court testimony. To solve a crime, which is the aim of any investigation, investigators have to review and study many documents. With this system, the information can be checked quickly to gain evidence. The second one, InvestigAID, contains data on break-ins. This software is leased to several Canadian police agencies including the Ottawa-Carleton Regional Police Department, the Thunder Bay Police Department, the Metropolitan Toronto Police Department and the Royal Canadian Mounted Police (CPRC, 1997).

Comments
These systems can produce great amounts of information through match-ups.

They improve traditional investigative methods by allowing the investigator to act more quickly, i.e. as soon as possible after the incident, and providing tools that keep him constantly aware of the events and enable him to make cross references automatically. It is sometimes impossible for one individual to remember everything and to identify linkages with various incidents, especially when months and even years have elapsed between events. VICLAS, CLEIMS and InvestigAID are among the expert systems used by investigators to learn more about their cases and to keep some order in their files. The Major Accident Reconstruction System helps officers attain a higher level of technicality and accuracy and makes it possible to solve crimes which, otherwise, could not have been solved or would have required more time.

In a way, these systems give police officers a perfect memory, as long as the data is entered regularly and methodically. How will the police manage these expert systems? Once the data is entered into the system, can it be recovered and under what conditions? Is it desirable for the police to have a perfect memory? Are we safer for all that?

Investigators Concerned About VICLAS

The investigators are not necessarily concerned with the time required to complete the questionnaire. A campaign was conducted to promote VICLAS. A guide on how to complete the questionnaire was prepared and lectures were given to various investigation courses throughout Canada.

Investigators are reluctant to enter their evidence into VICLAS for fear that it might be disclosed. The people in charge of the system certify that it is secure, that only 60 specialists have access to the data and that the information on key evidence is never disclosed, not even to another police officer (RCMP Website under VICLAS).

Crime Mapping

The technology behind the ?crime mapping? system was borrowed from geographers and the military who use it under the name Geographic Information System (GIS).

Police officers have traditionally posted city maps on walls and used tacks to pinpoint the areas where specific types of crimes are prevalent, such as break-ins, homicides, car thefts, etc. The Crime Mapping System enables police officers to quickly display a city map on a computer screen and identify areas of concern.

The territory can be divided into units as small as one metre square. The event number, the type of offense, the date, the name of the officer who wrote the report, the location, etc. are entered into the system. The police can find out quickly the number of offenses committed at or near a specific address, the offenses committed near the address of a person known to law enforcement, whether a known individual lives close to the area where the crime was committed or whether a convicted pedophile lives near a school. Research is being conducted to take full advantage of this information system. The National Institute of Justice (United States) has created a Crime Mapping Research Center[36]. Also, seminars focused exclusively on technology are sponsored every year by the NIJ. This technology is used in Canada, the United States and Europe.

In Canada, the RIGEL[37] system (formerly known as ORION) developed at Simon Fraser University, in Vancouver, should be combined with the RCMP=s VICLAS system (Violent Crime Linkage Analysis System). The RCMP signed a contract with ECRI (Environmental Criminology Research Inc.), in Vancouver, for the first Advanced Geographic Profiling Work Station. In 1997, the RCMP was planning to establish geographic profiling capabilities in Ottawa, Vancouver and Winnipeg. These stations were built on high technology and they will incorporate several investigative tools, including a direct link between RIGEL and VICLAS. This system will conduct automatic searches on violent and sexual offenders based on a ?geoprofile?.

Comments

Crime mapping is designed to quickly identify a city=s crime status. This system can rapidly collect large amounts of data, organize and classify them, and produce a graph in two or three dimensions. If done manually, these tasks would take a long time. For maximum efficiency, current crime data must be entered without delay into the crime mapping software. However, this is not always possible in the present context[38]. This software is configured in a user-friendly way.

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[36] The National Institute of Justice Crime Mapping Research Center is located in Washington and it has been cooperating with the National Law Enforcement and Corrections Technology Center, Rocky Mountain Region, Denver, Colorado. The CMRC provides geographic information on line: **http://www.ojp.usdoj.gov/cmrc**.

[37] Description of the system on the Internet: **http://www.ecri.com/GeoProf.html**.

[38] Information provided by a crime analyst.

With respect to the use of official crime data as basic data, Ericson & Haggerty (1993) quote a police officer who was asked if he was bothered by the fact that only official crime data are considered: ?This is what is real for us. We can only deal with what is real, not with crimes that we can only think are occurring? (p. 137). Ironically, this technology is also used for prospective work.

Performing crime mapping in the context of community policing is justified by the fact that this type of policing brings more information to the system (Ericson & Haggerty, 1993). Race-related data is sometimes used because it is helpful to the investigator. Ericson & Haggerty state their position as follows: ?What this means in practice is that race is called up on the computer screen as an item to be considered when an officer responds to a call or proactively looks out for trouble. The officer is thereby always reminded to think of race as a relevant variable when dealing with people. If the officer should complete an occurrence report which will note the subject=s race, race becomes that much more heavily imprinted on the computer system? (p.283).

Imaging technology

Still and animated photography were also affected by technology. Photography has been part of the police environment for a long time. Witnesses had to go through large photo collections to identify suspects. Fingerprinting involved unpleasant inking sessions. These police tasks have been made easier by technology. This report provides a short description of electronic and computer-related advances that led to the development of the following systems: photo radar, night vision, electronic imaging, hyperspectral cameras, video surveillance cameras, wireless video cameras, nooklooker cameras, digitization of photos, fingerprints, footprints[39], earprints[40], composite sketches.

Photo Radar

A photo radar system includes a camera, a monitor, a videotape recorder, a flash unit and a portable computer. The officer uses the computer to adjust the system and to contact a specific location. Any vehicle exceeding the speed limit when moving across the radar beam is photographed and a summons is sent to the owner by mail. This system can take three pictures per second with a 650-exposure film, which can be replaced in just a few seconds. This makes it ideal for heavy traffic areas. The vehicles can be monitored over four lanes in both directions. This system can also photograph vehicles going through a red light.

The photo radar system is used by traffic patrols in 75 countries. It has been available for about thirty years. Programs were implemented in Great Britain, Australia and New Zealand.

Operating conditions in Canada are as follows: The radar must target areas with a high accident rate or at least traffic problems. A radar site recommended because of its moneymaking potential would not be accepted. The revenues are not kept at the municipal level, they are put into the provincial government=s general fund. Pressures for a radar site come mainly from the public. Before setting up the radar, the patrol officers make sure the recommended speed is not too low. After checking the average driving speed in the area, the officers determine what the recommended speed should be. The officers should wait until the road signs are modified by the municipality before setting up the radar site. The public is aware of all photo radar sites and of the need to slow down in these areas[41].

