Chapter Six
A Brief History of Police Technology

Learning Objectives

• The student will explore the development of police technology against the backgrounds of the policing models—political, professional and community-based models—thereby gaining a perspective from which to examine police technology.

• The student will expand on his or her understanding of tactical and strategic information by looking at how technology changed the nature of fingerprint evidence.

• The student will understand the difference between policy and procedure and look at how technology may impact policy and procedure.

• The student will further explore fragmentation and the market-place.

Introduction

One of the greatest attributes you can develop is a sense of perspective. The ability to put things in perspective, or context, gives you a greater understanding of problems and their potential solutions. We are going to look at the history of technology in two ways. The first is a fairly straightforward look at what happened and when. Along the way, we will look at some of the consequences of the introduction of new technologies. However, most of our historical exploration takes place in subsequent chapters. For instance, in Chapter Seven, when we look at dispatch centers, we take a look at the development of the telephone and cellular communications and the universal emergency number 9-1-1. In the future, as users or decision makers, if you can put a technology in perspective, you can understand its limitations and potential.

The second method of exploration is by following a specific piece of information that has been critical to solving crimes for more than a hundred years. Yet it has been technological changes in the past five years that have unleashed its true potential. Even though this information was used by law enforcement for nearly a hundred years, a lack of technology cost lives and in one instance allowed a cop killer to roam free for almost fifty years after a rape and the murder of two police officers.

One of the important functions of government and business management is forecasting. In simple terms, forecasting is effort to predict future events based upon past events. There are some rather sophisticated mathematical models that allow fairly accurate predictions on what is to come based on what has occurred. In business you might use forecasting in an effort to predict sales so you could manage production. In law enforcement you might use calls for service or crimes to determine personnel deployment. While the most common type of forecasting uses numbers of something in the past to predict the future, a look at how police technology has developed in the past can help us make some assumptions about the future, or forecast.

A look at the historical development of technology in law enforcement can aide us in understanding some of the current challenges. For instance, recall from Chapter One that a core element of the community policing model is the use of enhancers. As we discovered, enhancers are the technologies used to further the
other core elements. Although technology is an enhancer in the community policing model, technology was present during the political era and to a greater extent in the professional era. By looking at how technology enhanced those eras, it is quite possible that we will gain some insight into the current era of community policing.

History can help us out in a couple of other ways. First, the way in which technology has been implemented nationwide has produced a significant problem. And, as we know from Chapter One, that problem is referred to as fragmentation. Although Chapter Eleven is going to take a look at some of the potential solutions to the problem of IT fragmentation in American law enforcement, to understand the problem and participate in the discussion about solutions, we need a historical perspective.

Finally, history is an excellent way to demonstrate how information management has changed. A historical view will further strengthen our understanding of how information is both tactical and strategic. Later, when we are practitioners, this foundation will enable us to make better decisions about information and information management.

**Police Technology in Time**

Today most criminal justice scholars tend to divide the history of American policing into three eras—the political, the professional and community-oriented. As those eras progressed, technology took on a greater role in policing. Just as policing progressed, so did the general development of technology. However, toward the latter half of the twenty-first century, technological advancements occurred very rapidly. At first, during the early history of American policing, the police were fairly rapid in their incorporation of a new technology. For instance, police organizations would experiment with the automobile and radio very soon after their commercial introduction, and within a decade they would fully embrace the technology. But as the speed of technological change increased, the police adoption of new technologies did not keep pace.

Some of the earliest accounts of policing in America point to the establishment of a night watch in Boston. Of course, information technology (IT) of the day was the printing press. The first recorded use of the printing press in policing was the publishing of the “Constables Pocket-Book” in 1710. In the 1850s Samuel Colt began the mass production of a multiple-shot revolver. For the next nearly seventy-five years, the revolver and a night stick remained the primary technology used by police officers. In 1867 Allan Pinkerton, the famous American private detective, spy, and originator of America’s first private security force, again used the printing press to publish a manual on private policing for his agents titled “General Principles of Pinkerton’s National Police Agency.” Most police forces established in the late nineteenth century consisted of men who had been appointed for limited terms by local politicians. Thus, the early part of American policing is typically referred to as the political policing era.

Much like the rest of American government, the policing system was one of patronage. A police officer’s primary source of information came from the people who lived in the community, or in the beat they walked. During this era, one of the first uses of a new science in law enforcement occurred around 1854 when San Francisco began to use photography for criminal identification. Information technology began to creep into law enforcement in 1877 when the police in Albany, New York, began using a police telegraph. In 1878 Washington, D.C., saw the first use of the telephone by a police agency.
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Figure 6.1  For the police officer on the beat, the first form of electronic communications was a simple telegraph system. The system was a one-way form of communication originating in the police headquarters wherein an officer moved a dial with about ten choices to let headquarters know what type of assistance he needed. Others were a simple signal that told headquarters that the police officer had arrived at his assigned beat. In 1880 telephones were put in call boxes, allowing two-way communications between the officer on the street and headquarters. Early in the twentieth century in Washington, D.C., police officers began using a telephone handset, which plugged into the box for voice communication with headquarters, as seen here in about 1910 at the intersection of Pennsylvania and 7th Street, N.W.

Source: U.S. Congress, Office of Technology Assessment, Criminal Justice, 12. Photograph provided by Cultural Tourism DC, image from Washingtonian Division, MLK Jr., Public Library.

