PLANNING FOR THE USE OF EXPERT SYSTEMS TO AID POLICE OFFICERS BY THE YEAR 2000

A plan for developing and implementing expert systems in a medium-sized California police department.

By

HUGH F. MOONEY

Command College Class 11

Commission on Peace Officer Standards and Training

Sacramento, California

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This Command College Independent Study Project is a FUTURES study of a particular emerging issue in law enforcement. Its purpose is NOT to predict the future, but rather to project a number of possible scenarios for strategic planning consideration.

Defining the future differs from analyzing the past because the future has not yet happened. In this project, useful alternatives have been formulated systematically so that the planner can respond to a range of possible future environments.

Managing the future means influencing the future--creating it, constraining it, adapting to it. A futures study points the way.

The views and conclusions expressed in this Command College project are those of the author and are not necessarily those of the Commission on Peace Officer Standards and Training (POST).

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ABSTRACT

The study examines some possibilities for development and use of expert systems in law enforcement to aid employees in their daily tasks. The author provides a review of pertinent literature, interviews of persons developing and using expert systems, analyses of significant trends and potential events, and scenarios of possible future states; and suggests policies and strategic and transition plans for financing, developing, and implementing expert systems in a police department. The results show a need to develop expert systems for police to cope with increasing crime, service demands, information processing requirements, and decreasing personnel and funding. Study includes trend and event evaluations; forecasts; graphs and tables; references; appendixes.

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Executive Summary

This study examines the technological advances taking place in the computer industry related to expert systems and how they may be integrated into police operations during the next decade. The focus of the study centers on the question: To what extent may expert systems be used to aid line police officers by the year 2000?

Futures Study:

The study method consisted of a review of literature on the subject, interviews with persons working with expert systems, and a forecast of current trends and potential events that may impact the issue.

The study projected decreases in available police experts, funds for police, and prices of computer technology. The study projected increases in crime rate, amount of information that police must process, police service demands, computer literacy of employees, use of expert systems in law enforcement, and most significantly computer technology.

Potential events with a high probability of occurrence by the year 2000 and significant potential impact on the issue were determined to be voice interaction between computers and operators, government funding for development of expert systems for law enforcement, linkage of police data bases, and low-priced ultra-high speed computers.

Strategic Plan: A strategic plan was devised for development and implementation of expert systems in a medium-sized police department. The essence of the strategy is to engage in joint ventures with other city departments, develop small expert systems internally, use "asset forfeiture" funds for initial purchases, utilize existing police records data bases with embedded expert systems, and budget for technology upgrades through an amortization process.

Transition Management: The plan for transition to a police environment using expert systems calls for a project manager and small staff to direct development and integration of computer applications over a period of four to eight years.

Conclusion and Recommendations: The study concludes that use of expert systems is vitally important to the future delivery of effective police services. Development of expert systems for law enforcement will suffer from funding shortages and take a prolonged period to develop.

The study recommends further study of voice interactive computers, alternatives for funding police technology, and state sponsored development of expert systems for law enforcement.

PREFACE

The office of today is organized like a factory where the product is paper...[W]e must recognize that the product of the office isn't paper, but ideas-that people and not machines are the source of economic power.

- Samuel E. Bleeker, 1987

Today's typical law enforcement agency is challenged by the daily necessity of meeting the expanding needs of the public with only limited resources. Police departments everywhere are confronted by escalating street and gun-related violence, and other traditional and non-traditional demands for service, while coping at the same time with constantly changing priorities, uncertain or shrinking resources, and fewer seasoned personnel. These stresses can lead police executives to adopt a defensive or "siege" mentality, where protecting the status quo becomes acceptable, and is more comfortable than exploring new avenues that might lead to a more efficient and productive use of resources. In fact, these trying times are precisely the occasion when senior police officials should seize the initiative and search for and experiment with new techniques and technologies.

- Edward C. Ratledge, 1989

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Chapter 1

INTRODUCTION

- An expert system is a set of computer instructions that represent the knowledge, inferences, and rules-of-thumb used by an expert in analyzing information about a particular situation. When applied to data, the expert system will reach the same conclusion an expert would achieve.

The success of a police department is dependent on the application of expert knowledge. To date, we have counted on the training, experience, and memory of workers to accomplish police tasks. During the next decade, police departments will be faced with diminishing financial and personnel resources needed to meet public service demands. Computer technology offers a viable solution to the crisis that may result from these trends.

Technology is now available which will capture and effectively use the expertise of veteran employees. Expert systems can fill the gap between decreasing personnel and financial resources and rising service demands.

This report will discuss the applicability of expert systems in future police operations: how these systems can be developed and integrated into routine operations, and how such technology can be financed.

The report will not discuss the various technical aspects of computer hardware and software pertaining to expert systems. There is a wealth of literature available on

these topic and it is better explained by computer experts.

Computers and expert systems in the work place

The computer was invented just a few decades ago. Intended to deal with complex mathematical problems, the early computer was cumbersome to use and required a room full of hot vacuum tubes and wires. Today, many of the same calculations can be done on a solar powered pocket calculator in a fraction of the time.

Computer development is one of the most rapidly advancing fields of American technology. This advance, exponential in rate, has led to ever increasing capability and speed of operation with decreasing size and cost. The computer has entered new environments and been adapted to new uses; it is now an integral part of virtually every American business, and is found in many of our homes and all of our schools.

Expert systems are a sub-field of Artificial Intelligence (AI). AI is a branch of computer science dealing with symbolic methods of problem solving. Expert systems mimic the human decision-making process. They emulate inductive and deductive reasoning.

Henry Mishkoff (1985:2) defines an expert system as "a computer program designed to act as an expert in a particular domain (area of expertise). Also, known as a knowledge-based system, an expert system typically includes a sizable knowledge base, consisting of facts about the domain and

heuristics (rules) for applying those facts"

Expert systems are intended to aid experts, not replace them. They support decision-making, monitor the environment to make decisions and take appropriate action, and capture and preserve human intelligence. An expert system can explain its logic to the operator when asked. It can perform many time-consuming routine or mundane tasks, thus freeing its human partners for other tasks.

The first major expert system, used in diagnosing problems, was MYCIN. Developed at Stanford University in the 1970's, it used a system of about 500 rules to diagnose infectious diseases and prescribe proper treatment. While highly accurate, this computer program could not match the speed of a competent physician. Though not marketable in its time, MYCIN became the impetus for designing the expert system shells that are now widely marketed. These shells are generic object-oriented programs that allow users to plug in the decision-making rules that they desire.

According to L.E. Frenzel (as quoted in Ratledge, 1989:12), expert systems offer distinct advantages to workers:

They permit non-experts to do the work of experts.

They improve productivity by increasing quality and quantity of output.

They permit new kinds of problems to be solved, making the computer more useful.

They capture and store valuable knowledge that might be lost.

They make expert knowledge available to a wider audience, thus increasing the problem-solving ability of more people.

Humans and their logic have remained essentially unchanged for several millennia, but their societies have changed in response to new technologies. Tools that were made of wood and stone were subsequently made of bronze, then iron and steel. Information that was once memorized and passed from one person to another was later recorded in writing and passed to many. Social organization has always adapted to new technologies.

According to Samuel Bleeker (1987:6), "Today it is the mind and not the body that sits at the core of the economy. Information is the currency. Ideas are the products. Information is power. How well people understand is critical to the means of production. Knowledge workers are asked to inquire and to think, to gather information, to evaluate it, communicate it, and to act upon it."

Expert systems in law enforcement

Bleeker's description of a "knowledge worker" clearly describes the traditional role of the police officer and police investigator.

"In the criminal justice environment, expert systems are now used to support crime-solving, decision-making, training, and program planning and design." (Ratledge, 1989:1)

Police use two forms of "knowledge", individual

knowledge based on years of experience, and collective knowledge or information gathered by all officers and stored in police records. The current use of individual knowledge is quite satisfactory, but the use of collective knowledge is dismal. John Eck (1983:xxvi) and others have noted that police consistently fail to take advantage of information stored in their own records systems. The reason for this may be the difficulty in locating and retrieving useful information in a timely manner from a remote and antiquated system.

Two technological advances that can greatly change the use of police computers and expert systems are voice interaction between operator and computer and the parallel processing capabilities of future computers. These two changes will drastically increase the speed with which information is gathered, transmitted, stored and retrieved, and analyzed by police.

New computer technology can expedite police operations in a proportion similar to the introduction of the radio and automobile.

The potential for improvement of police operations through expert systems is clearly present. The question is how to adapt, develop, finance, and integrate this technology into our police departments for the benefit of future police operations.

There are many things to consider when attempting to answer this question. For the purpose of this study, a few

relevant issues were chosen to serve as a focus for research. The main issue and several sub-issues are listed below.

To what extent may expert systems be used to aid line police officers by the year 2000?

How would utilization of expert systems impact the financial planning of the police department?

Will the cost of AI technology come within reach of local government?

What circumstances will dictate demand for expert systems in the near future?