Public awareness of the sites enhances the credibility of the program. The population supports it more when it is perceived as being fair. During an informal conversation with an RCMP member (04/23/98) we learned

[39] The West Midland Police (Great Britain) is developing a computerized shoeprint data base to identify offenders from the shoes they wear (BBC News, March 2, 1998). The FBI also operates a data base of this kind (RCMP Gazette, Dec-Jan 1999, p. 11).

[40] An ear mould was made for the first time in Great Britain. A facial mapping expert was able to match the ear mould with the suspect=s ear (BBC News, Feb 20, 1998).

[41] For more information check this Website: **http://www.uniserve.com/photoradar**.

that using a photo radar reportedly violates basic rights. This explains why it is not used more. The photo radar was taken out of service in Ontario and Quebec. Only British Columbia still uses it.

One impact mentioned by users is the ?halo effect?. The police noticed a drop in driving speed in areas with no radar system. In Australia between 1989 and 1992, the number of road fatalities fell 50% due to the implementation of a photo radar program combined with a proactive impaired driving program. The Vancouver and Victoria Police Departments reported a 20.3% and a 15% drop in their respective territories in 1997 (RCMP Website).

Electronic Imaging

The RCMP Forensic Identification Unit Photography Section provides electronic imaging to isolate and enlarge video surveillance images for the identification of individuals involved in criminal activities. High-resolution scanning techniques are used to improve negative and positive pictures for purposes of identification. The Photography Section directly supports the investigators (RCMP Website, 1996, Forensic Identification). The MUCPD and the FBI also provide this type of service. Police departments with access to this technology also use it for crime scene investigations. Crime scene photos are computerized and recorded on a compact disk. A compact disk can contain about one hundred photos and it can be used in court. However, the courts are not always equipped to handle this technology. In some cases, adjustments still have to be made between the police and the court in this area.

Hyperspectral Camera

Plants use solar radiations of different wavelengths for the photosynthesis process, i.e. each plant has its own light signature which, in a way, is like a ?finger print?. Research based on this property has helped the police locate marijuana plantations (*Découverte*, Radio-Canada, Saturday Sept 28, 1997). The Sûreté du Québec uses this technique mainly for its drug control section; in 1996, it reportedly helped the Sûreté identify over 300 marijuana crop sites (Quirion & Lamy, 1999).

Night Vision

In the United States, the U.S. Army has tested the following systems for the police: the Saber 203 Illuminator which uses a semiconductor and a low-intensity laser light to illuminate suspects; the Bear Eyes, an infrared sensitive camera designed to see through tinted glass on a car or building; and finally, the Night Eye, a night-vision photographic lens (scope & video recorder & impulse detector). This device is capable of identifying the shape and size of items hidden in luggage or car trunks. It can also detect the heat left in the wake of a swimmer on a water surface.

Thermal imaging and infrared technologies are not recent breakthroughs. They have been around for several years and have been continuously improved by the military in both Canada and the United States. Thermal imaging is also used by the Border Patrol.

One application called "Forward Looking Infrared" (FLIR) was recently mounted on police helicopters in Texas. A camera is connected to a video recording system to allow the police to review a car chase, a crime scene or a stakeout. The NIJ is hoping that the testing conducted by these police departments will provide evidence of greater mobility and flexibility (TECHbeat, Spring 1998, p. 1 and 5). The TECHBEAT article, on the front page, containing the above mentioned information reads as follows:

> ?With a new generation of night vision devices that see in the dark by detecting heat, there is no more hiding in dark corners, crawling under bushes, or crossing borders on a moonless night. No more tossing out of evidence, ditching weapons, or stashing drugs. Serving as test beds for these lightweight, handled thermal imaging devices, 10 Texas police agencies are putting some new ?heat? on criminals by getting them out of the dark? (TECHbeat, NELCTC, Spring 1998, p.1).

Comments: This night vision technology does not appear to be used routinely by Canadian police agencies. However, one can easily imagine that it will ultimately become a regular working tool like the others. The police should have no problems providing a rationale for this technology.

Video Surveillance (CCTV[42] and Camcorder)

Video surveillance is widespread in businesses, industrial plants and public institutions (universities, hospitals, government offices). Law enforcement also uses cameras in various ways.

In Canada, police surveillance cameras have been installed downtown in Drummondville, Sherbrooke and Hull. Activities occurring downtown can be monitored from the police headquarters. Based on what they see on the monitor, the police officers can decide whether they need to respond. The use of surveillance cameras by Canadian law enforcement agencies is governed by specific legal guidelines[43]. These cameras are also used for conducting investigations and monitoring designated areas. Also, the Sûreté du Québec systematically records its crowd control operations with camcorders (Le Beuf & Soullière, 1995).

The RCMP has been using closed-circuit television systems (CCTV) since 1993 in its patrol cars. These systems include a VHS camera mounted in the vehicle and a wireless microphone worn by the officer. They have a reading function and they can be connected to a radar displaying the speed of an intercepted vehicle. A significant drop in not-guilty pleas for speeding and impaired driving violations has been observed (RCMP Website, Traffic).

Ericson & Haggerty (1996) report that vehicle-mounted cameras have allowed police officers to be more creative. They can anticipate the multiple potential applications of these cameras: ?Anything that your imagination could come up with? (p. 138). The applications suggested by the police officers that were interviewed by the authors include: surveillance of suspects, individuals who hang out in bars, union demonstrations, public protest, noisy parties, even family disputes (the latter case refers to the possibility of recording the conversation).

These cameras can also monitor police actions. However, according to Ericson & Haggerty (1996), police officers have already devised ways of avoiding the adverse effect of these recordings. They control the technology and they can basically use it to their advantage: ?Officers might position the camera in a way that would produce a recording fashioned to induce the viewer to empathize with the officers rather than the suspect? (p. 139). In addition, they can simply erase the tape.

Video surveillance is widespread in the United States. The legal guidelines seem to be different trom those in Canada. Law enforcement uses video surveillance for deterrence, detection and evidence collection purposes. This technology is also applied in prisons by Correctional Services.

In Los Angeles County for example, video surveillance is used a) to control shoplifting in shopping centers, b) to control crowds at Universal Studios, c) as a security device in subway stations, where it is connected to a microphone to communicate with passengers in the station, d) as a monitoring device for organized crime (prostitution, gambling, drugs), e) for crime scenes, f) for major events, i.e. floods, riots, fires, g) for traffic control.

During an NIJ conference (1996) on technology and public safety, the conferees pointed out the advantages of video surveillance: the video camera produces more and better prosecutions - recorded transactions lead to a reduction in the number of trials (financial savings), an increase in arrests, a rise in officer satisfaction and a lowering of police and community frustration. Due to its nature, this technology reduces confrontations in drug bust cases and does not isolate the officers involved. Cases are supported by evidence and, as a result, ?innocent parties are not mixed up with criminals?. This increases police credibility and improves relations between law enforcement and the community. Since surveillance cameras were introduced (Berkeley, California), prosecution rates have jumped from 70 to 90%. Through the ?Buy-Let-Go? program (drugs are purchased but no arrest is made on the spot), dealers are identified on videotape (National Institute of Justice, 1996).