One of the first sciences to become actively involved in criminal investigations was fingerprints. This began in the early 1900s and by the mid-1920s had greatly increased a police officer’s ability to solve a crime. During the 1930s, police use of automobiles became a fairly standard practice; shortly after that, in 1934, Boston, Massachusetts, installed the first two-way radio in a police vehicle. The effect of the automobile and the two-way radio was to increase police productivity in responding to incidents. At about the same time, the government and policing evolved out of the patronage system into a civil service system. Moreover, many of the ideas on bureaucracy and organizations from Wilson, Von Weber, and Taylor began to take hold. The advent of a civil service system and organization models that prized hierarchy, centralization rules, and standards became the professional policing model. What early twentieth century reformers accomplished was the movement of control of day-to-day operations of the police from politics.
No technology changed policing like the combination of the automobile and the radio. Police mobility may have been a force in changing policing from the political to the professional. It is interesting to consider that in 1911, August Vollmer, whom many consider the father of modern policing, put his police department in Berkeley, California, on bicycles. Apparently not satisfied with the speed of the bicycle, he instituted motorcycle patrols in 1912. Of course, our search today is for the speed of data. Vollmer must have wanted response time because in 1913 he started automobile patrols. Although Detroit is credited with the first full-time use of the radio, Vollmer had experimented with a radio in a police vehicle nearly seven years beforehand. It seems that for Vollmer, technology was a driving force for professionalization of policing.

Source: Vila and Morris, Police in American Society, 75–76.

Police reformers clearly saw technology as a key part of the drive for better police efficiency and greater crime control. It is likely that police reformers were influenced by the technological advances of the day. They could look around and see the automobile, the radio, and other science and technology. The reformers tended to be chief executives of police agencies, businesspeople, public administrators, and scholarly people. They tended to be pretty smart people who saw a new development and how that development enhanced their model of policing—professional policing.

In 1923 Los Angeles Police Department established the first crime laboratory in the United States. In the same year, the Pennsylvania State Police initiated the use of the teletype. It wasn’t until 1928 that police first began to experiment with the use of the radio. The first city to use one-way radios was Detroit, Michigan. With the one-way radio, police could receive calls, but not acknowledge them, nor request information. As more and more police departments began to use automobiles, police officers began to leave their foot patrols. When someone wanted a police officer, they could no longer find him walking his “beat.” They began to call police headquarters. The situation wherein the community called a central location and the police were dispatched to the scene was accelerated and enhanced by the proliferation of the private telephone and the installation of radios in police vehicles. By the second half of the twentieth century, police being dispatched from a central location became the standard.

Before the commonplace use of automobiles and radios, a police officer on the beat was pretty much on his own. The central dispatching fed into the idea of a central bureaucracy—one of the hallmarks of the professional era. Through the 1950s and 1960s, the idea that police supervisors and managers should control the production of service began to take hold. In 1950 an influential police administrator and educator, O.W. Wilson, published a textbook called Police Administration, which became the Bible for police administrators in America. Supervisors and managers began to count the numbers of calls for service an officer handled and how fast he arrived at the scene of a call.

This professional model of policing was about mobility and bureaucratic control of officers. During this era, any problems that were noncriminal tended to be viewed as social work by police officers and police managers. It is likely that the axiom, “you get what you count,” significantly affected the police service. Not only were police officers not walking the community any longer, they were being
Figure 6.2  During the last half of the twentieth century, most IT inventions and innovations have developed largely based upon two inventions—the transistor in 1947 and the microprocessor in 1971. It is difficult to tell where the transistor will ultimately take us. One observer said that trying to forecast where the transistor and microprocessor will take us would be like the person who invented the wheel being able to predict the automobile.

*Source*: Laidler, *To Light Such a Candle*, 224. Photograph provided by Robert Eplett, California Governor’s Office of Emergency Services.

... evaluated on the number of calls they handled and how fast they got to the call. This is somewhat of a simplification, but if you were being judged on the number of calls for service you handled, would you be more interested in developing a long-term solution to the problem or moving on to the next call as rapidly as possible?

In addition to placing the maximum number of police officers in patrol vehicles, the professional model developed a belief that random patrol was an efficient strategy for apprehending criminals.
strategy for preventing crime. Moreover, the centralized bureaucracy placed a very high value on the rapid response to calls for police service in the belief that speed was necessary to apprehend criminals.\textsuperscript{13}

Through the 1970s there continued to be a reliance on what was to be seen as incident-driven policing. The technology was definitely enhancing the police’s ability to respond rapidly. Moreover, the advent of the computer made it possible to organize and review this information on incidents and response. Although computers were on the horizon and would make their debut in the late 1970s and early 1980s, it is interesting that between the 1920s and the 1970s police technology did not really change all that much. In response to public concern about crime, President Lyndon Johnson appointed the President’s Commission on Law Enforcement and Administration of Justice. In 1967 the Commission published “The Challenge of Crime in a Free Society.” That same year, the President’s Commission on Law Enforcement and Administration of Justice made the observation that while police were using crime laboratories and radios, the technology was essentially unchanged for the previous thirty or forty years.\textsuperscript{14}

Although this era is called the professional era, it is alternately described as incident-driven policing. American police had become very good at responding to incidents, primarily calls for service. As we shall see in Chapter Seven, the development of the universal emergency number, 9-1-1, only added to the police’s ability to handle incidents. At the same time the police were becoming incident driven, a ton of statistics was being captured about policing in America.

The professional policing model which relied on science, technology, standards, and centralized bureaucracy did produce professionals. As the police officers who were judged on the number of calls and arrests they made began to rise through the ranks of the police service, the concept of professionalism increased. If you spend a major portion of your life becoming an expert in your field, you are probably going to believe that you know what you are doing. This phenomenon, for the police, had unintended consequences. Police managers, who as police officers took direction from the radio and headquarters, did not rely on community input in the same manner or degree to which the beat officers of the earlier era did. At this point, in the late 1960s and early 1970s, the idea that the police were the professionals who knew best, responded quickly, and handled incidents became organizationally entrenched.