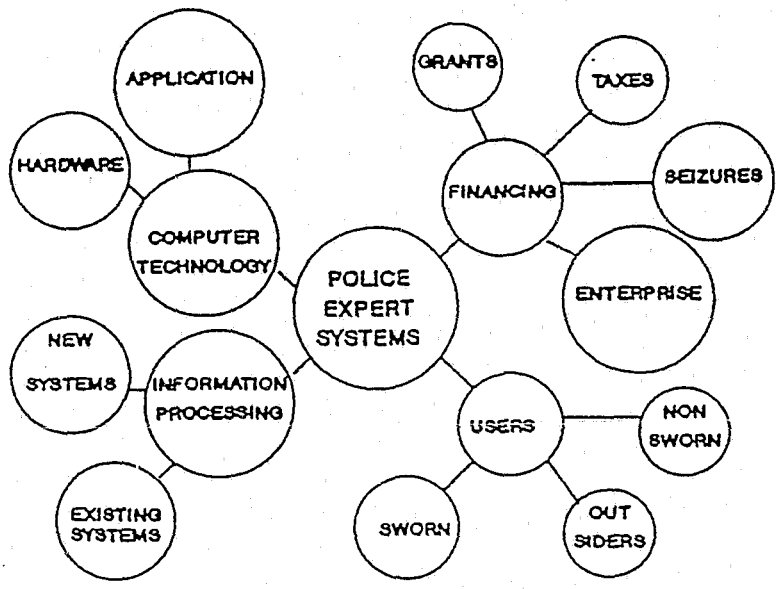


Figure 1

FUTURES WHEEL

Figure 1 shows the issue of police expert system development in relationship to some of its sub-issues.

CHAPTER 2

FUTURES STUDY

This chapter uses three methods to postulate future directions. The first is a review of literature pertaining to the topic. The second is a discussion of the issue with experts working in the field. And the third is a forecast of significant trends and potential events that may impact the issue.

Expert systems in operation today

There is no doubt that the computer will change our society to a degree at least equal to the changes wrought by the industrial revolution. As S.E. Bleeker (1987:21) points out, "In the Industrial Age, people aided machines: today, machines aid people. This shift is central to the most dramatic change in the history of production."

In today's environment, we can see many applications of expert systems in industry. At Digital Equipment Corporation, the XCON system uses and expert approach to select the right hardware and software for the customer, based on the application needs. This system saves the company about $25 million annually in previous labor costs and increases customer satisfaction with the product.

Interestingly, production costs for computers will likely decline by use of expert systems. For example, each printed circuit board must be tested before sale. Joseph

Kroger (1987:38) notes that "[c]onventional testing uses hardware valued at $1.5 million and requires a high paid and trained technician. This will be replaced by AI for $100 thousand and a two week trainee."

According to Harmon and Sawyer (1990:10), the 1990's will see widespread use of expert systems. They will be integrated into larger knowledge networks and within five to ten years will commonly operate on parallel processing hardware.

Kalman Toth (1989:34) estimates that by the year 2000, "Silico-Magnetic Intelligence" workers (robots) will be available for $50 thousand (software and hardware) and replace workers costing thousands more per year.

In 1984, the "Defense Science Board Task Force" (1986:6) examined "Military Applications of New-Generation Computing Technologies". It found that "...expert systems are at the core of military [computer] applications..." It recommended that systems be devised that can read and understand text and interact directly with human experts without the intervention of computer scientists. In 1984, the Defense Advanced Research Projects Agency (DARPA) (1985:1) began a five year, $600 million expert systems development project that is presumed to have accomplished these goals by 1989. (Most results are classified as secret and are unavailable to the public).

Modern weapons systems, employed by our armed forces, must operate a speeds which no human could control. Today's

fighter pilot flies the plane, while expert systems operate his offensive and defensive weapons. The same pattern holds for naval vessels. Rather than the old close encounters with broadside salvos, the modern navy can engage an enemy not yet visible on the horizon.

These modern weapons systems are augmented by high-speed computers in the Department of Defense. These "super" computers utilize parallel processing and embedded expert systems to analyze satellite and other data , tracking the location of aircraft, ships, and armies around the world.

The government funded research and development which brought about these new military systems has led to many improvements in computer technology which have spun off into the public market place.

One such example is the "HAL-ES" (trademark, Voice Connexion, Irvine, CA). Today a quadruplegic can operate all systems in his or her home with this voice-operated personal computer. He or she can control the temperature, lock or unlock doors, write letters, or dial the telephone. The system can use a vocabulary of up to 1000 words and each spoken word can represent up to 1000 keystrokes of instruction entry. This reduces the cost of care for the disabled and gives the user a sense of independence and self-esteem.

Text to voice translation is now available in most languages. Voice to text transcription is a few years away, because it requires a more complex program to deal with

allophonic words such as, two, too, and to. It is possible now, but affordable operating systems are too slow to make a marketable product (see Runge, 1990).

Today there are several manufacturers of voice operation circuitry. This hardware is quite small. It can be plugged into a lap-top computer in today's patrol car for hands-free voice operation of all standard Mobile Data Terminal functions. The component can be trained to respond to the user's chosen vocabulary in a matter of minutes. It will display information on the screen and respond orally to the operator. It is easier, faster and safer than keyboard operation. The cost of a "386" lap-top computer with this capability is about $2000. United Parcel Service and Kodak are currently using voice operated, hand-held computers in their shipping departments today.

As alluded to earlier, speed of operation is a critical component of technological development in the realm of computers. The United States military, for example, uses "super" computers designed by Seymour Cray. The "Cray-3" is designed to make 16 billion calculations per second at top speed (Mitchell, 1990). Initially, this speed was thought to hinge on the perfection of the Gallium Arsenide (GaAs) circuit, being developed by the Rockwell corporation. However, present and former Cray associates have equalled this desired speed with existing silicon chip computers. By comparison, what the "486" personal computer can do in 96 hours, a "super" computer can do in one minute. Clones of

Cray's original "super" computer are now marketed for about $250,000.

While parallel processing is quick, it is not yet practical for police applications. Another means of improving the speed and accuracy of information flow is an embedded expert system in the records computer. This system would monitor the data stream flowing into storage, and copy and transfer vital information as it was encountered. For example, using "if-then" criteria, when the program saw the word "robbery" in any report, it would note the case number, persons named, descriptions, vehicles, dates, and locations. These data would be copied and exported to the robbery detail's micro computer. The embedded system could sort and file persons, arrests, crimes, locations, etc. in any way desired, without additional human data entry. By reading the offense code, the system could do all report distribution instantly and with absolute accuracy.

The "Profiler" system, being developed by the FBI, is intended to aid sexual assault investigations by emulating the psychological profiling skills of an expert psychologist. It is accurate in its assessments about 50 percent of the time. (The same rate as the human expert). While this seems little improvement over the use of a human expert, consider that this computer application can be in thousands of locations and available 24 hours a day (see Reboussin, 1990).

One of the few police experiments in expert systems development has taken place in five major police departments,

Baltimore County, Maryland; Charlotte, North Carolina; Rochester, New York; Tucson, Arizona; and Tampa, Florida. The initial setting for this experiment was the Baltimore County Police Department. Using a grant from the National Institute of Justice and the aid of research specialists from the Jefferson Institute, an expert system for burglary investigation was developed. The system took two years to develop and cost about $70,000 (including $45,000 in salaries). According to Ratledge (1990:50) the advantages of this system are: "Retention of knowledge and expertise of experienced detectives; It never forgets a suspect, even when they are gone for years; It can search and match records quickly (38,000 in 90 seconds); It promotes uniform and comprehensive collection of information; It belongs to the detectives and is located in their office; It provides a basis for training new detectives."

This "Burglary Expert System" operates much like the standard crime analysis systems of the late 1970's, and requires special data collection and entry by select personnel. It operates on a data base of known burglars and crimes of burglary, which is separate from the main records system. Data are received via special forms from crime scene investigators and arresting officers. While the "Burglary Expert System" operates much faster than a human crime analyst, it requires redundant reporting by field officers and additional data entry time. This process adds costly officer time to the process. Drawing the needed information

directly from existing reports or main records systems, without secondary entry, would be much faster. This is the method currently employed by the United States military in threat analysis. Transmission of the data from the field directly to the main computer, via radio frequency, would be another means to speed the entry and use of needed crime information.

The Baltimore County project is the most successful at matching known criminals to crimes and nearly doubled the detectives' case clearance rate. The Tucson project has yet to make a match. Officers have been reluctant to comply with the additional reporting requirements in both departments.

One of the best expert systems in use today is the automated fingerprint classification system known as Cal ID. This system can classify and enter a set of fingerprints into data base in a fraction of one second. It can search all state fingerprint files for a comparison in a few minutes. The previous method required a human expert to study the fingerprints and compare them to a named suspect, if his prints were available.

According to Joseph Kroger (1987:39), those who would seek to take advantage of expert systems technology to improve their operations must be willing to "1) invest heavily in research and development, 2) operate directly with data already in traditional information processing systems, 3) conduct extensive training programs for users, 4) use university researchers for assistance in application

strategies, and 5) undertake joint ventures."