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[42] Closed-circuit television

In England, cameras are positioned so as to create a ring around the city and barriers around sensitive buildings (Thomas, 1993 ; Wallace, 1993).

Nooklooker

The Nooklooker camera was developed at the Canadian Police Research Centre (CPRC) in Ottawa. This is a stand-alone portable video system designed to look into hard-to-reach places such as suspended ceilings, vehicle undersides and inside semi-trailers. Three police departments have been operating a Nooklooker camera since 1995, i.e. the Edmonton Police Department, the Ontario Provincial Police and the RCMP. It is also used by Revenue Canada and Customs and Excise Canada. They are also operating and testing a black and white model (CPRC, 1997).

Wireless Video Camera

Another type of camera was developed by the Canadian Police Research Centre (CPRC). The HUD/Body Cam is a wireless camera connected to a transmitter. It can be hooked up to an officer=s uniform. The image and sound can be transmitted up to 1/4 mile away. The officer can go over or examine the recorded situation. This camera was tested by the Montreal Urban Community Police Department and the York Regional Police Department. It was subsequently decided that it should be modified before being commissioned (CPRC, 1997).

Digitization of Photos

Photo digitization has been used, among others, by the Bavarian police in Munich, Germany, since November 1993. The photos are taken with a video camera instead of a still camera and they are recorded on disks with the name, sex, date of birth and description of the suspect. Similar projects were planned for Hamburg and Thuringe in 1993. Also in 1993, based on the Belgian experience, the German BKA was digitizing its central photo collection containing the pictures of two million individuals (Rebscher, 1993).

France uses the STIC-CANONGE system. The Canonge database was operated manually at first. It included a large number of card files classified by description. It was later computerized by digitizing the photos in advance of their integration into the *Système de traitement de l=information criminelle* (STIC)[44].This system is operated with microcomputers. According to the French Ministry of the Interior Website, it is highly efficient. In 1996, it reportedly helped identify 6799 suspects and solve 5587 crimes. All judicial police regional departments have the video equipment required to produce photographs. This enables them to manage regional databases (French Ministry of the Interior Website).

In Canada, the Montreal Urban Community Police Department operates a similar system called ?photo gallery?. The digitization process for photos started in 1994 and it is now done at the live capture stage.

Digitization of Fingerprints

The Automated Fingerprint Identification System[45] has been used for several years all over the world by large police departments, including the FBI, the RCMP, the MUCPD and the German BKA. These systems were improved and enhanced over time. In Great Britain, the National Automated Fingerprint Identification System is capable of comparing one million prints per second. It has been in operation since May 1998 (Home Office Website).

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[44] Databank similar to the Canadian CPIC.

[45] Fingerprint images in the form of master fingerprint files and trace photos are automatically recorded and digitized with highly sophisticated algorithms. These prints are compared to those already in the system. A visual comparison with a list of suspects is done with a digital image storage system (Rebscher, 1993).

In Canada, the Automated Fingerprint Identification System (AFIS), managed by the RCMP, contains fingerprints from over 2.5 million individuals. This system is used by law enforcement to research the national master fingerprint collection and the repository of latent prints collected from crime scenes, for comparison and potential identification of police records (RCMP Website, Forensic Identification Unit, 1996). The Montreal Urban Community Police Department has been computerizing its fingerprint collection since 1994. Fingerprints are now digitized with a live scan right at the capture stage.

In Germany, this system was started in Dec 1991. It was first set up to identify asylum seekers. It has been used to identify offenders since Dec 1993 (Rebscher, 1993).

In France, the *Fichier Automatisé d=Empreintes Digitales* (automated fingerprint database) represents the first computer application commonly shared by the *Police* and the *Gendarmerie nationale*. Traces collected from crime scenes are compared to the reference collection, which currently contains 760,773 individual files (updated in June 1997). In 1996, over 22,400 cases of personality appropriation were detected and 2,356 traces were identified. This database can now be queried from 12 operational sites (French Ministry of the Interior Website).

The French Ministry of the Interior Website contains the following comment on the automated fingerprint database: [Translation] ?This system contributes in a significant way to the control of all types of crimes, particularly minor and mid-level offenses such as car theft, burglary, etc. This unique database, accessible in real time, provides for quick and complete searches, and consequently, relevant results? (French Ministry of the Interior Website).

X-Ray Technology

X-ray technology is used more specifically for the detection of illegal and/or dangerous materials. A more sophisticated technology than traditional X-rays is even capable of identifying materials with a low atomic number, thus making it possible to detect certain drugs and explosives. This system is called "Backscatter" and is designed to scan suitcases, car trunks and the contents of heavy trucks (Canadian Security, Nov-Dec 1997).

This technology is widely used in the United States. The scanners are mounted on trucks to provide greater mobility.

Comments on Imaging Technology
In summary, imaging technology is wide ranging and it includes systems that are often sophisticated and sometimes complex. Television should not be overlooked. It plays a significant role, as shown in police operation centres, for example at the Sûreté du Québec, where TV is very prominent and the RDI network and others provide continuous news.

Imaging technology generally expands significantly an individual=s normal visual capacity. In fact, some systems are capable of performing tasks that are humanly impossible, such as identifying traffic violators among vehicles travelling in both directions on a four-lane highway, seeing in the dark (night vision), locating marijuana plants such as with the hyperspectral camera, picking out on photos and video images what the naked eye cannot see, thus making it possible to collect direct or rebutting evidence that would have been unavailable were it not for the electronic imaging technology.

Some technologies, including digitization of photos, fingerprints and composite sketches, speed up file search and facilitate testimony during police investigations. It is indeed easier for a witness to look at photos on a computer screen than to go through photo binders. (Rebscher, 1993).

The police can use these systems to monitor specific sites or observe incidents without being physically present. They help the police anticipate disturbances and respond before the situation gets out of hand. They make it possible to collect evidence while complying with specific legal guidelines. Police officers can use them as witnesses when making arrests or as a teaching tool, for example when reviewing a crime scene with

a wireless camera or making accessible and visible humanly inaccessible locations such as **can be done** with a Nooklooker.

On the other hand, some police officers may misuse this technology, for example by conducting unreasonable surveillance with cameras or using electronic imaging to falsify evidence. Finally, police officers themselves can be watched with a camera, but as mentioned by Ericson & Haggerty (1996), they find various ways of avoiding it.

Forensic Laboratories

Lab technology is another aspect that needs to be looked at. Excerpts from articles published by the RCMP describe how electronic microscopy, spectrometry and forensic entomology are used. (These articles have been quoted almost verbatim so as not to confuse the reader.)