A hundred years ago, if you got into a fight, you were more likely to rely on someone from the community coming to your assistance. With technological changes, you could call other officers to the scene. After all, if you didn’t need the community’s help in a fight, did you really need their advice about a problem? So the model, enhanced by the technology, likely distanced the police from the community. During the 1960s this became a recurrent theme in cities across the country—the demands for the professionalism of the police. Essentially, the different model and the technology changed the relationship between the police.

\begin{quote}
Probably sometime between the 1940s and the 1960s, the implementation of technology in the police service began to lag behind commercial applications of technology. Interestingly enough, just two years before the President’s commission would observe that police technology was stuck, Gordon E. Moore, co-founder of Intel, predicted that the processing power of integrated circuits would double every eighteen months for the next ten years. Known now as Moore’s law, it has remained a truism for nearly thirty years. So technology begins to zip ahead without the police.
\end{quote}


and the community (with the heavy reliance on efficiency, mobility in the field, and centralized bureaucratic control) and introduced a new problem of the growing distance between police officers and the communities they served.15

So technological change, primarily in the form of the automobile and the radio, also presented the police with some serious challenges. As officers moved from the intimacy of foot beats to the isolation of the radio car, casual day-to-day contact with the average citizen diminished substantially.16,17 Worse still, when officers did come in contact with the “noncriminal” general public, it was often while issuing a traffic citation.18 With increased involvement by police in traffic enforcement, many people who previously regarded police officers as their protectors came to see them as adversaries.

Throughout the last half of the twentieth century, as the police were able to collect more and more statistical information about crimes and incidents, these statistics began to be used for some meaningful and often dynamic research. The research and some scholarly ideas began to change the nature of policing. One of the primary research projects of the 1970s was the Kansas City Preventive Patrol Experiment. During this project, three controlled levels of policing were used. One area had no random patrol, a second experienced twofold and threefold increases in police presence, and a third area received the normal level. The final analysis revealed no significant differences in the level of crime or public attitudes toward police.19 With the president’s commission, the civil unrest in the 1960s, the rapidly rising crime rate, and the acknowledgement through research that some professional era concepts such as random patrol did not work, people began looking for an alternative model.

In the late 1970s something happened that I suspect most cops instinctively knew. It was realized that police officers were responding to many of the same problems repeatedly. While the technology was enhancing the professional model and quite possibly further distancing the police from the people they served, it was also opening another door. That door was the new model—community-oriented policing.

Between 1979 and the mid-1980s, two projects were conducted that would lead the way to the development of community-oriented policing. The first, conducted by Michigan State University was called the Neighborhood Foot Patrol Program. The second was a problem-oriented policing program in Newport News, Virginia. In both cases, the research found that solving crimes and arresting offenders alone did not solve a particular community problem. What solved problems was an analysis followed by actions designed to work on the conditions that created the problem.20

In March of 1982, James Q. Wilson and George L. Kelling published an article in the Atlantic Monthly entitled “Broken Windows.” Their discussion revealed that

The 1960s and 1970s were certainly decades of change. Not only did the President’s Commission and many scholars look at policing, but a number of important court decision changed the nature of policing. The Warren Court rendered a number of significant decisions. For example:

- **Mapp v. Ohio** established the exclusionary rule prohibiting the use of illegally obtained evidence.
- **Escobedo v. Illinois** established that an offender has the right to an attorney when questioning turns to accusation.
- The ever famous **Miranda v. Arizona** where the right to an attorney and against self-incrimination were established.

*Source: Shafritz, Public Policy Administration, 725.*
daily incivilities disrupted neighborhoods. What they said was that an un repaired broken window can send a message to people in the neighborhood that nobody cares about the building. If nobody cares, this can lead to further and ultimately more serious vandalism. Just as with windows, negative behavior in a neighborhood can signal to others that the behavior is acceptable and lead to more serious consequences.  

Community-oriented policing is founded on two social science theories: normative sponsorship theory and critical social theory. In normative sponsorship, we believe that most people are good and willing to cooperate. It tells us that people will work together if the goal is within the normal standards of the community. So for people to become involved in community-oriented policing, they must agree that it is worthwhile based upon their attitudes and values. Critical social theory looks at the way the community comes together in order to analyze a problem that is preventing the attainment of their goals or needs. Of course if community values, needs, and standards are different from community to community, their police technological needs are also different. We will look at how this may be increasing fragmentation later in this chapter. Community-oriented policing isn’t the only modern theory of policing. The problem-oriented policing theory shares many of the same characteristics of community-oriented policing. However, problem-oriented policing concentrates on situational crime prevention. Where community-oriented policing efforts generally define community based upon geography, problem-oriented policing looks more at the community of the problem. In problem-oriented policing, communities of interest would shift as problems were solved or new problems become apparent.

Changing the Value of Information

By looking back at developments in the past and examining how problems with information have been resolved, we are able to put the current state of information technology into perspective. Although a time line would provide us with some interesting information, it helps little in showing how technology changed the way in which law enforcement officers gather, organize, and use information. By somewhat closely following the development of a specific type of information and viewing how technology enhanced its use in both a strategic and a tactical sense, we should garner further insights into the concepts of strategic and tactical information. Moreover, we may begin to observe some common themes emerging.

The use of scientific methods of conducting criminal investigations has had a long, and sometimes controversial, history. One of the hallmarks of the professional policing model is a reliance on scientific investigation. One of the earliest forms of scientific criminal investigation, which is still used today, is fingerprint classification. The use of fingerprints in criminal investigations has significantly changed as it has been impacted by information technology. Because of its longevity, the history of the use of fingerprints in law enforcement is an excellent vehicle to view how information technology has changed the use of fingerprints.

As early as the seventeenth century, it was noted that fingerprints had specific patterns. Around 1880 it was suspected and later confirmed that no two individuals’ fingerprints are alike. Fingerprints are tiny valleys and ridges on the human hands. Their biological purpose is to make gripping objects easier.
Wrap a small piece of medical tape around your fingertips and try to pick up a large glass of water. Caution: Use a plastic glass!