This warning is echoed by Tod Newcombe (1990:1) as "you really have to know what you're doing" to be successful in working up an expert system. Mr. Irby (Newcombe,1990:9) of Montgomery County, Maryland, recommends that, at present, local government should benefit with small systems of 50 to 500 rules, "Anything larger than that won't have a high payoff at the local level."

Forecasting the future of expert systems in law enforcement

Industry and government have become increasingly dependent on technological forecasting as a prelude to strategic planning. In 1970, Dean James R. Bright (1970:64) of the Harvard Business School, wrote that managers must understand the process of technological innovation. He gave five factors in the process.

> A radical new technological advance is made visible in... writ[ing]...then refined, enlarged, and [made] more effective...long before it achieves widespread usage.
>
> The potential impact of the innovation is usually evident years before the new technology is in use on a scale great enough to affect existing societal conditions appreciably.
>
> Social, political, and...ecological changes may alter the speed and direction of the innovation's progress.
>
> Innovation may be abruptly influenced by decisions of key individuals who control supporting resources or determine policies the affect applications.
>
> Technological capabilities increase...exponentially once bottlenecks are broken...will level off if they encounter scientific, economic or societal barriers.

Based on Bright's premise, one can see the spread of technology in business and industry fostered by imagination, knowledge, competitiveness, and money. New technology is blocked by lack of these key ingredients or social resistance from labor, management, or consumers. By analyzing current trends and potential events, an organization can prepare to take advantage of favorable future conditions and avoid some difficulties to propel itself to a more desirable future.

For this study, a modification of the Delphi Process was used to study some significant trends and potential events which might impact the development of expert systems in law enforcement. An initial list of current trends and potential events was developed by the author. This list was examined and expanded by a panel of five police managers and two non-police managers familiar with the subject.

After discussion, a final list of trends and potential events was compiled and defined. After assembling the lists, the group was asked to rate each trend in response to the question "How valuable would it be to the planning process, to have a long-range forecast of this trend?" The top rated ten trends were selected for further evaluation.

After assembling the trends to be forecasted, the group was asked to rate the potential events in relation to the significance of their potential impact. The ranking was used to reduce the list to nine potential events.

These trends and events were then sent to thirteen experts in the fields of computer science, management, and

police management for their evaluation. The experts were asked to project the course of the trends from 1985 to 2000; first, as they thought they were likely to evolve, and second, as they would like them to evolve. An open-ended scale that gave 1990 a value of 100 was used. The events were forecast on the basis of three factors; first, the number of years until the event could occur; second, the probability that the event would occur by 1995 and 2000; third, the positive or negative impact on the issue, if the event did occur.

Medians and interquartile ranges were calculated for the data resulting from the first round of responses. The group's estimates were sent back to everyone for consideration and reevaluation. This process is designed to narrow the range of response without subjecting it to the distortion of "group think".

Twelve of the experts responded to both rounds of the forecasting process. The results were examined by the author and one assistant for accuracy, focus on the issue of expert systems, and manageability. This examination led to the elimination of three trends and three events.

The following pages list, define, and forecast the seven trends and six events used for further study. The graphs depict the median and interquartile range of the most-likely forecasts.

The desired trend levels are described, but not graphed.

Trend analysis

Trend 1 - Ability of local government to finance public service demands. Defined as: Municipalities' ability to generate sufficient revenues to pay for services demanded by their communities, especially police services. Willingness of the community to pay taxes. Cost of police services versus their perceived benefits.

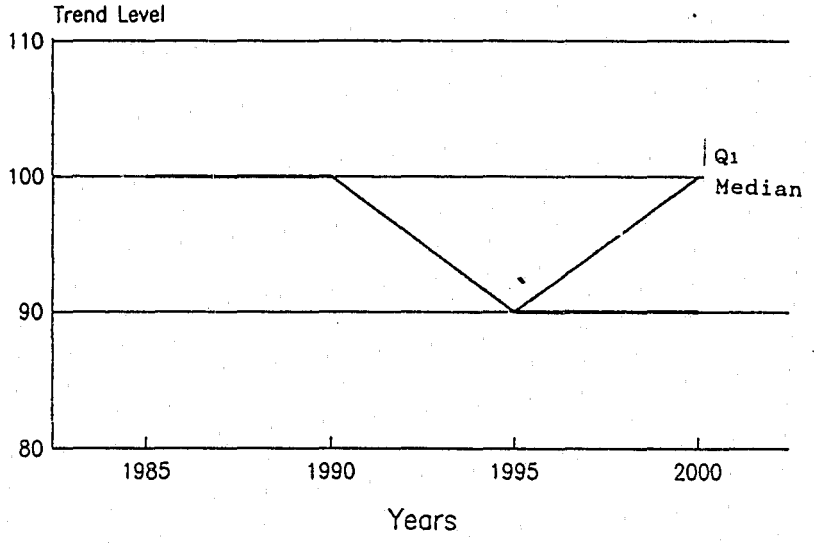


Figure 2

Ability of local government to finance public service demands

Figure 2 shows level of local government financial resources. The median and range coincide from 1985 to 1995. From 1995 to 2000, the median and high range coincide. The consensus is that local government financial ability will drop ten percent in the next five years. The majority feel it will return to the current level by 2000. This corresponds to expert opinion found elsewhere. The desired level range is 120-135 (1995) and 120-150 (2000). The desired level shows concern for maintenance of public service levels.

Trend 2 - Developments in computer technology. Defined as: The extent to which computer hardware and software will perform more functions, work at greater speeds, have more compact size, and be easier to use.

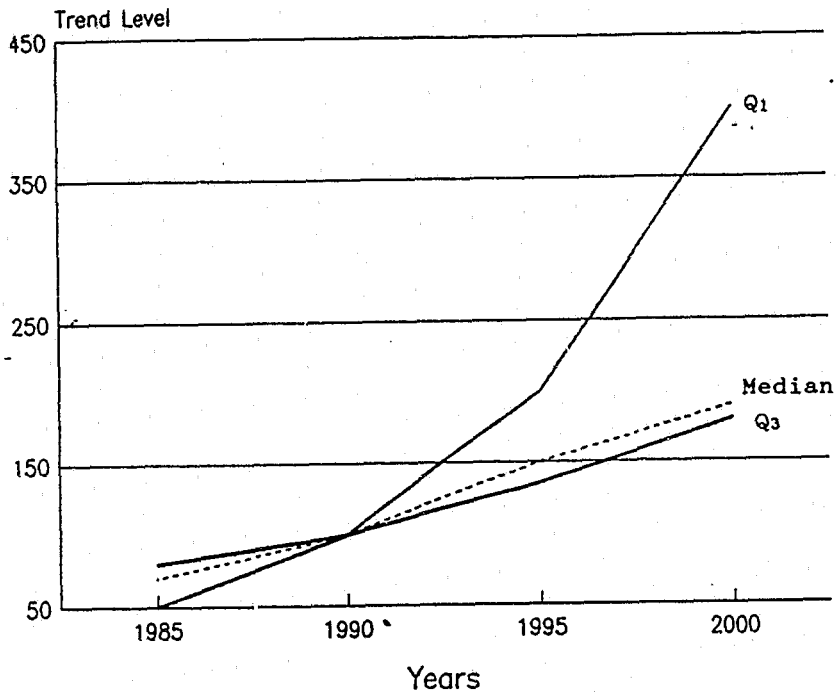


Figure 3

Developments in computer technology

Figure 3 shows the advance of computer development. The opinion is generally conservative, the median follows a straight trend line, nearly doubling the current level by the end of the century. The interquartile range spreads considerably by 2000, with some experts opining that computer technology will quadruple. The desired range is more conservative, 150-180 (1995) and 200-250 (2000). This may indicate some anxiety about the social effects that rapidly changing computer technology may bring.

Trend 3 - Computer literacy of employees. Defined as: The extent to which personnel are skilled in the use of computers. Their level of comfort in computerized work environments.

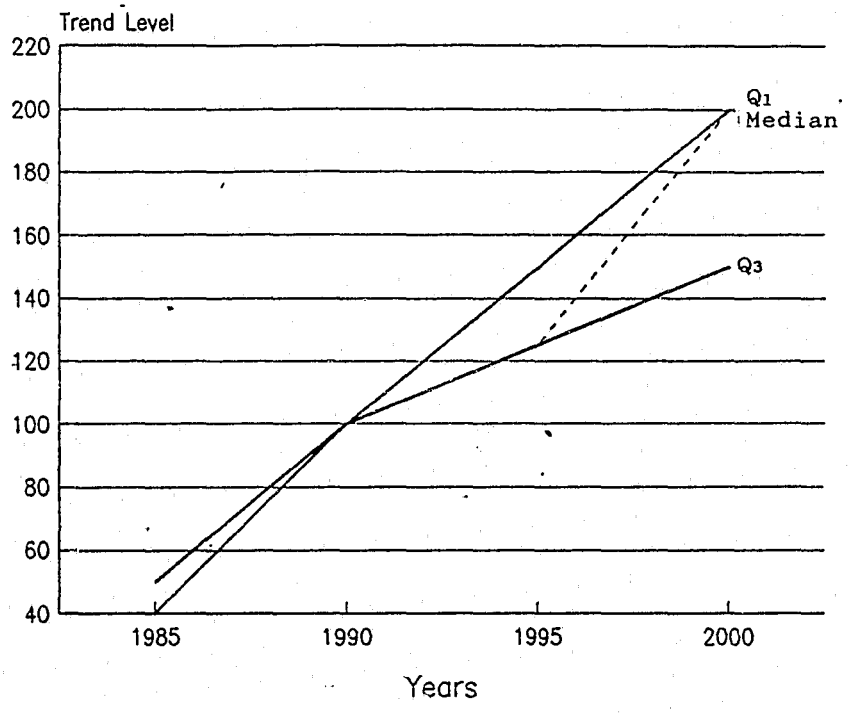


Figure 4

Computer literacy of employees

Figure 4 shows the computer literacy of employees. The median corresponds with the low range forecast from 1990 to 1995. This may reflect some conservatism in estimates for the first five years. All agree that there will be a significant increase, 25 percent by 1995, and 100 percent by 2000. The desired range is similar, yet higher, 150-175 (1995) and 200-250 (2000). The forecast and desired levels for 2000 reflect both optimism and perceived necessity.