With respect to the microscope, Johnson (1997) states that: ?A microscope can be programmed to automatically search up to 10,000 locations on a one-inch diameter sample for the presence of gunshot residue, using a finely-focused electron beam? (p. 18). The efficiency of robotic samplers, extractors and analyzers means investigators in the field can get their test results a lot sooner. What took previously three months to complete can now be done in six weeks (Johnson, 1997).
Mass spectrometry is a process that can separate and identify minor constituents in a complex mixture of drugs and poisons, and give a ?fingerprint? of each compound found. Chemical fingerprints are just as reliable for identifying and confirming the presence of a given substance, as a human fingerprint is in identifying a crime suspect (Johnson, 1997, p. 18). Used in combination with a chromatograph, the spectrometer can find microscopic traces of explosives and accelerants in contaminated fire debris, helping investigators confirm their suspicions of arson or terrorism (Johnson, 1997).

Entomology, a science dealing with insects, also has a role to play in forensic labs. It is used during criminal investigations to determine the date of death from human remains. It can also provide evidence of imported drugs or neglect in child or elderly care. Being an exact science, it has more weight than witness accounts before the courts. Forensic entomology has resolved various cases in Canada (Anderson & Gaudet, 1996).

A technique called ?Alpha Napthoflavone? makes body impressions so visible that they don=t need to be transferred. After the body is exposed to iodine vapours and then sprayed with another chemical compound, the impressions are revealed in very dark blue. This technique comes from a British procedure used in the past to collect terrorist fingerprints on walls and it is being applied on human remains (Richardson, 1997).

Comments:
Chemistry, biology, physics as well as robotics and even entomology are part of everyday operations in a forensic lab. The processes used are highly complex and specialized. They are performed by civilian experts. Finally, it should be pointed out that the equipment used in forensic labs is very costly ($600,000 for a tandem spectrometer).

Forensic laboratories give police agencies a professional image and a scientific status, even though the work is performed by civilian experts.

Biometric Technology

All biometric technologies share one common feature: they use the human body, most often a part of the body, for purposes of identification. Fingerprints and dental impressions have been used for a long time. In recent years, biometric technologies designed for detection and control were added to these identification procedures. Biometric technologies are increasingly prevalent in our society.

DNA Identification

Several laboratories have started developing criminalistics programs based on the discovery of Alec Jeffreys[46]. In North America, several private laboratories were the first providers of this service to law

[46] DNA, an essential component of the hereditary material, was discovered in 1944 and used by the American Army during the Vietnam War to

enforcement. Two federal police agencies, the RCMP and the FBI, cooperated in adapting DNA testing to forensics. The FBI started performing DNA testing in 1988 and the RCMP launched its own program in early fall 1989 in its forensic laboratory in Ottawa. A short time later, the Toronto Forensic Science Centre started accepting testing requests, followed by the Montreal Forensic Laboratory, since renamed Forensic Examination Directorate (Department of Justice Canada, General Considerations, June 1995).

This technique was instrumental in getting convictions for hundreds of violent offenders (homicide, assault, etc.). Also, suspects were exonerated and wrongly convicted inmates were released thanks to DNA testing. Several countries use DNA testing for forensic purposes: the United States, Great Britain, France, Germany, Australia, New Zealand (Solicitor General of Canada, January 1996, Creation of a national DNA databank, Consultation paper).

DNA Identification in Canada

Since 1994, DNA testing has evolved in Canada. A few of the more significant milestones are described below:

1994: The Federal Department of Justice tabled a document entitled *Collection and Storage of Genetic Forensic Evidence*. This report highlighted several issues related to DNA identification, including the collection of DNA or genetic evidence during criminal investigations. It also discussed laboratory regulations required to guarantee high-quality results for court testimony.

1995: In July, the Federal Government passed bill C-104 dealing with warrants authorizing the collection of samples for DNA testing. Modifications to the Criminal Code of Canada and the Young Offenders Act gave judges the authority to issue warrants to the police for purposes of collecting biological evidence from crime scenes during criminal investigations.

1996**:** Following the document *Creation of a National DNA Databank, Consultation Paper*, the Solicitor General of Canada, the RCMP and Justice Canada conducted discussions with provincial and territorial governments, police departments and associations, correctional services, human rights agencies, victim groups, the legal community and medical and medicolegal associations. Bill C-3 resulted from these discussions.

1997 (Sept 25)**: First reading in the House of Commons under the title** *An Act Concerning DNA Identification and Amending Accordingly the Criminal Code of Canada and Other Statutes.* Short title: *DNA Identification Act*.

1998 (March 27): Second hearing of the bill as amended by the Justice and Human Rights Standing Committee. It was tabled as a working document for use by the House of Commons at the report stage (Department of Justice Canada Website).

This bill provided for the creation of a national DNA databank under the responsibility of the Royal Canadian Mounted Police Commissioner.

The databank was made up of two databases: A criminalistic database containing DNA profiles developed based on samples collected from major crime scenes, and a convicted offender database containing DNA profiles developed from bodily substances collected from convicted or exonerated suspects.

The bill amended the Criminal Code of Canada by providing for the issuance of court orders for the collection of bodily substances and authorizing the collection of samples from selected categories of offenders serving prison terms.

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identify the remains of soldiers. It was introduced into forensic medicine for the first time in England in 1986, following Alec Jeffreys' discovery, in 1983, of the polymerase chain reaction or PCR testing technique. The police was able at the time to identify the person responsible for a double murder. This technique was implemented in medical research, forensic labs and immigration services in several countries.

The bill also contained provisions governing the use of collected samples, DNA profiles, developed from these samples, as well as the information contained in the databank, its disclosure and access.

Sections 10 (1) and 10 (2) of this bill state: ?Forensic DNA analysis of stored bodily substances may be performed if the Commissioner is of the opinion that the analysis is justified because significant technological advances have been made since the time when a DNA profile of the person who provided the bodily substances, or from whom they were taken, was last derived?.

The samples will be collected by a peace officer.

1998 (Dec 8): The bill is passed by Parliament.

Comments
With DNA identification the quality of the evidence is clearly enhanced. It is almost non-negotiable. The use of DNA evidence requires the involvement of specialized and trained technicians.

It also validates police actions. Several countries are in the process of passing or have already passed legislation identifying the people responsible for DNA databanks and the procedures to be used for the collection of DNA samples.

According to the document from the Solicitor General of Canada, DNA evidence helps the police and the courts by pointing the investigators in the right direction and by reducing the duration of trials, including the presentation of the prosecution case. It can also deter some offenders from committing major crimes. In addition, those who support the legislation contend that using this type of evidence more frequently will lead to long term savings for the criminal justice system. Also, DNA databanks will make it possible to solve crimes when there are no suspects (assuming we=re dealing with repeat offenders). Finally, DNA identification can be used to solve previously unresolved crimes, if DNA evidence is available.