While the basic pattern for human fingerprints comes from their genetic coding, the fingerprints are also affected during development by the conditions in the womb. The position of the fetus, condition of the amniotic fluid in the womb, and other environmental factors affect the formation of the fingerprints. The combination of the vast number of possible genetic combinations and the unpredictable and endless combinations of the environmental factors mean that no two individuals are going to have the same fingerprints, not even twins. Once found to be a positive way to identify individuals, fingerprints had a number of uses in the police service. Fingerprints can be either visible, plastic, or latent. Visible prints would be those left by touching a substance before touching a surface, like a bloody fingerprint; plastic fingerprints would be prints left in a soft substance like wood putty. **Latent fingerprints**, or hidden fingerprints, are left behind by the natural oils from our hands. These oils stay on an object, in the pattern of the fingerprint.\(^\text{23}\)

In 1880 Dr. Henry Faulds published an article in a scientific journal. The essence of his article was about how fingerprints could be used for personal identification. He also introduced some of the earliest technology of the recovery of fingerprints—printing ink. During the late nineteenth century and early twentieth century there was work to develop classification systems for the prints. For instance, in 1888 Sir Francis Galton developed a system of classification that is still in use to today. A few years later, Sir Edward Richard Henry would develop the Henry Classification System; it also is still in use today.\(^\text{24}\)

Around the turn of the twentieth century, the use of fingerprints in police work and criminal justice rapidly evolved. In 1902 the New York Civil Service began using fingerprints as a means of identification. In 1903 the New York State Prison System began the first organized use of fingerprints for prisoners in the United States. In 1904 the Leavenworth Federal Penitentiary and the St. Louis
Police Department began to use fingerprints. For the next two decades, more and more police agencies in the United States implemented fingerprints in their criminal investigations.25

As the trend to use fingerprints accelerated, police agencies throughout the United States began to send copies of their fingerprints to the National Bureau of Criminal Investigation, which had been established by the International Association of Chiefs of Police. Finally, in 1924 Congress established the Identification Division of the Federal Bureau of Investigation (FBI). By the end of World War II, the FBI had 100 million fingerprint cards on file from agencies around the United States.

For the next twenty-five years, the FBI continued to amass fingerprint cards from police agencies throughout the United States. In that time the number of paper files doubled to 200 million. By this time, the FBI had the beginnings of a huge database (databases will be explored in Part Three on information systems), but that database was millions of paper files in an untold number of filing cabinets. In 1967 the FBI organized the National Crime Information Center (NCIC) (NCIC will be explored in Part Three on information systems) to handle fingerprint cards and requests for comparison. In 1971 the NCIC began to incorpo-
rate criminal histories and correlate them to offender fingerprint cards on file. The medium of transmission for all of those fingerprint cards and criminal histories was the U.S. mail—what is referred to today as “snail mail.”

At this point, through most of the 1970s fingerprints had no value as tactical information and little value as strategic information. Consider a police officer in the field. He has stopped a motorist who does not have identification, and that motorist is a fugitive who is actively trying to conceal her identity. Through skillful questioning, the police officer might be able to determine the individual’s true name, and thus, her status as a fugitive. But even though the suspect’s identity is at the tip of her own hands, there was no way to use the information tactically because the officers in the street had no way of comparing the information (the fingerprints) to official files.

If the police officer were able to determine probable cause sufficient to arrest the suspect and take her to the police station, the police officer might be able to confirm the suspect’s identity but not ascertain her identity. Consider that NCIC held in 1971 200 million fingerprints. If a police officer sent the prints to NCIC (at this point the mail would take some time), which card would they compare the fingerprints to? It would probably take a fingerprint expert years of doing one-to-one comparisons to find a match.

Shortly after it was founded, NCIC came up with a partial solution to this problem. The Henry Classification system was mentioned earlier. It is a complex system and not, at this point, necessary to understand. NCIC, however, came up with a system to classify fingerprints that is much simpler. Both the Henry Classification system and the NCIC Classification system are based on patterns of loops, swirls, and ridges (see Figure 6.5) and the finger on which those classifications occur. The NCIC Classification code is a twenty-digit code, ten sets of two numbers. The ten sets represent the eight fingers and two thumbs. Each of the numbers indicate the pattern type on the finger.

As you can see from the chart, by examining each fingerprint and assigning the specific print a pattern type, you end up with a twenty-digit code. However, because this code is about pattern types, more than one person can have this code.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Definitions and Information</th>
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<tbody>
<tr>
<td>01-49</td>
<td>Ulnar Loop</td>
</tr>
<tr>
<td>51-99</td>
<td>Radial Loop</td>
</tr>
<tr>
<td>AA</td>
<td>Plain Arch</td>
</tr>
<tr>
<td>TT</td>
<td>Tented Arch</td>
</tr>
<tr>
<td>PI</td>
<td>Plain Whorl–Inner Tracing</td>
</tr>
<tr>
<td>PO</td>
<td>Plain Whorl–Outer Tracing</td>
</tr>
<tr>
<td>PM</td>
<td>Plain Whorl–Meet Tracing</td>
</tr>
<tr>
<td>CO</td>
<td>Central Pocket Whorl–Outer Tracing</td>
</tr>
<tr>
<td>CI</td>
<td>Central Pocket Whorl–Inner Tracing</td>
</tr>
<tr>
<td>CM</td>
<td>Central Pocket Whorl–Meet Tracing</td>
</tr>
<tr>
<td>DO</td>
<td>Double Whorl–Outer Tracing</td>
</tr>
<tr>
<td>DI</td>
<td>Double Whorl–Inner Tracing</td>
</tr>
<tr>
<td>DM</td>
<td>Double Whorl–Meet Tracing</td>
</tr>
<tr>
<td>XI</td>
<td>Accidental Whorl–Inner Tracing</td>
</tr>
<tr>
<td>XO</td>
<td>Accidental Whorl–Outer Tracing</td>
</tr>
<tr>
<td>XM</td>
<td>Accidental Whorl–Meet Tracing</td>
</tr>
<tr>
<td>XX</td>
<td>Amputation</td>
</tr>
</tbody>
</table>

Figure 6.5 NCIC Pattern Chart

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This is a filing scheme that makes it easier and quicker for prints to be compared. It would be akin to looking for someone in the telephone book. You would first turn to the appropriate last name and then begin your search for specific identifiers. Although this scheme made it easier to compare fingerprints, there were still more than 200 million on file. A fingerprint expert, doing one-to-one matches on an unidentified suspect might take only days. However, the NCIC classification system required fingerprints from all eight fingers and both thumbs. Few full sets of fingerprints are recovered from crime scenes. Therefore, the NCIC classification system wasn’t much help in identify suspects from fingerprints left at crime scenes.