Trend 4 - Amount of information that must be processed by police. Defined as: The relative change in police departments' need to gather, store, retrieve, and analyze data, in order to meet the needs of law enforcement functions, community demands for service, and legal requirements.

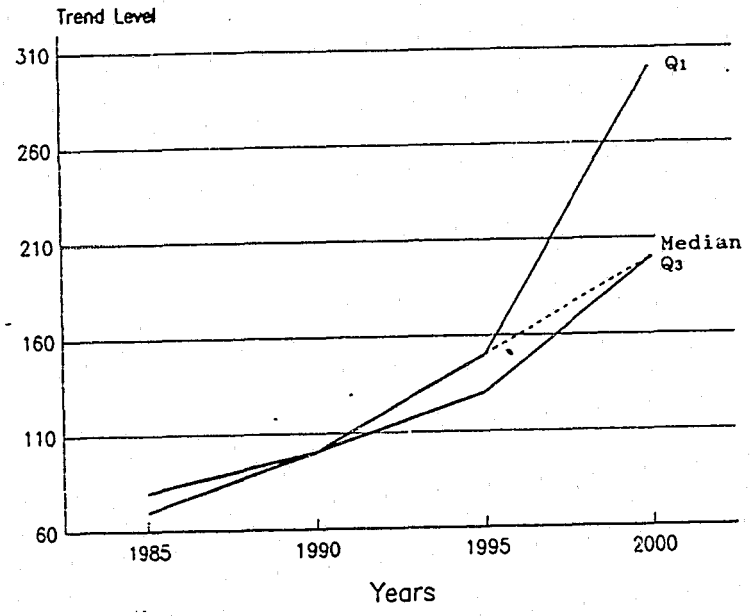


Figure 5

Amount of information that must be processed by police

Figure 5 shows the rise in the amount of information that police must process. The median coincides with the high range from 1985 to 1990, and the low range from 1990 to 1995. The average estimate is that information processing needs will double by 2000. The desired range is 120-150 (1995) and 180-250 (2000) and nearly coincides with the estimate. This appears to reflect the ongoing trend of the "information age". It is clear that police planning must incorporate increased information processing needs.

Trend 5 - Use of expert systems in law enforcement.

Defined as: The degree to which expert systems are used in routine police functions. (i.e. Computer Aided Dispatch of calls for service, interactive training, crime analysis, etc)

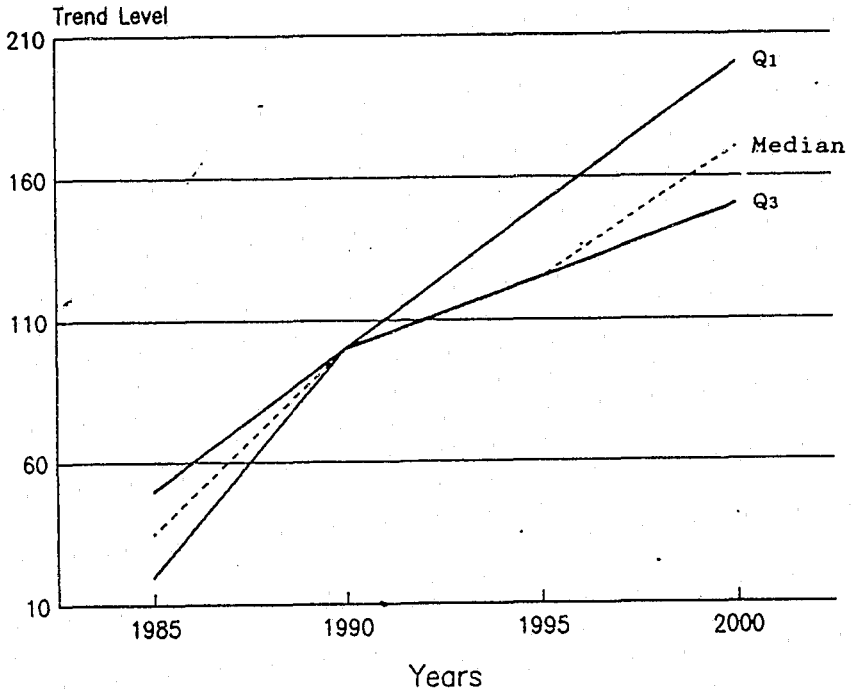


Figure 6

Use of expert systems in law enforcement

Figure 6 shows the level of use of expert systems in law enforcement. The group forecasts a rising trend level of 25 to 50 percent over the next five years, followed by a sharper increase, possibly doubling by 2000. The range at 2000 is rather broad, indicating uncertainty. The desired range runs above the high estimate, 150-200 (1995) and 200-250 (2000). The group does not think that law enforcement will make full use of available technology for expert systems, primarily due to police budget constraints.

Trend 6 - Level of crime in the community. Defined as: the rate of increase or decline of crime in California.

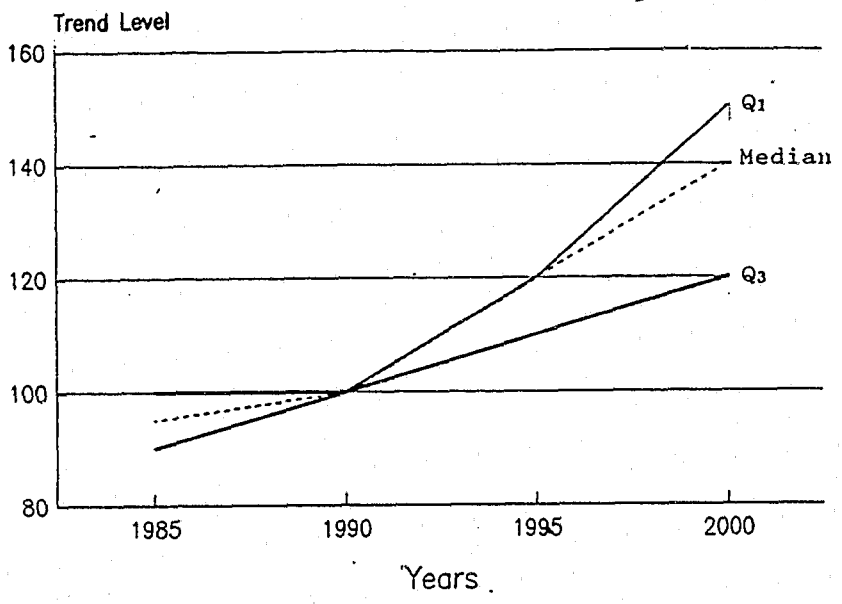


Figure 7

Level of crime in the community

Figure 7 shows an the level of crime in the community. The forecasters see a continuing rise in the crime rate, 20 to 50 percent over the next ten years, the median rises 40 percent by 2000. The desired level is 80-100 through the decade. Coupled with economic and social factors, the criminal justice system is not going to reduce criminality in the community during the next decade. The high range of estimates reflects skepticism about police departments' ability to cope with crime, while facing shortages in financial and human resources. Police plans must account for continuing increases in crime rates.

Trend 7 - Use of non-sworn employees to conduct police work. Defined as: The extent to which lower paid, less specially trained, unarmed personnel are employed by police departments to carry out traditional police duties and new police functions.