The Canadian Privacy Commissioner states in the document *Genetic Testing and Privacy* (1992):

?Genetic databases should be used only for identification. The information contained in a genetic database and any genetic samples related to the crime should not be used to try to identify other characteristics that may have a genetic link, such as personality.

Furthermore, not every form of criminal activity would warrant including a criminal=s DNA profile in a genetic database. Databases should be considered only for persons who have been convicted of crimes involving serious violence.?

This irreversible procedure is aimed at the criminal population in Canada. However, the managers of law enforcement and other agencies may eventually identify specific advantages in this technology and try to extend it to the overall population. Already in Great Britain, in the spring of 1998, the Home Office was suggesting that DNA typing be extended to all British citizens in order to speed up the matching process during criminal investigations (BBC News, 1998).

This national DNA databank raises some real questions. The long list of identified offenses includes assault, assault against a peace officer and indecent acts. A study of ?mentally ill? offenders conducted at the Montreal Municipal Court in 1991-1992 shows that a large number of individuals suffering from a ?mental illness? or perceived as such are charged with this type of offense on a regular basis (Laberge & Al, 1995). Enforcing the act could affect the criminalization process for demonstrators, who are sometimes charged with assaulting a peace officer.(Le Beuf & Soullière, 1996a).

Other Biometric Identification Procedures

Other biometric procedures, including voice identification and eyescan, help identify an individual=s unique features. The human ear is also used for that purpose. For the first time in Great Britain a mould was made of a suspect=s ear and a facial mapping expert was able to match the mould with the suspect (BBC News, Feb 20, 1998). Also in Great Britain, the West Midland Police Department is developing a computerized shoe print database.

Biometric Control and Detection Procedures

Biometric detection procedures known and used by law enforcement include the breathalyser and the polygraph. The correctional service also uses the ankle bracelet for control purposes (Landreville, 1987). Other less familiar technologies are the alcohol detector, the automated border control device, the heartbeat detector and the night vision.

Alcohol Detector (detection and control)

The alcohol detector is a device commonly called alcohol ignition interlock. It keeps the vehicle from starting if the driver cannot provide an acceptable breath sample. This technological countermeasure is mandatory in Quebec for drivers convicted of impaired driving. It comprises a ?black box? containing data regularly checked by the *Société de l=assurance automobile du Québec*. This procedure is required by provincial legislation (Bill 12) and it has been in effect in Quebec since December 1, 1997. The driver covered by this procedure must ?blow? regularly into the device, at times set by the device. If the individual fails to comply with the device controls, an alarm goes off automatically. Installation and rental costs are paid by the convicted driver. A police officer told us that these costs can be substantial for some, even to the extent that they cannot afford it.

As the police cannot track the movements of every driver convicted of impaired driving over long periods of time, this technology allows law enforcement once again to perform a task that would have been humanly impossible without it. This device plays the role of a guard for a population on the move too numerous to be monitored.

Automated Border Control (control)

In December 1993, the German border police began testing an automated control device used to check the identification of airline passengers at the Frankfurt Airport. It was following the example of Schiphol Airport in the Netherlands and also New York and Newark in the U.S. These tests lasted three to six months in 1993. The participation of passengers was voluntary. The purpose of this system is to reduce waiting times at the identification control stations.

Participants are required to sign a registration form and undergo an identification check as well as a biometric control (fingerprints from one finger in each hand or handscan). The individual shows his or her scanner-readable identification card and places his finger or hand in a machine (livescan) which captures the person=s biometric data and sends it to a computer for automatic match-up. To prevent fraud, the machine measures the temperature of the finger or hand at the same time (Rebscher, 1993).

The automated border control can check a large number of people in a very short period of time. Just like the alcohol ignition interlock, it plays the role of a guard for a large population on the move.

The Heartbeat Detector (detection)

The Heartbeat Detector is currently used at the Riverbend Maximum Security Prison, in Tennessee. This technology was initially implemented for security purposes at nuclear plants in Tennessee. To put an end to escapes by convicts using transit vehicles, the prison acquired a machine capable of detecting a heartbeat from both small and large vehicles. This machine is made up of a portable computer. The detection officer enters the size of the vehicle on a touch screen and within a few seconds, the computer can either confirm or rule out the presence of an individual in the vehicle. The machine operates somewhat like an electrocardiograph (Strauss, 1997).[47] The installation cost is $65,000 US. Research is being conducted to develop a machine capable of detecting a heartbeat in a moving vehicle, for example in a train (Strauss, 1997).

[47] Website of the manufacturer of this machine: **http://www.beicomm.com/avian.html**.

Night Vision (detection)

The thermal imaging technology described above makes it possible to see in the dark and detect the presence of people from the heat produced by their bodies, for instance the heat left in the wake of a swimmer on a water surface (see section on imaging technology).

Comments

Even though the police do not use all these technologies, they are available in the social environment and they could eventually be adopted under the proper circumstances.

The impact of these technologies is difficult to assess at this time. However, it is interesting to note that the human body is increasingly becoming a source of information for law enforcement.

Research, Development and International Conferences

Several police research centres were established around the world. Also, during the 1980s, international conferences were initiated to discuss police technology in use, under development by the police or at the research and development stage. These conferences are international in scope and they are held, among other places, in the United States, France, Belgium and Australia. The *Salon Milipol Paris* has been held since 1984. In the United States, the NIJ organizes several conferences each year on police technology.

Police Research Centres

In Canada

The Canadian Police Research Centre (CPRC) is one of three functional services provided by the RCMP=s Science and Technology Branch. In the introduction to the 1996-1997 annual report, it is stated that the CPRC=s mission is to manage and direct a national research, development, assessment and marketing program for law enforcement and public safety in Canada. The Centre is responsible for making sure that police departments across Canada have access to the best equipment possible and that Canadian companies have the opportunity to develop an expertise in this specialized field. Its main partners include the Canadian Association of Chiefs of Police, the Royal Canadian Mounted Police and the National Research Council of Canada. Its first task is to support research and develop new technology for law enforcement and public safety agencies all over Canada. To this end, it stays in contact with police agencies, government departments, the industry, universities and other research organizations (CPRC, 1997).

The Canadian Police Research Centre is one of three units under the RCMP=s Science and Technology Branch. The other two are a research centre on weapons quality and a management and advisory unit on intellectual property.

In the United States

In the United States, the National Institute of Justice (NIJ) sponsors all police research conducted under the aegis of the National Law Enforcement and Correction Technology Center (NLECTC). The work is performed through a partnership involving the Justice Department and the Department of Defense.