At this point, NCIC began to correlate fingerprint cards with criminal histories. In the early 1970s a police agency could send a teletype or make a telephone call to NCIC and, based upon the fingerprint classification scheme, begin to make preliminary identifications of suspects. Moreover, as duplicate cards were submitted (primarily from repeat offenders), NCIC began to uncover aliases that suspects used.

In the mid-1970s another technology was introduced into this scheme—the facsimile machine, or fax. This technology allowed agencies to send facsimiles of fingerprint cards directly to NCIC. Once there, not only could they be classified, but the fingerprints could be examined (reintroducing the complex Henry system) so that an exact match could be made. However, the fax machine only sped up the transmission of the information, it did not help to organize it or improve the speed of classification. Moreover, because fax machines rapidly became popular, the use of the technology (which sped up transmission of information) created a bottleneck because technology had not improved the speed of comparison.

The next technological innovation was the Automated Fingerprint Identification System (AFIS) project. In the late 1960s and early 1970s the FBI began working with other federal agencies to develop algorithms for searching and matching fingerprints using computer technology. As we have seen, prior to this point, fingerprints had a huge untapped potential. There were millions of fingerprints, many of them from repeat offenders. At the same time, all around the nation, police officers were recovering fingerprints from crime scenes. Yet there was not an efficient means to bridge the gap between the police officers and the information contained in the fingerprint files. Up until this point, the fingerprints were of no value as tactical information (for the police officer in the street) and of little value as strategic information (for solving crimes).

The process of analyzing fingerprints is known as dactylography. The AFIS technology further advanced fingerprint information toward becoming true strategic as well as tactical information by comparing fingerprint features known as minutiae. Moreover, they concentrate on details where ridge lines end or split in two. These splits are known as bifurcations. Together, these and other features are known as typica.

The computer software then uses sophisticated and complex algorithms to recognize and compare minutiae. A simple explanation of what the computer is doing is a connect-the-dots game. The computer determines that the minutiae are a point, or dot. It then draws a straight line between the dots, completing a geometric shape or pattern. It then searches the other fingerprints in the database for a shape with the same size and dimensions. So if fingerprints have the same pattern, there is a great likelihood that the two fingerprints are a match. For most of the United States, matching points of comparison are necessary to consider the match positive.
Use of Automated Fingerprint Identification Systems (AFIS) in local police departments, by size of population served, 2000

<table>
<thead>
<tr>
<th>Population served</th>
<th>Percent of agencies with AFIS ownership or remote access</th>
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<tbody>
<tr>
<td></td>
<td>Total with access</td>
</tr>
<tr>
<td>All sizes</td>
<td>20%</td>
</tr>
<tr>
<td>1,000,000 or more</td>
<td>100%</td>
</tr>
<tr>
<td>500,000-999,999</td>
<td>85%</td>
</tr>
<tr>
<td>250,000-499,999</td>
<td>95%</td>
</tr>
<tr>
<td>100,000-249,999</td>
<td>85%</td>
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<td>50,000-99,999</td>
<td>58%</td>
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<td>25,000-49,999</td>
<td>39%</td>
</tr>
<tr>
<td>10,000-24,999</td>
<td>26%</td>
</tr>
<tr>
<td>2,500-9,999</td>
<td>17%</td>
</tr>
<tr>
<td>Under 2,500</td>
<td>13%</td>
</tr>
</tbody>
</table>

Figure 6.6 The use of AFIS is steadily increasing. As of 2000, Americans living in the largest cities were provided police service by a local agency that had some type of access to AFIS.

Source: Department of Justice, Bureau of Justice Statistics, 2000 Law Enforcement Management Statistics.

Although this work in the 1970s was moving toward making the fingerprints on file useful information, there were a number of stumbling blocks. The relative processing speeds of computers at that time was slow. It took a long time for a search. Moreover, in addition to the development of the algorithms, hardware, and software needed to store the information needed to be developed. Finally, there were 200 million fingerprints that needed to be computerized.

While NCIC was developing their national database, the local government agencies forged ahead in developing their similar applications. The efforts of local and regional agencies to develop AFIS technology created successes and highlighted a recurring theme in the development of police technology—fragmentation. Fragmentation will be discussed later in this chapter. However, the introduction of AFIS technology did unleash the potential of fingerprints as strategic information.

Police officers, especially detectives, had a new and powerful tool in solving crimes. AFIS technology began to be used routinely, especially in the investigation of cold cases. Essentially, a cold case is a criminal investigation wherein all leads have been exhausted. Recall that while detectives, for nearly a hundred years, might have a suspect's fingerprint from a crime scene, they were unable to match it to the suspect, unless they already knew the suspect's identity. Technology changed this. Now the real potential for fingerprint evidence was beginning to be unleashed.
In 1999, the FBI launched the Integrated Automated Fingerprint System (IAFIS). At that moment, the fingerprints of 33 million people who had committed crimes were now available to law enforcement agencies nationwide (although by the 1970s the FBI had more than 200 million fingerprint cards on file, many of them were duplicates, the cards were for some reason unusable, or the fingerprint cards were noncriminal in nature). Additionally, NCIC was replaced with NCIC 2000 (NCIC 2000 will be fully explored in Chapter Nine). Recall that beginning early in the twentieth century, law enforcement agencies had been sending fingerprint cards to NCIC, and now, with the advancements in technology, those records were available for relatively easy comparison. IAFIS made fingerprint evidence true strategic information.