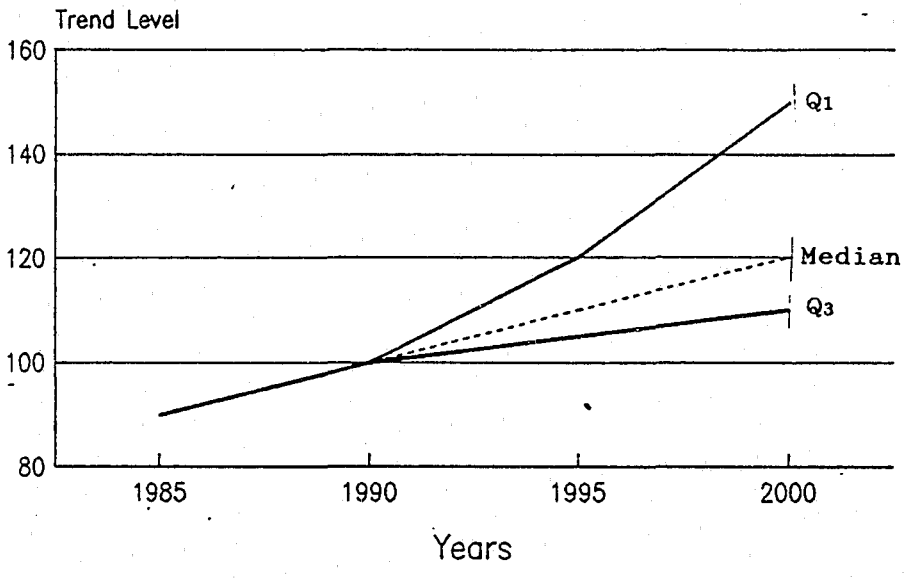


Figure 8

Use of non-sworn employees to conduct police work

Figure 8 shows the usage of non-sworn employees to conduct police work. There is concurrence on the level of usage from 1985 to 1990. Use of non-sworn employees will rise 10 to 50 percent in the next decade. This will vary according to financial and human resources available to police departments. The desired level is close to the estimate, 100-125 (1995) and 100-150 (2000). It appears the actual level will match the desired level in most cases. The estimate and desire reflect the panel members previous consideration of the resource situation.

Event analysis

The six selected events are described below:

Event 1 - Low-priced "super" computers marketed. Defined as: First large-scale introduction of ultra-high-speed, parallel processing computers at relatively low cost.

Event 2 - Special government funding for development of expert systems in law enforcement. Defined as: State or federal legislation creates a fund for development of law enforcement applications of expert systems.

Event 3 - Major economic depression occurs. Defined as: A severe down-turn in the state and national economies, reduced business activity, large-scale unemployment, falling prices and wages, etc.

Event 4 - Computer keyboard replaced by voice operation. Defined as: Computers that perform a wide range of operations through oral interaction with the operator.

Event 5 - State-wide linkage of all police computers. Defined as: Government mandates that all police data bases will be accessible to all other law enforcement agencies.

Event 6 - Initiation of public safety satellite communication network. Defined as: Government funds satellite communication network for all police and fire departments.

Table 1 depicts the medians and interquartile ranges of the estimates for the numbers of years until the event could possibly occur, the probability that the event will occur by the years 1995 and 2000, and the impact on the issue if the event did occur.

Table 1

EVENT EVALUATION

EVENT	Years until probability exceeds zero	Probability of occurrence 0 to 100% 1995	2000	Impact on issue if event occurs rated 0 to 10 positive	negative
1	4 * 2-5 **	40 35-50	90 85-90	7 7-8	0 0
2	3 2-5	50 30-60	80 70-90	6 5-8	0 0
3	1 1-2	50 40-50	50 50	0 0	8 8
4	2 2-4	50 30-60	90 50-90	8 3-8	0 0
5	5 3-5	40 10-60	80 80-95	8 8	0 0-1
6	5 4-5	25 20-30	70 40-80	7 5-8	0 0-1

N = 12 * = Median ** = Interquartile Range

EVENTS:

1. Low-priced "super" computers marketed
2. Special government funding for development of expert systems in law enforcement
3. Major economic depression occurs
4. Computer keyboard replaced by voice operation
5. State-wide linkage of all police computers
6. Initiation of public safety satellite communication network

By these projections, none of the events has a greater than 50 percent probability of occurrence in the next five

years. There are three events with a 50 percent chance: government funding for expert systems in law enforcement, an economic depression, and voice operation replacing the computer keyboard.

According to the projections, by the year 2000 there is a greater than 80 percent probability that computers will be voice operated, the government will fund development of expert systems for law enforcement, low-priced "super" computers will be marketed, and police computers will be linked state-wide.

Economic depression is the only negative modifier to the issue, yet its impact would be considerable. Voice operation and state-wide linkage of police computers would have the greatest positive impact on the issue of expert systems, followed closely by marketing of low-priced "super" computers, a satellite communications network for public safety, and special government funding for development.

Cross-impact analysis

Upon obtaining the forecasts of trends and events, a cross-impact analysis was conducted by the author and an assistant. This analysis is depicted in Table 2 and shows the change in trend levels and event probabilities which would be caused by the occurrence of the events. The positive numbers represent percentage of acceleration of the trend level or increased probability of events' occurrence. The negative numbers represent deceleration of the trend level or

decreased probability of events' occurrence. The symbol "NC" indicates that the trend or event would not be impacted.

Table 2

CROSS IMPACT EVALUATION

IMPACTING EVENT

		1	2	3	5	7	8
	1		+10%	-20%	+20%	+30%	+15%
E	2	+20%		-40%	+15%	+20%	+10%
V	3						
I E	4	+10%	+10%	-10%		+10%	+15%
M N	5	+50%	+25%	-50%	+15%		+15%
P T	6	+20%	+10%	-80%		+40%	
A							
C	1	+10%	+10%	-60%			
T T	2	+25%	+10%	-20%	+20%		
E R	3	+5%	+10%		+30%		
D E	4	+25%	+15%	-20%	+10%	+10%	+10%
N	5	+25%	+80%	-20%	+20%	+25%	+5%
D	6		-5%	+15%		-5%	
	7	+15%	+5%	+10%	+15%	+5%	

Legend: + = Acceleration of trend level or event probability by percentage indicated
- = Decrease of trend level or event probability by percentage indicated

Events

1. Low-priced super computers marketed.
2. Government funding for police expert systems
3. Major economic depression
4. Voice operation replaces computer keyboard
5. State-wide linkage of all police computers
6. Initiation of police satellite communication network

Trends

1. Ability of local gov't to finance public service demand
2. Developments in computer technology
3. Computer literacy of employees
4. Amount of information that must be processed by police
5. Use of expert systems in law enforcement
6. Level of crime in the community
7. Use of non-sworn employees to conduct police work

Table 2 shows that a major economic depression (E3) is

not influenced by any other trend or event and would have a very negative impact on trends and events pertaining to the development of expert systems for law enforcement. The occurrence of any other event would have a positive impact on all trends and increase the probability of other events. The most significant impact to the issue would be the occurrence of marketing of low-priced "super" computers (E1) and government funding for police expert systems (E2).

Scenarios

The following scenarios are offered as a means of tying together the various facts, trends and possible events described previously. They depict the possibilities of expert systems use in law enforcement by the year 2000.

There will be two scenarios. The first is an "exploratory" future, which assumes that the trends continue as projected, and that none of the events take place in the next decade. The second is a "normative" future, which assumes that those events with an 80 percent or greater probability of occurrence do occur and have their expected impacts, and that they were considered and impacted by a department strategic plan. The setting is the fictitious city of Santa Cogitas.

Exploratory future scenario

"Santa Cogitas P.D. continues to persevere"

Date: January 22, 2000

The department had managed to struggle through the 1990's. There were shortages of sworn personnel caused by a drop in the applicant pool. These vacancies were filled by a twenty-percent increase in the number of non-sworn personnel with modified police duties. This shift to lower-paid personnel, also, helped to maintain adequate salary levels in the face of budget constraints caused by several years of nation-wide economic recessions in the early 1990's.

New computer technology had become cheaper during the recessions and the department had purchased some good hardware and software with the little available funds at its disposal. This new equipment sped many operations. thus saving valuable man-hours. Unfortunately, the piece-meal purchases resulted in a lack of compatibility between systems which took nearly five years to overcome.

A few expert systems had been developed to replace the work of employees. These consisted mainly of crime analysis programs and required additional data entry. Data entry was much faster with the optical scanners acquired in 1994. The new employees of the 90's proved to be quite adept at using the automated systems and assisting in the development of new applications including small expert systems.

The new technology came at the price of adding needed personnel. Wages had almost kept pace with inflation, but

crime had risen by nearly 40% during the decade. The average work-load of every employee had increased significantly, and productivity had declined. A significant cause of the declining productivity was the doubling of the amount of information that the police department was compelled to process. Even with some expert systems embedded in the mainframe computer to speed its operation, the system was over-loaded and slow to give employees the information needed to fulfill their tasks. Field officers often avoided computer inquiries rather than waste time waiting for a response.

Normative future scenario

"Santa Cogitas P.D. succeeds through technology and planning"

Date: January 22, 2000

The department had struggled through the 1990's, but had come out of the decade in good shape. The key factors had been improvements in its use of computer technology, government assistance in developing expert systems that saved time and labor, and coordinated strategic planning.

Like all other California cities, Santa Cogitas had financial problems in the early 1990's. These problems were exacerbated by a series of economic recessions early in the decade. There was, also, a shortage of available recruits to fill sworn officer vacancies and many of these positions were converted to non-sworn personnel.

Advances in computer technology and a slow economy caused significant reduction in the cost of computers and software. Santa Cogitas and many other police departments took advantage of these price reductions, to acquire needed equipment. Fortunately, Santa Cogitas was prepared to take full advantage of the situation. It had developed a strategic plan for acquisition and use of new computer technology.