In Great Britain

In Great Britain, the Police Scientific Development Branch (PSDB) is responsible for providing technical advice to police divisions, Cabinet Ministers, police departments and corrections facilities, enhancing operational efficiency and helping improve police policy in specific ministries, such as Transportation and the Home Office, to fight terrorism and cooperate internationally.[48] Their activities are focused on the operational equipment purchased or requested by police departments or by the Association of Chief Police Officers (ACPO). ?The PSDB=s involvement with the police is aimed at broad issues rather than specific policing activities? (Wallace, 1993). This Branch is working on perimeter intrusion detection, on defense X-ray technology and on all aspects of ?cracking?, i.e. for customs and indirect contributions. The PSDB operates two sites: Sandbridge

[48] The Branch=s aims are: to provide technical advice to the Police Policy Directorate, the police and Ministers; to improve the operational effectiveness and efficiency of the police service (and other customers); to support the Home Secretary=s responsibilities for counter-terrorism.

(Herst) and Langhurst (Sussex). About 90 people work on these sites (scientists, engineers and a police team playing the role of interface between the scientists and the 43 police forces in the United Kingdom). The funding in 1993 was six million pounds. The PSDB tries to find on the domestic market (in Great Britain) and abroad the products needed to meet the demand. If the product required cannot be found, a research and development process is initiated (Wallace, 1993).

In Germany

In Germany, in 1957, a permanent committee under the Federal and Länder Ministries of the Interior set up a subcommittee named *Technische Kommission* responsible for standardizing police equipment in the Federal Republic of Germany, coordinating the approach to all technical problems and developing unique instructions for police operation and management. In 1975, the Germans created a research and development centre for police technology (*Forschungsund Entwicklungsstelle für Polizeitechnick* - FESTPT), linked to the Police Managers Academy, in Muenster. The work performed at this R & D centre is focused on direct field applications. It takes into account operational tactics as well as organizational, personnel, budget and legislative requirements. It also conducts information exchanges with foreign agencies on police technology. The work is performed in cooperation with the BKA (Federal Criminal Operations). Unlike the Centre, the BKA conducts research on its own on operational electronics and scientific policing. Coordination between the Centre and the BKA is done through the *Technische Komission*. The Centre is involved with rapid information and communication systems (computer and telecommunications), mobility equipment (locomotion), maintenance and restoration of order (phototechnical, optical and sound equipment) (Rebscher, 1993).

Since 1975, the BKA has developed a real interest for police technology. This interest is combined with the implementation of a research and development process by large police departments or police-related agencies for the acquisition and implementation of these technologies.

International Conferences

Conferences on police technology developments have been held in the United States every year since 1994 under the sponsorship of the National Institute of Justice. A conference on Technology for Public Safety was held in 1996. Also in 1996, five conferences were held on community policing and the central theme was: Using technology to bring the police closer to the community. Ten sub-themes were discussed, including: The evolution of police technology; Cops (Community Oriented Police Services) on the Web[49]; Law enforcement information and technology centers; Technology as a force multiplier; Organizational change and community policing; Mapping and tracking crime; Communication interoperability, technology liability considerations; Technology: supporting the officer in the community; Community oriented policing: technology and strategies; Detecting concealed weapons (Technology for Community Policing, NIJ, 1997). A conference held in August 1998 was entitled ?Combatting gangs through technology?.

In Europe, the *Salon Milipol Paris* has been held in France every two years since 1984 by the French Ministry of the Interior. Initially intended for security professionals, industrialists, users, purchasers and exhibitors of all nationalities, this event introduced various police, civil defense and military equipment. Its mission was extended to include the safety of public and private communities, industries and businesses, protection of the population and national security.[50] This event was last held in France in 1997. In 1998 it took place in Qatar.

Participants in 1997 included Germany, Canada, Spain, Israel, the United Kingdom, Russia and France.

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[49] Home Office Web Site.

[50] The products exhibited during this event are divided into seven categories. The first includes electronic and computer equipment used for telecommunications, detection, wire tapping, surveillance, control and ballistic measurements. The second is for mobility equipment including land, sea and air transportation, and shielding equipment. Engineering (risk management and analysis), training (equipment and facility) and services (access control and special transport) come under the third category. The fourth category includes weapons, ammunition and special equipment, such as water cannon. Optical and optronic equipment (telemetry, mapping, transmission of still or TV images with a projector, word transmission with an infrared projector, stereoscope) fall under the fifth category. Textiles, uniforms, miscellaneous and special equipment belong to the sixth category. Finally, the seventh category covers ?other areas and technology? including disaster equipment, logistic support equipment and special items (to handle confidential documents, laboratory materials and mine clearing equipment).

CONCLUSION

This historical review looks at the technological advances made by police departments in North America from the end of the nineteenth century to the end of the 1970s. Present-day police technology is considered within the framework of a long-term technological development process, thus putting the current situation in a historical perspective.

Placing the relationship between the police and technology in a historical perspective is one of the ways this situation can be looked at. We believe, at the end of the first part of the report, that technology had a major impact on police organization, in that it was instrumental to a large extent in building up the police both symbolically and concretely. Technology has played such an important role in restructuring the police that one can reasonably wonder if, ultimately, the organization can be understood any other way. This would of course be clearly insufficient as it would overlook the fact that the police are involved in numerous interactions with other public and even private law enforcement agencies and that they are affected, just like the rest of society, by technology, by specific social requirements, by their own cultural values and by various management techniques.
The computer has greatly changed the way today=s police officers operate. Their job is more complex and they have access to better work tools than their predecessors when they patrolled on foot or used the first vehicle-mounted radio communication system. Today=s officers can no longer view their job the same way as those who came before them.

It appears based on our analysis that four types of technology can be identified: transport-related technology (since 1904), communication technology (1930), forensic lab technology (during the 1930s) and computer technology starting in the mid 1960s. Placing today=s technology in a historical perspective enabled us to point out that following the advent of the computer around the mid 1960s, all technological developments except for DNA identification were linked to the computer and its benefits, especially communication and imaging technology. In other words, the factors that led to today=s technology have been in place since the mid 1960s.

The importance of these various technological advances has evolved. They were useful when they were first acquired, but today they have become necessary, even critical, to the operation of police departments. They now form an integrated web, and discarding one or the other would have a severe impact on police operations and on the organization itself, hence the acknowledgement that the technological development process is irreversible.

Irreversibility of the Technological Development Process
The police reflect the community in which they operate. Like all of us, they have been impacted by technology since the start of this century. This historical review of police technology has shown how law enforcement agencies have progressively acquired various technologies through the years. The basic technologies (transportation, communications, forensic labs and computers) have been acquired, maintained and improved. Law enforcement has become dependent on transportation and communication technology in the same way as the community as a whole. In addition, just like society, the police had to keep up with the pace of technological change.