Advances in technology have also begun to make fingerprint information tactical in nature. For fingerprints to be tactical, police officers in field situations would have to be able to examine and compare them against databases in the field. In order to be available in the field, a number of technical challenges remained. The information transmitted between local agencies and the NCIC’s IAFIS was conducted along existing networks (networks were explored in Chapter Four). However, for the information to be used by the field police officer, the information would have to be transmitted in some wireless mode (wireless communications were explored in Chapter Three). Moreover, it required a computer in the police vehicle, optical scanning equipment compact enough and rugged enough for the field, and a variety of other hardware and software. In 2000, much of this technology came together, enabling fingerprint information to become tactical information. While some of the technologies that made it possible for fingerprint evidence to become tactical information are subjects of subsequent chapters, this chapter looks at two devices; the optical and the capacitance scanners give us a good overview of how fingerprint information can be viewed and used as tactical information.

There were other developments in the area of fingerprints over much of the twentieth century. In addition to how fingerprint evidence is stored (now as data), compared, and retrieved, there were advances in how fingerprints were taken from suspects and lifted from crime scenes. The way that fingerprints were taken from suspects had not changed in almost one hundred years. The ink was rolled onto the suspect’s fingers and hands, and then the fingers were rolled or pushed against paper, as required. The rolling of the finger onto paper was necessary in order to get the most area of the finger and the clearest print for comparison.

The problems with taking a suspect’s fingerprints using the ink technology were improved by digital scanning devices. Recall that the AFIS technology examined the minutiae on the fingerprint in order to detect a searchable pattern. The digital scanning device is the other half of the technology. The first task of a digital scanning device is to obtain an image on the fingerprint, it then begins its examination and comparisons.

In January 2003, two 45-year-old partial fingerprints led to the arrest of Gerald F. Mason, a man from South Carolina. Mason eventually pled guilty to murdering two El Segundo police officers in 1957. Authorities believe that the police officers stopped Mason shortly after he had committed a rape. The prints linking Mason to the murder scene were critical. The fingerprints Mason left at the scene had lain dormant for nearly fifty years. It was AFIS technology that solved this cold case.
While there are a number of different ways to obtain a fingerprint from a human being (as in the case of an officer taking a suspect’s fingerprints), the two most common methods of digital scanning are **capacitance scanning** and **optical scanning**. While they both obtain the image, they use vastly different technologies.

The optical scanner uses the same technology you would find in a digital camera or camcorder. It uses a charged coupled device (CCD). A CCD is a collection of light-sensitive diodes called photosites. Now, there is significantly more technology involved in the details of the workings of a optical scanner. For instance, we did not even look at, or need to look at, the “analog-to-digital converter.” Suffice it to say, there is a lot going on inside the technology, but now let’s look at its use.

For our officer who is fingerprinting a suspect, the process typically begins by the officer inputting some basic information into the scanning device, such as the name and date of birth the suspect has given. The information is generally input by using a keyboard and monitor. The suspect’s fingers are then placed on a glass plate. A light source inside the optical scanner illuminates the suspect’s fingertips and the CCD camera takes a picture. In reality, the CCD system creates an inverted image of the fingers, with darker areas representing more reflected light (the ridges of the fingerprints) and lighter areas (less reflected light) representing the valleys.

Prior to the introduction of optical scanners, the clarity of the fingerprint was judged by the officer. For a variety of reasons, a large number of fingerprints were unusable for later classification or comparison. The fingerprints might have been smudged, too light, too dark, or lacking in detail. Some even had the left-hand fingerprints printed onto the side of the fingerprint card for the right hand. Because officers were required to complete a manual task and the subject of the collection was at times uncooperative, some of the information gathered (the fingerprints) was essentially corrupted data. The fingerprint information that was being taken manually was a paper file. The AFIS technology would eventually convert the paper file to a computer file. Because the fingerprinting was being done manually, the error rate was substantial, and ultimately, the corrupted files were worthless.

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**Figure 6.7** The photosites respond to light photons by generating an electrical signal. The electrical signal is recorded as a pixel. Together, the pixels form the image of the fingerprint.
Another way to measure the actual distance of the ridges and valleys of fingerprints is through the use of sound waves. Ultrasonic fingerprint scanners are not as common as their electrical cousins, but because they measure actual distances as opposed to taking a photograph, they are more difficult to deceive, or “spoof.”

With optical scanning, the scanner processor makes sure that the CCD has obtained a clear image. In other words, the error rate of manually fingerprinting suspects was all but defeated. Essentially, the fingerprint scanner checks to see if the overall image is too dark or too light. After that check, the scanner looks at the fingerprint definition. In this instance, definition is how sharp the image appears. The digital scanner checks the definition by moving straight lines horizontally and vertically across the scanned image. If the definition is good, the straight line passed over the ridges of the fingerprint will have alternating dark and light pixels. After the digital scanner determines that the image is good, the fingerprint is captured and added to the agency’s fingerprint file. In some instances, the fingerprint is compared against local, regional, and national databases.

The second type of digital scanner used to record fingerprints is a capacitance scanner. Like their cousins, the optical scanners, capacitance scanners also make an image of the ridges and valleys of the fingerprint. However, instead of using light, like the optical scanners, the capacitance scanners use electrical current. The sensor that actually views the fingerprint consists of one or more semiconductor chips that contain tiny cells.

How the capacitance scanners actually take an image of the fingerprint involves some fairly technical science like the operations of an inverting amplifier, a capacitor, and an integrator circuit. It is enough for us to know that when a fingerprint is placed against the glass of a capacitance scanner, the device is constructed in such a way as to recognize the fingerprint as a third capacitor.