In 1991, faced with increasing service demands and decreasing financial and human resources, the department drafted a plan reduce labor needs by increasing automation of tasks. The focus of this plan was purchase new computer technology and develop new applications, particularly expert systems that would capture existing employee expertise before it was lost.

In 1991, the department launched an assessment of its future computer needs and began its own development of small expert systems with existing PC's. The first expert systems were used to augment investigation of burglary, forgery, vice, narcotics, and sex crimes. There were some initial problems caused by excessive data entry time. This was remedied by 1992 with the use of optical scanners for data entry.

In early 1993, the department joined with two other agencies in a well priced joint purchase of lap top computers to replace its old Mobile Data Terminals in all police vehicles. The lap tops had voice operation circuit boards that allowed hands free operation for all MDT functions.

In addition, Santa Cogitas contracted for development of an embedded expert system in the records computer. The records computer was then capable of sorting information into many more useful files, accepting reports as input from remote terminals, distributing reports automatically, and conducting considerable crime analysis. Pertinent information from incident reports was extracted by the expert system and sent directly to affected investigation details or field units. The cost of this undertaking was borne out of the department's seized drug monies.

The most significant change began in 1995. That was the first marketing of parallel processing computers for less than $200 thousand. By 1996 there were several high quality parallel processing systems on the market at affordable prices. In 1997, the state funded a Department of Justice program for enhanced automation, including development of expert systems, for California law enforcement. In late 1997, Santa Cogitas was selected as one of fifteen test sites for new programs. In January of 1998, it received a new "super" computer, purchased with some State grant money and funds saved by the city's five-year-old policy of amortizing all computer hardware.

Development of the new computer systems went faster than many expected. The launching of the public safety communications network satellite, in 1999, proved to be a tremendous asset to police computer communications. Intended to help in natural disasters it was capable of handling

relays between departments through out the state.

Personnel at the Santa Cogitas Police Department were certainly more effective today than they were ten years ago. Today, employees could call upon expert systems in their mobile computers or remote mainframes to help deal with any situation that arose. Most of the field officer's or investigator's computer interaction was now oral. Reports, inquiries, and other information were transmitted via radio frequency between computers. A field officer could be quickly linked to other agencies and data bases through the communications satellite.

During the last decade. Santa Cogitas P.D. had been able to reduce the rate of crime increase and continue existing service levels without significant budget increases. Though it been hectic at times, it had been a fruitful ten years.

Chapter 3

Strategic Plan

The purpose of this plan is to alter the police department's course into the most likely future, as described in the exploratory scenario, and precipitate events and elevate trends that may lead toward the more desirable future described in the normative scenario.

The strategic planning process will entail four primary steps:

First, statement of a goal or mission.

Second, assessment of the current situation using the WOTS-UP and SAST models.

Third, creation of strategic policies that will support policies that will support the development and integration of expert systems in this environment.

Fourth, statement of the strategic plan for developing expert systems in a police department.

Rather than limit the strategy to an existing police agency, the plan will be designed for the hypothetical, medium-sized police department of Santa Cogitas, California.

The Santa Cogitas police department has 400 employees serving a diverse population of 175,000 in a large urban area. The city has a mix of residential, retail, office, and light manufacturing zones. It is a Charter City with a

Council/Manager administration. The City Manager is appointed by the Mayor and six council members. There are 1200 city employees in the various departments.

The police department is headed by a Chief of Police, and three Captains and is divided into three divisions, Field operations, Investigation, and Administration. The department has had a good reputation for efficient law enforcement service over the past decades, as well as, a good working relationship with surrounding law enforcement agencies. There have been recent problems meeting increased service demands and the citizens and department members are growing concerned about the department's future ability to provide needed services.

Funding for capital improvement and additional personnel throughout the city has been suffering for the past ten years. The police department is operating with a Computer Aided Dispatch center and records system that are using twenty-year-old technology. It has purchased sixteen personal computers in the last few years to augment operations. All city facilities are over twenty years old and suffering some deterioration and considerable over-crowding.

There is mutual respect amongst the various city departments, though activities are often not coordinated. There is a general desire within all city departments to increase automation of functions through new computer technologies. There is definite interest in developing and using expert systems to increase operational efficiency.

The mission

To focus the remaining planning efforts. it is important to clarify purpose in a mission statement. This micro mission will serve to define the area of concern, guide behavior, express values, build commitment, and insure consistency.

"Mission of the Expert Systems Program"

The purpose of the Expert Systems Program is to promote the delivery of efficient and effective law enforcement services to the community and our personnel. The swift movement of thorough and accurate information amongst all personnel is the key to our success. This is accomplished through the use of computer applications that share the knowledge of our valuable employees.

Situation Assessment

There are a number of methods for assessing an organization's current status and future potential in relationship to an issue. A W.O.T.S.-UP analysis was selected for use in this study.

W.O.T.S.-U.P. is an acronym for an environmental analysis considering Weaknesses, Opportunities, Threats, and Strengths that Underlie Planning. This process is intended to examine both the internal and external conditions that will affect the issue of expert systems in law enforcement.

Threats and Opportunities pertain to the external

environment. A Threat is any unfavorable condition that would impede achievement of a goal. An Opportunity is a condition which would support the organization's strategy for achieving its goal.

Weaknesses and Strengths pertain to the internal environment of the organization. A Weakness is a limitation or defect which would hinder the organization in reaching its goal. A Strength is an organizational resource or capacity which can be used effectively to reach a goal.

Threats and Opportunities

There are numerous external environmental factors that present threats and opportunities to organizations and their goals. These factors generally involve resources and the power to use them. Police organizations require financial and human resources, which vary considerably between different agencies. These resources come from the community, at large, and while some officials have the authority to allocate existing resources, it is the public who wields the ultimate power over the generation and allocation of resources. Therefore, police and other organizations always look to cultural factors and social trends when assessing the threats and opportunities associated with their plans.

The following assessment covers some of the most obvious trends that may provide threats and opportunities to the development of expert systems for law enforcement.

City financial status

Threats: City revenue will remain relatively static or decline slightly through the next ten years. New projects, such as expert systems, requiring capital outlay must compete with existing financial demands. There will not be sufficient money in the general fund for the project.

Opportunities: The labor-saving aspects of expert systems will be appealing to financially pressed government officials. If an expert system can pay for itself with reduced human labor costs, it will constitute a long-term financial saving to the city.

Developments in computer technology

Threats: Computer technology is advancing so rapidly that some hardware and software items are obsolete in a few years. Purchase of the wrong technology could be a costly mistake for the project.

Opportunities: Rapid developments in computer technology are causing continued price reduction of high-quality hardware and software. There is stiff competition amongst developers and more will be turning to local governments and police departments as a market for products.

Availability of experienced police officers

Threats: The percentage of expert police officers will decline in the next decade. Expert knowledge is vitally important to expert system development. When experts leave,

they take their knowledge with them.

Opportunities: As with financial constraints, alternatives must be found for the labor-intensive activities of police. The expert knowledge of experienced police officers can be incorporated into expert systems for future use. This will aid the less experienced new employees and augment the remaining experts.

Computer literacy of employees

Threats: No significant threat to the goal is perceived.

Opportunities: Future employees will be much more familiar with work in a computerized environment. They will be quick to accept and use expert systems. Some will have the ability to aid in developing such systems. A computerized work environment may incidentally increase the number of desirable police applicants.

Amount of information that must be processed by police and government agencies

Threats: The benefits of small expert systems may be nearly invisible against the glut of information that has to be processed by police. Lack of significant impact by the first efforts may stall further development.

Opportunities: Expert systems offer real advantages in dealing with the increasing amount information that police must process. In the long-term they are far cheaper than added employees. They, also, process information faster and

more accurately than humans.

Increased use of expert systems in law enforcement

Threats: Similar to those mentioned in information processing. Well publicized failures would slow further development of expert systems in many government agencies.

Opportunities: Success of expert systems in other law enforcement agencies will stimulate interest and growth throughout the profession. Most people are fascinated by technology and want to participate in its uses.

Increasing police service demands

Threats: Increased service demands of any type could divert attention and funds from expert system projects.

Opportunities: Police budgets and available manpower cannot meet increased service demands without new operating systems. Expert systems could supplant workers that would be needed to handle additional work loads. Some informational services could be offered by computer only, requiring no employee action.

Level of crime in the community

Threats: A sharp increase in the crime rate could divert attention and funds away from expert systems and into traditional suppression operations.

Opportunities: Again, increased work demands in the face of financial and manpower constraints call for new operating

systems. Expert systems offer an opportunity to spread skills quickly and cheaply to less experienced personnel, increase crime solution rates, and cut operating costs.

Use of non-sworn employees to conduct police work

Threats: No significant threat to the goal is perceived.

Opportunities: With expert systems, less well trained or knowledgeable employees can be used to perform many police functions. This could compensate for a decline in the availability of police applicants and police experts.

Litigation and legislation to block use of data bases

Threats: Some data bases, such as unpublished telephone numbers are closed to routine police inquiry. Such privacy laws will retard development of potentially useful applications of expert systems. If new systems upset the balance of the current adversarial trial system, there is likely to be law suits to block their use.