It seems that once these technologies were integrated, actual needs drove the process. This was indeed the case for the automobile where, in the beginning, law enforcement agencies used two or three vehicles and eventually built complete fleets of vehicles, helicopters, boats, etc. This is also true for forensic labs and computer technology where, for example, the amount of computer data related to police management as well as to ?clients? has become so large today (new databanks are continuously being added) that there is a need for new analysis and processing software, more powerful computers and an increased number of computer specialists.

One of the major issues resulting from this dependence on technology are the costs of purchasing, maintaining and replacing the equipment, and training the users.

The technological development process is tied more and more to the computer and to electronics, while advances in genetics will also play a role.

Building Up the Organization

Police technological developments helped build up the organization. Indeed, new technologies were instrumental in structuring the organization, modifying its area of responsibility, enhancing its expertise and changing its image. Its as if the police were adapting and evolving based on available and, above all, acquired technology.

First of all, our review has shown that the technological development process within law enforcement has occurred more or less within the same time frames as society as a whole. This process is gradual, not linear, i.e. all police departments do not have access to everyone of these developments at the same time. It was also observed that just as these technologies are not available to all police agencies at the same time, they are not provided to all police officers within a department. The technologies used are different for various jobs: traffic police, criminal investigators, crime scene technicians, ambulance technicians, emergency response team members, crowd control technicians, computer crime specialists, etc. Sophisticated technology is not distributed evenly. Police technology is specialized. Nogala suggests that: [Translation] ?Police agencies seem to be divided into police teams based on communication and citizen officers on the one hand, and highly sophisticated special teams on the other? (1993). Technology has not only changed daily policing activities (officers have become traffic cops, computer crime specialists, etc.), and as a result the management and rank structure of the organization, it has also allowed police officers, who worked in isolation early in this century, to gradually become part of a police organization and then be included in a national and international network of police agencies. More policing tools were developed as the number of police officers within their own and other organizations increased.

New technological developments expanded the physical area of responsibility or territory of the police (automobile, communications), eventually giving police officers the ability to go beyond these limits (Marx, 1997; Bogard, 1996) through cyberspace and DNA. The limits of this territory are thus progressively being changed. Who will define how these tools will be used and their impact on society and on individual freedom? Who will look at possible misuses?

As a new technology is acquired, the officer=s territory and expertise (in terms of information) are expanded. Nogala (1993) states that this new knowledge increases the power of the officers, i.e. they have a greater access to information and a greater ability to use this information to fight crime. Nogala also suggests that technology in a law enforcement context has the ability to increase power. This power is further increased as technologies are acquired or combined (through system integration).

As shown earlier, the image of the police is modified as fast as these technologies are implemented within the organization. We also saw that forensic science was giving the police an increasingly scientific image.

Management

This review has also shown that the police adopted a way of doing things shared by other public and private agencies and institutions, i.e. management.

These various technologies and the increase in the number of tasks resulting from these developments made the police organization more complex: new technology, new units, more information, more staff. The police, in the same way as other agencies, institutions and private companies, came to embrace a management philosophy. This had a substantial impact on the police. In fact, the police seem to be managed today just like any private corporation. The latest fashion is ?reengineering? based on a best seller by Michael Hammer (1993) *Reengineering the Corporation*. Law enforcement agencies like any other organizations have been impacted by administrative fashions. It would be interesting to know to what extent and for how long. Our data shows that law enforcement agencies started to centralize file management at the end of the 1950s. As for management practices, they have been around for a century[51].

[51] [Translation] ?Management deals with all practices related to the organization of production and the control of human resources. These practices emerged early in this century with the advent of large industrial or bureaucratic organizations, and the first attempts at

In short, police departments have become more and more technology-dependent and bureaucratic since early in this century, through an irreversible process. They have gained a professional and scientific image and they have acquired increasingly sophisticated tools to obtain more information. Seen in this light, the police have much in common with other agencies and institutions. Ericson and Haggerty (1996) contend that the police have become information providers for other risk management institutions.

How are law enforcement agencies different from other institutions when it comes to their relationship with technology? To what extent do they make choices specific to their primary role? What is that role? To what extent do they continue to play the role of police among all the agencies responsible for monitoring and managing risks? External and internal forces promote the development of police technology (Nogala, 1993). What about the external and internal forces that hinder these developments (Nogala, 1993)?

Inform, Monitor, Control and Respond

In fact, the technologies used by the police build on those implemented by other institutions to inform, monitor, control and respond. Information and surveillance technologies are now widespread in educational, medical and corrections facilities, private corporations and the retail industry.(Nogala, 1993; Marx, 1988).

The image of Bentham=s panopticon used by Foucault in *Surveiller et punir* (1975) partly reflects the situation today. Countless devices are used to monitor and control citizens at all times and everywhere, without their knowledge. Cohen=s fishing net with an ever tighter and stronger mesh (quoted by Marx, 1988) is added to the image of the panopticon. The surveillance traditionally conducted in corrections facilities is increasingly being used on the public at large. Indeed, information technologies are becoming more numerous and more complex; detection, surveillance and control devices are multiplying, and more and more, those who conduct surveillance operations are being put under surveillance themselves (Marx, 1992).

The role of information and surveillance technologies in a modern society is explained in Bogard=s book *The Simulation of Surveillance: Hypercontrol in a Telematic Society* (1996). Borrowing an idea from Beaudrillard, Bogard states that the symbolic presence of panopticon guard towers is now a sufficient deterrence. There is no need for a human presence; the symbolic presence of a surveillance device is enough to do the job. He further states that the simulation of surveillance: ?...is the apotheosis (not negation) of panoptic control; it still allows us to speak meaningfully of not only the simulation of power but the power of simulation, i.e., of the hyperdisciplinarity effects of simulation as productive of a (hyperreal) social order. Simulation is not at all the opposite of power, but another mode of exercises, in fact its most elevated and most paradoxical mode? (p.72).

Bogard also uses the idea of space sterilization through surveillance: ?Surveillance is always a dream of order, and that links it to a project of sterilization B ordered space is clean space (p.39). He further states that it is no longer necessary to differentiate between normal and abnormal, that the deviance model takes another form and requires another interpretation. In this, he probably agrees with Ericson and Haggerty (1996) who state that: ?Gutted of a moral wrongdoing, deviance is treated as a normal accident. That is, deviance is treated as a contingency for which there are risk technologies to spread the loss and prevent recurrence. Deviance becomes a technical problem that requires an administrative solution, rather than an occasion for expressing collective sentiments and moral solidarity, which are relegated to mass media morality plays through which people remember values that are increasingly at odds with those of their institutions?(p.448).

A Massive Amount of Data

The literature shows that the police use several powerful tools to gain access to a massive amount of complex data on citizens through a whole range of technologies such as information, telecommunications, surveillance, expert systems and biotechnologies. This increased access to information brought about by technology raises, among others, the problem of managing this information. How can the police manage effectively such a large amount of data? In Great Britain, the Manchester Police manages 10 million files in 50 different databases.