A capacitor is a device that can store an electrical charge. Therefore, the amount of electrical charge it can store, or is storing, can be measured. Recall the fingerprint is a series of ridges and valleys. When placed against the capacitance scanner, the valleys of the fingerprint are ever so slightly farther away from the device than the ridges. This difference in distance (and the air in the ridges, which acts as an insulator) means that the valleys and ridges, when viewed as a third capacitor, have a very slight difference in the ability to store an electrical charge. The capacitance scanner measures this difference and produces a map, or image, of the fingerprint.

The differences between an optical scanner and a capacitance scanner are important for two reasons. First, the capacitance scanner does not contain the CCD and is more readily miniaturized. Second, because the capacitance scanner is actually taking measurements, it is more difficult to fool. When we examine the science of biometrics, the ability to fool scanning systems will become an important consideration. Prior to the introduction of digital scanning devices, there were a number of drawbacks with the ink technology. First, taking fingerprints from a suspect who was under the influence of drugs or alcohol or was hostile was exacerbated by the time it took to take the fingerprints—rolling ink on their fingers and hands and then the fingerprint cards. With digital scanning technology, the ink is removed from the equation, and the time it takes to complete the task is usually much less. In essence, digital scanning technology has made the process of fingerprinting a suspect some-
Automatically obtaining digital fingerprints and then comparing them to a database of stored fingerprints is a key component of the science of biometrics. In essence, biometrics is the science of automatically identifying people based upon physiological characteristics (such as fingerprints, facial structure, thermal image, gait, speech, and handwriting). We will take a more in-depth look at biometric applications in Chapter Twenty-One.

A Look Ahead

what safer for the individual police officer. Secondly, it takes some skills to take a “clean” set of fingerprints. Taking fingerprints is a perishable skill. In other words, if you don’t perform the task often enough, your ability to perform the task degrades. One of the common problems with the fingerprint cards received by NCIC was the quality of the initial fingerprinting. Smudging, distortion in correct fingers, was a common problem. The digital scanning technology significantly improves quality because the digital scanner will not accept the fingerprinting task as completed unless the clarity of the fingerprints meet minimum quality standards—the computer has become a quality control inspector of sorts. Finally, the digital scanning technology significantly

Figure 6.8 Many law enforcement agencies are transitioning from traditional ink on paper fingerprinting to digital fingerprinting. In this photograph, the police officer is using Cross Match Technologies’ ID 1000 Live Scan to fingerprint an offender. Photograph provided by Cross Match Technologies, Inc.
increased the speed of identification. Police agencies with this type of technology are at the very minimum immediately checking their own records to verify identity. Many agencies are accessing regional and national databases.

With the introduction of fingerprint scanning devices, fingerprint information was becoming tactical information. Consider the police officer who is taking the fingerprints of an arrested suspect. The suspect is being booked (booking is the process of intake into the jail). Generally, it involves a search of the suspect’s person, fingerprinting, photographing, and the recording of the suspect’s personal information for a minor charge. With the ink technology, the officer might not have any means to verify the name the suspect was giving. In many instances, fugitives from other jurisdictions would use an alias, be booked on a minor charge, and be released before the true identity and status as a fugitive were known. This was a very common occurrence.

Police agencies using digital scanning devices to verify suspects’ identities and determine if they have any warrants are using the fingerprint information tactically. The digital scanning device improved the quality of information input into the system (better prints), made the process quicker and, thus, safer for the officer, and improved public safety by reducing the number of fugitives released before their identities could be ascertained.²⁹

So far we have looked at fingerprint scanners that are used in the police station. There have been a number of other technological innovations that allow scanners to be used in the field. Later in the text, we will look at NCIC 2000, as it is being used in the field. However, the idea is to use a mobile imaging unit inside police vehicles that will contain a handheld fingerprint scanner, a digital camera, and perhaps even a small printer.³⁰

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Figure 6.9  Mobile wireless fingerprint capture devices can be used in the field during traffic stops or at crime scenes to determine in a matter of minutes whether or not an individual is wanted or has outstanding warrants. If an offender is determined to be dangerous, this new knowledge heightens the officer’s awareness, improving his or her ability to remain unharmed. Moreover, the technology can increase police efficiency by reducing the number of offenders taken to the station for their identification to be verified. In this photograph, the police officer is using Cross Match Technologies’ MV-5 Mobile Wireless Capture Device.

Photograph provided by Cross Match Technologies, Inc.
Policy and Procedure

The differences between policy and procedure are important for any student of police science, and technology may have a role in changing how we think of the differences between the two. Procedures are a set of instructions on how to do something. Like an algorithm, there is very little room for deviation. On the other hand, policy is a broad statement on how things should be done. In field police work, policy is necessary because no two situations are ever exactly the same. No one can give you an exact algorithm on how to handle even the most basic radio call. Policy is a set of organizational guidelines about how we want human beings to exercise judgment. Computers do not exercise judgment, they follow a set of rules. Whenever we insert technology into the decision-making process, we reduce human interaction and turn over our decision-making ability to computers.

Somewhere between organizational policies and implementation in the street, policies sometimes get modified by the person carrying out the task to meet the demands of a particular situation. In other words, people make judgments. We want police officers to have good judgment. We want them to make decisions about situations in the broad framework of organizational policy. At times, the way in which organizational policies are acted out at the line level has been called street-level bureaucracy.

Recall our traffic violator scenario from Chapter One. Not every traffic violator receives or probably deserves a traffic citation. I could come up with scenario after scenario where justice would be better served by a warning or education than a citation. However, police agencies are increasingly relying on cameras, sensors, and computers to monitor traffic at problem intersections. In some instances, police agencies have installed devices that take pictures of vehicles that run red lights or speed. Remember computers can only follow a set of instructions. They cannot make judgments. Every time we insert a technology into the decision-making process (automated databases of fingerprints and DNA, for example), we remove human judgment. This phenomenon of replacing human judgment with computer procedure has been called screen-level bureaucracy. As we look at technologies in subsequent chapters, consider if we are replacing human judgment with computer algorithms.