Opportunities: Minimal opportunities exist. Expert systems could be developed to guard the public's privacy, by monitoring public and private data bases. However, it is unlikely that police would be called upon to provide this monitoring.

Strengths and weaknesses

The next segment of the W.O.T.S.-UP analysis is to determine the organizational strengths and weaknesses of

Santa Cogitas P.D. (This may also be referred to as a capability/resource analysis). This focuses on the skills and resources needed to implement an expert systems program. These aspects are discussed below and shown in Appendix C.

Organizational strengths

Management Skills - Well trained and organized management and supervisory staff. Creative problem-solvers.

Police Officer Skills - Experienced officers with broad exposure to police tasks and various methods of operation.

Training - High regard in the department for training. Outside schools and in-house training are frequent.

Image - The department has a good reputation in the community and among law enforcement agencies.

City Manager Support - The City Manager likes the Police Department. He considers it to be efficient and generally effective in relation to its broad responsibilities.

Justice System Support - The District Attorney and Courts respect and support the department.

Community Support - The community supports the department and would like to see more of the city budget go to police services.

Organizational weaknesses

Personnel Adequacy - The department is never up to full staffing. Workloads are heavy and there is little undedicated time for employees.

Technology - The main computer cannot process the information needed. PC's are not integrated with other systems.

Money - Any budget increases go to compensate for inflation, or a few new patrol officer positions. Capital expenditures are low.

Service Demands - Calls for service and other demands are increasing.

The remaining aspects of the department organization are relatively normal without significant strength or weakness.

Based on this analysis the department is in relatively good condition to make a change. The weaknesses noted are amenable to improvement with a proper plan. Financial shortages are the primary obstacle to expert system development, but there are no major internal obstacles to development. There are a number of organizational strengths which will aid the development program.

Strategic assumption surfacing technique (S.A.S.T.)

Organizational functions are dependent on human communication and interaction; therefore, it is important to consider the individuals who will impact the strategy, or be

impacted by it. These individuals are known as Stakeholders. Among the Stakeholders are some Snail Darters (seemingly little interested, but potentially threatening). The aim of the S.A.S.T. is to determine how these Stakeholders will affect the issue and vice-versa.

Stakeholders

1. City Council
2. City Manager
3. Chief of Police
4. Sworn employees
5. Non-sworn employees
6. Citizens
7. District Attorney
8. Neighboring Police Agencies
9. Courts

Snail Darters

10. Public Defender
11. Police Union

Stakeholder assumptions

Having identified the concerned parties, it is necessary to evaluate their positions on the issue of expert systems for law enforcement. These are to oppose, support, or remain neutral on all or any part of the issue. Following are some general assumptions that can be made about their positions. (These do not include issues of interpersonal conflicts and hidden agendas that often exist in cities).

1. City Council - mixed feelings

Council members support the concept and approve of the cost saving aspects of using expert systems. They recognize a partial solution to their increasing employee costs.

They are reluctant to spend General Fund money on "experiments", and require "proof" that development is feasible and cost effective.

They will likely provide matching funds for state or federal grants, after reviewing criteria. They favor using "Asset Forfeiture" money in limited amounts.

2. City Manager - supportive

Recognizes future cost-savings and potential for increased productivity. Sees a means of delaying expensive increases in police staffing. He will support limited funding of small projects at present. If these prove successful, he will support broader funding in the future.

3. Chief of Police - supportive

He can delay some new personnel costs. Increased productivity will improve his leadership image inside and outside the department. He believes it will improve employee morale.

4. Sworn Employees - mixed feelings

Though mistrustful of new management programs, they know how effective computer applications have become in the business world. The majority feel that swift and accurate information is critical for general effectiveness.

Some enjoy the comfort of their routine tasks. They have spent years developing their knowledge and resent having

these functions done by computer programs. They do not want to learn new jobs.

5. Non-sworn Employees - mixed feelings

Most see expert systems as a cure for tedious tasks.

There is some fear of job loss, particularly amongst clerical staff. They are not in jeopardy with small systems, but broad-scale implementation would eliminate much typing, copying, and filing work.

6. Citizens - supportive

They want increased effectiveness from all government agencies. They would rather spend money on police programs than most social welfare programs. (There is no differentiation among citizens. No lawful subgroup would benefit more or less than another from police expert systems).

7. District Attorney - supportive

The D.A. hopes for more evidence for prosecution of criminal cases. Resources will be available to D.A. investigators as well. He anticipates some legal challenges, but deems them inconsequential.

8. Neighboring Police Agencies - supportive

They hope to share in the benefits of development of expert systems. Most feel it supports their efforts in the

same direction. Some are interested in entering small joint venture projects to develop expert systems for use in their departments.

9. Courts - mixed

Most judges are supportive. They want police to have the tools they need to be effective.

A few are distrustful of police information systems and feel that police routinely abuse their power and unfairly target some citizens for scrutiny and prosecution.

10. Police Union - mixed (Snail darter)

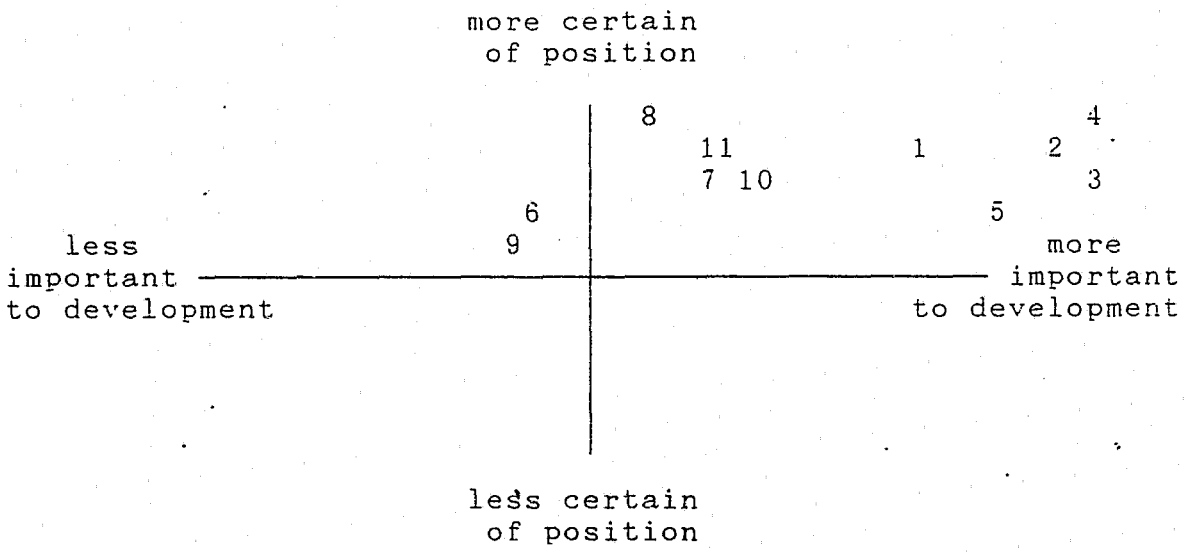
It does not represent police clerical staff, but it does represent other non-sworn personnel. Union members are not resistant to technological improvements, but will block change if it seems to jeopardizes members positions, wages or benefits.

11. Public Defender - opposed (Snail darter)

The Public Defender feels it will give the prosecution a greater advantage in trials. He thinks it may lead to more arrests that will increase his work load.

The Public Defender may encourage civil rights attorneys to challenge the use of expert systems that establish probable cause for arrest or search warrants.

Having made these assumptions, it is important to know the degree of certainty in these estimates and how important these Stakeholders are to the issue. Figure 12 presents a graphic display of these two aspects.



1. City Council
2. City Manager
3. Chief of Police
4. Sworn Employees
5. Non-sworn Employees
6. Citizens
7. District Attorney
8. Neighboring Police Agencies
9. Courts
10. Police Union
11. Public Defender

Figure 9

Assumed Stakeholder Positions

In Figure 9, the further above the horizontal, the more certain we are of the stakeholder's position. Relative importance of the stakeholder to the plan runs from limited on the left to very important on the right.

Developing policies to support the mission

Establishing policies

Having assessed the environment in relation to the development of expert systems in our police department, it is necessary to develop policies that will aid in accomplishing the mission.

Accordingly, several Command College students were asked to participate in a Modified Policy Delphi process to develop policies that would assist the development of expert systems.

The group suggested a number of fundamental policies that would serve as foundations for a strategic plan. After discussion, these suggestions were condensed into the following policy statements.

1. Start small and work up.

Begin with small expert system applications, using existing and new personal computers. Work with small groups of employees. Polish designs and functions before integrating with other programs. Network the small systems when suitable. Modify workers roles to adjust to assistance of expert system.

In case of failure, stop and reassess. Build on success.

Pros

This approach is initially inexpensive. It has a flexible time frame. Program setbacks will draw little attention. Employees will not feel threatened. Small systems developed over a period of years will encounter and solve

many application obstacles; thus preparing for future applications in the main data computer.

Cons

Independent systems require more time for data entry. Existing PC's are already being used for necessary work. Buying more PC's would seem wasteful, if we intend to use a mainframe and multiple terminals in the future. Development and integration will take a very long time.