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formulating them were made by engineers.? (*Sciences Humaines*, no 20, March-April 1998, p. 54)

In Hampshire, with a population of two million, the police have files on 80,000 individuals[52]. Are these data and technological tools making the police more efficient? The FBI has an 18-month backlog in evidence processing. It has been using private companies such as Per-Se Technologies specializing in health care information technologies (Federal Computer Week, vol. 12, no. 12, p. 1, April 27, 1998). This could mean that the private sector is starting to be used for data processing.[53]

In addition, dealing with such large amounts of data on individuals raises the following problem: If the police can be connected to the databank of a government agency, is the opposite true? Ericson and Haggerty (1996) show that police information flows to other risk management institutions, including private insurance companies and car manufacturers. In fact, they demonstrate how police work by its very nature involves providing information to risk management institutions, who use police data to produce statistics, in the case of insurance companies, or to improve their product, in the case of car manufacturers.

Dealing with such a massive amount of data also raises a problem related to the use of this data, i.e. officers conducting unjustified random checks on the CPIC or QPIC, or using data in ways not authorized under the law.[54]

The use of mobile data computers has already affected the police power structure. The way in which support softwares are configured enables officers to provide more accurate and complete reports. In some cases, the supervisory role of the sergeant is reduced as the supervision is performed by the machine (Ericson & Haggerty, 1996). In addition, Ericson & Haggerty consider that the way in which softwares are configured is instrumental in reducing officer discretion: ?The communication formats provide the means through which the police think, act, and justify their actions? (p.33). With respect to their relationships with the community, it seems that technology is not helping. On this topic, Ericson and Haggerty quote Manning (1988 p.155)*:* ?They are timed to the second on every break by the computers, they are supplied work by an automatic computer that shifts calls their way as soon as they are ›libre=; the order of their work is technologically determined and demand driven. They are servants of the public in name only, for although the public pays them, they work for the machines that lurk behind them, glow in front of them, click, and buzz in their ears and fill the air with electronic sounds? (Ericson & Haggerty, 1996, p.35).

On another topic, the offender database posted on the Internet by the Ohio corrections service and the sexual offender database which will be posted eventually in Ontario were made possible by the implementation of a new technology enabling the corrections service to update their procedure.

Finally, collecting information through the use of biotechnology raises a question with regard to the restrictions that should be imposed. In Great Britain, where a national genetic databank already exists, Peter Gammon, President of the Police Superintendents= Association, suggested extending the sample collection to the whole population based on the following argument: ?To help make it easier to identify offenders: the time taken to collect and analyze samples from suspects after a crime is time consuming and can delay the progress of an investigation? (BBC News, May 5, 1998). Alec Jeffries, the driving force behind the national genetic database, is opposed to this move: ?A determined criminal might be very tempted to try to hack into such a database and alter their entry and so give them the ultimate alibi for any crime they might commit? (BBC News, May 5, 1998).

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[52] (BBC News, July 28, 1998).

[53] The former Director of the Maryland Criminal Justice Information System operates a Website where he provides advice on projects and programs dealing with the growing noncriminal justice customer service requirements placed upon State Central Repository and CHRI delivery systems ... apply and integrate tracking numbers routines, fingerprints, mug shots and audit methodologies to improve, measure CHRI quality ...develop and implement Notifications Systems; whether reporting criminal activity to involved criminal justice officials, or registration such as those for child sexual offenders to concerned citizens. Facial biometrics is also addressed.

[54] Poitras Commission, 1999.

Counter measures
The illegal use of technology forces the police or gives them an argument to acquire even more technology. They had to use motor vehicles to intercept offenders driving these new machines. Today, electronic fraud, computer crimes, violations of telecommunication laws and software piracy on the Internet have convinced the police that they need to be on the cutting edge of electronic communications in order to be able to deal with these new types of crimes. This is a good example of what Nogala (1993) calls the ?technological arms race?. In this area, the abilities and skills of the offenders often exceed those of the police.

Information technology can be used to commit all sorts of offenses including traditional crimes such as fraud, pornography and pedophilia. Software piracy is one of the crimes associated with this new technology. Also, computer geeks can gain access to police data on cruiser-mounted computers. The physical barriers of the past are now becoming abstract barriers made up of codes, which means that these data cannot be protected by physical or mechanical force alone. To deal with this issue, the police are demanding more technology and more specialists. Police data are increasingly vulnerable to intrusions where they are stored as they cannot be locked away in a filing cabinet. In this situation, does the current legislation on access to information provide adequate privacy protection? Ericson and Haggerty (1996) explain that police data are widely distributed to various risk management institutions, both public and private, without the consent of the people involved. Encryption appears to be the main tool to control access. However, will this ultimately be such a beneficial move or will it give those who travel on the information superhighway to commit offenses or protest, more opportunities to be creative?

We already know that protesters in France and notably in Japan have acquired new technologies to keep up with the police. They now have vehicles, cell phones, fax machines, etc. that can match those used by the police. To deal with this situation, the police requested even more technology (LeBeuf, Soullière, 1996a). With the advent of the Internet a new form of public protest has emerged, i.e. several demonstrations held in different locations on the same issue (Marx, 1997). This could be worrisome for the officers responsible for crowd control and raise doubts about their response procedures. They will need new tools and approaches to deal with these new situations.

One last issue exemplifies the vulnerability of technology. If police data are vulnerable to outside aggressions, they are also threatened by technology. The Y2K bug has generated numerous reports in police organizations around the world and the work required to make computers Y2K-compliant has been costly, but no one can be absolutely sure at this time that all computers will pass muster when the day comes.

Biometric Technology
It seems that biometric technologies are becoming more and more prevalent not only in society as a whole but also within law enforcement. The human body is now a major source of information and ?biosurveillance? has its own implications and issues. This topic should be discussed further.

The impact of these technologies on the criminalization of ?mentally ill" individuals (or perceived as such) and protesters in a demonstration could be an interesting research topic. Knowing that the people in the first group are often charged with assaulting a peace officer or committing indecent acts and that the second group can easily be charged with assaulting a peace officer, may suggest that genetic information from these individuals is likely to be included in the national DNA databank.

One other aspect that should be looked at is the economic incentive behind this development. Axel Khan, a French geneticist and researcher at the *Institut national de la santé et de la recherche médicale* (INSERM), stated during an interview on CBC television that genetic discoveries, especially those used to identify illnesses, represent a potential market of 40 billion dollars. This is a strong motivation for researchers. He added that besides this economic incentive, genetic research is also driven by the insurance industry, the employers and the banks.

Let=s suppose that a well-intentioned researcher decides to use the data contained in the national DNA databank to identify genes common to all ?criminals?.

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