Fragmentation

Fragmentation of technological development and implementation in law enforcement is such a critical issues that we should return to it momentarily. As we know, the United States has more than seventeen thousand state and local law enforcement agencies, and from Chapter One, we know that this phenomenon is due in part to how our country was founded. In addition to the founding principles of our democracy, fragmentation is caused by a number of other factors. Key among them are the differences among communities.

The vast majority of law enforcement agencies in our country are small, local jurisdictions providing service to some type of municipal political subdivision—a town, a city, and the like. In many instances, these small municipalities have very different community expectations and standards. One of the more interesting sociological and political theories, Tiebot’s Law, examines how people group themselves together based on common expectations.

For our police departments, these different expectations play out in vastly different equipment acquisitions. For instance, one community may have a problem, a major thoroughfare running through it and thusly be concerned with speeding. That police agency may choose to purchase technology, like radar, in order to meet the
community expectations. Another community may have a large number of young people, so the police agency concentrates its available budget on youth programs.

For the local agency, the budgets are small and most devoted to personnel costs. Technologies are chosen to meet basic officer safety needs and community standards. Add to the problem that many police technologies are drawn and adapted from the commercial marketplace and you have a situation wherein the marketplace cannot make a profit by responding to technology needs of local agencies. Fragmentation causes equipment and technology acquisition to be on an agency-by-agency basis. Therefore, in addition to having different equipment, state and local agencies develop expertise at different rates. The problem of fragmentation has the most dire consequences when state and local law enforcement agencies with contiguous or overlapping jurisdictions have incompatible technologies. The result is that local agencies are generally very poor at the tactical and strategic exchange of information.

In Chapter Eleven, when we look at information exchange, we will look at several possible technological solutions to the problems associated with fragmentation. Moreover, we will look several times at the creation of regional authorities. Many times, by pooling resources, there are organizational and technological solutions to the problems associated with fragmentation. One organizational solution was the founding of the technology section of the National Institute for Justice (NIJ) in 1986. It acts as a technological clearinghouse for law enforcement. They test products (from tires to radios), conduct research, and provide direct assistance to state and local agencies in solving technological problems. Later in the text I will give you the Web site.

Chapter Summary

In this chapter we looked at the development of police technology against the backgrounds of the policing models—political, professional, and community based. Our job was to gain a historical perspective of the different developments and how they affected the models. It is fairly clear from the literature that many scholars believe that the introduction of early technologies like the automobile and the radio enhanced the development of the professional model.

We saw where the professional model ultimately produced incident-driven policing and community dissatisfaction with the police. However, the professional model, with its emphasis on record keeping, did give researchers plenty of information from which to explore the nature of American policing. Out of the research, a primary new model, community-oriented policing, and a secondary model, problem-oriented policing, emerged. As we explore police technology further, we should look for technologies that continue to reinforce the professional model and those that do, or could, enhance the community-based model.

By looking at the development of fingerprint technology, we were able to see the tactical and strategic value of information in law enforcement. Moreover, we saw how technology significantly enhanced the value of this information. It was transformed to true strategic information and ultimately will be of significant tactical value.

We introduced the new concepts of policy and procedure primarily to think about what happens when we substitute computer decision making for human decision making. Certainly computers are much better at storing, organizing, and recalling vast amounts of data. But we should be on the lookout where we may want to insert human judgment in any criminal justice loop. If someone mistypes a name, your name could end up in NCIC as wanted. We don’t want our police officers acting solely on that information. We want them to exercise judgment.
We also looked at fragmentation again. Fragmentation is an overriding, constant theme in police technology. The more we understand its causes and effects, the more able we will be able to deal with the problems and search for solutions.

Discussion Questions

1. Law enforcement is not the only field that has been changed by technology. What other fields have been changed by technology?
2. Other technologies and sciences were applied to police work in the past fifty years. How did technologies such as radio communications impact the professional policing model?
3. When we looked at the difference between policy and procedure, we introduced the concept of screen-level bureaucracy. What other examples of screen-level bureaucracy have you experienced?
4. Throughout the professional era, the implementation of police technology was primarily concerned with enhancing the model by speeding up the response times to calls and improving communications and technologies for criminal investigations. How can technology be used to enhance the community-based model?
5. Police agencies are not the only organizations that may be unintentionally removing human judgment. Can you think of situations you have seen where a computer is making a decision that used to be made by a person? What are the positives of this? What are the negatives?

Key Terms

- Automated Fingerprint Identification System (AFIS)
- Capacitance Scanning
- Charged Coupled Device (CCD)
- Community-Oriented Policing
- Critical Social Theory
- Dactylography
- Fingerprint
- Incident-Driven Policing
- Latent Fingerprint
- Minutiae
- National Crime Information Center (NCIC)
- Normative Sponsorship Theory
- Optical Scanning
- Policy
- Political Policing
- Problem-Oriented Policing
- Procedure
- Professional Policing
- Strategic Information
- Tactical Information
- Typica

End Notes

4. See note 2 above.
5. See note 3 above.
6. Shafritz, Public Policy and Administration, 1678.
8. Shafritz, Public Policy and Administration, 1678.
9. See note 2 above.
12. Shafritz, Public Policy and Administration, 1679.
13. Ibid., 444.
15. See note 2 above.
16. See note 7 above.
20. Ibid., 445.
21. Ibid.
22. Ibid.
24. Ibid., 71.
25. Ibid.
29. See note 26 above.
30. Ibid.
31. Bovens and Zouridis, “Information and Communication Technology.”
34. See note 7 above.
35. Ibid., 14.