2. **Use embedded expert system in the records computer**

Purchase an expert system shell from the manufacturer and program system to automatically sort and send pertinent information to PC based expert systems.

Pros

This saves a great deal of employee time in dispersing information, reduces redundancy in data entry, and prevents field officers' objections to additional information gathering.

Cons

This will take $20,000 from already scarce funds. It will disrupt the records operation for a brief period, and any disruption of the records operation is harmful.

3. **Long range financial planning for computer systems.**

Knowing that the financial resources are limited, plan for best use of existing monies. Put seized drug monies into computer applications. Make grant applications whenever

possible. Shop in advance for bargain rates. Tie police budget and city council to continued funding commitments. Make contingency plans for funding, scaling back or accelerating development as needed. Establish replacement accounts for computer equipment, calculating a five year useful life span. Lobby for legislation to fund expert system development at the state level.

Pros

The needed technology cannot be acquired or developed without appropriate funding. Long-range financial planning will guarantee a relatively stable program budget, and avoid damaging halts to the projects. It will aid in all aspects of technology acquisition.

Cons

The Chief, City Manager, and City Council must agree to this change in priorities for department budgeting. It may be hard to sell this plan without demonstrable advantages at hand. There are other department needs that have counted on funding from seized drug money. Successful lobbying must be supported by a large segment of the police profession and government official.

4. Practice scientific and participative management.

Insure that management understands the tasks workers do, their history and origins, and the results achieved before making changes. Always involve impacted employees in designing expert system applications. Use expert systems to enrich jobs, don't overload workers with additional

responsibilities. Record decisions made and assess their results.

Pros

This focuses management and workers on objective work analysis, which limits the problems of "internal politics" and builds better working relationships. It involves the expert workers in improving work methods, giving them a vested interest in the success of the venture.

Cons

This is a very time-consuming management style, when compared to the traditional authoritarian management structure of police departments. Some managers and workers won't want to participate in task analysis and decision-making.

5. Interagency and interdepartmental cooperation

Share ideas and products with other police departments and city departments. Seek out joint ventures that benefit both organizations in expenses, time or manpower savings, and improved service levels.

Pros

The time and money the department spends to develop expert systems can be reduced by sharing development tasks. Multiple purchasers will lead to discounts on equipment and contract services. Involving other city departments and police agencies builds political and financial commitment to the goal. Each department has mutual support when requesting

funds for development.

Cons

More participants will take longer to reach agreement on actions to be taken. One department or city council can stall the progress of several agencies.

6. Get professional help.

There is a lot at stake, so don't bite off more than you can chew. Use local college students and professors to help analyze work tasks and develop systems in pilot projects. Use experienced, reliable contractors and consultants when needed. Seek knowledgeable input whenever uncertainty arises.

Pros

Most of the work performed by students and professors would be done as research projects at little or no cost to the city. This would save staff members time and increase the objectivity of the research. It also ties the department to more research and ideas in the collegiate network. Use of professional contractors and consultants involves a bidding process, which will reevaluate the feasibility of the project, and carries some performance guarantees.

Cons

Research will be time-consuming and may lead to additional questions about organizational structure and function. Researchers are not decision makers, and may delay management decisions by their devotion to thoroughness. They

are less likely to be familiar with current workplace applications of computer technology. Consultants are initially costly and may be biased by ties to certain vendors.

Policy analysis

These proposed policies were then judged as to their feasibility and desirability in achieving the goal. Each policy was rated from 1 to 4, with 1 being not feasible or desirable, and 4 being highly feasible or desirable. The results are shown in Table 4. (Policies are abbreviated)

Table 4

Feasibility/Desirability Chart

Policy	Feasible	Desirable	Sum	Rank
1. Start small, work up	4	4	8	1
2. Embedded expert system	4	4	8	1
3. Financial planning	3	4	7	2
4. Scientific/Participative Mgmt	3	3	6	3
5. Interagency cooperation	2	4	6	3
6. Professional help	3	4	7	2

Table 4 shows that all policies were rated as desirable. It was noted that while a Scientific and Participative Management style would be effective most of the time, group

consensus will often not occur, when a decision is desperately needed. Therefore, management will make authoritarian decisions when time and momentum require. This should not pose a problem in a police environment.

Feasibility of policies rated lower than desirability on average. Lack of money affects the feasibility of most policies. The start small and work up and embedded expert system policies are low cost and rated highest on feasibility. Interagency cooperation is feasible, but coordination would be very time consuming. Useful written agreements between cities would be difficult to achieve. Spending one city's resources to aid another would pose serious problems for a city council. A verbal covenant between cooperating city managers, police chiefs, and other concerned department heads would best serve intercity cooperation. Intracity coordination would be much easier.

Recommended policies

The goal of developing expert systems for the police department requires the analysis of all department operations, determining where expert systems will be applicable, and acquisition of computer hardware and software. The primary obstacles to development are the scarcity of financial resources and existing models for police use. With this caveat and the preceding analysis, the following policies are recommended.

1. Start small

Use existing personnel and PC's to develop small expert systems in various department operations. Current employees have the skills required to work with expert system shells to produce working systems. This will provide impetus for further developments; involve workers across department boundaries; identify those workers who show desire and ability to assist larger projects.

2. Get professional help

Use professors and students from the local university in concert with staff to analyze current operational systems, as they pertain to the goal of developing expert systems. Note and correct as many problems as possible before hiring professional consultants.

3. Financial planning

Be up-front with city officials about the costs of the project and time frames. Use seized drug monies for initial purchases of computer hardware and software. Establish replacement and maintenance funds for all computer hardware. Emphasize long-term efficiency and cost-savings of expert systems.

4. Cooperative efforts

Liaison with other city departments and other police agencies to share ideas and problems. Enter joint ventures on

projects that aid both parties. This enhances funding possibilities and can reduce the waste of duplicated operations.

5. Develop embedded expert systems

Establish criteria for embedded expert systems in the records computer and computer aided dispatch system. Involve line level personnel in determine the most useful means of sorting, storing, analyzing, and exporting the data that is currently sent to these computers. Plan to allow the police embedded systems to access other city data bases, such as the Fire Department, Public Works, and Licensing.

Actions and time lines

While the plan for expert systems development is relatively sound, the course is still uncharted. The lack of knowledge, experience, and financial resources within the department requires flexibility in action plans and time lines. Therefore, the following phased plan with general time lines is recommended.

Phase 1 - Small development and functions analysis

Timeline - Now to 1 year

Appoint project manager to coordinate tasks, evaluate status, and maintain course.

Purchase expert system shells for use by employees in developing expert systems on existing PC's.

Inform city officials and other departments of expert system plans. Get approval.

Analyze operations and repair disfunctional aspects as possible.

Research expert systems use in industry that seem compatible with police uses. Site visits.

Determine potential target operations for expert systems.

Examine organization's compatibility with expert systems operations and plan for possible changes.

Phase 2 - Preparation for expansion

Timeline - 1 to 3 years

Obtain approval of city council for project and means of funding.

Hire consultant to evaluate and recommend system design. (Coordinate as part of city-wide systems evaluation if possible).

Formalize project management team.

Begin grant applications to augment funding.

Acquire computer hardware and software.

Set up system for employee input, feedback, training, and progress updates.

Phase 3 - Full implementation

Timeline - 1 to 3 years

New CAD and records computers with embedded expert

systems to sort, analyze, store and export information.

Automated data input systems using voice interaction and optical scanning methods in lap-top and PC computers, linked to mainframes via radio transmission.

Completion of job specific expert systems at all PC and peripheral terminals.

Evaluation and modification of systems to locate and eliminate problems and tune operations.

Chapter 4

TRANSITION MANAGEMENT PLAN

This chapter details the methods which will be employed in moving from the current state of police operations to the desired future state, which uses expert systems to aid line personnel.

Each police department has unique qualities of history and environment that must be considered in a transition. The following transition plan will be expressed in general terms that apply to most situations, although it will proceed as though Chief Brown of Santa Cogitas P.D. has put forth the issue of expert systems and is pressing for commitment.

It is important to note that "change" is a highly undesirable state for mankind. Though we frequently talk of change or innovation, this is a form of consensus building about a more rewarding "status quo", not a desire to enter a change state. In discussing the correlation between biological evolution and human history, Stephen Jay Gould (1988:11) noted that "...change is concentrated in infrequent bursts and that stability is the usual nature of species and systems at any moment".

Current management literature is filled with the sagas of heroic "change agents". (Tom Peters' books for example) They are heralded as the saviors of American Industry and role models for all. From the perspective of many employees,

these heros are nothing more than tyrants, manipulators, and ego-maniacs. The goal of the police "change agent" should not be speed, degree of change, profit, or personal glory. It should be improved service to all parties.

To reduce the anxiety associated with states of change, it is necessary to clearly state the course to be taken, changes to be made, motives, and new status quo to be reached. This route needs plateaus or rest periods of stasis between changes.

The key elements of this transition are: the strategies and policies to be employed; the "critical mass", key individuals who affect the outcome; the management structure of the transition team; and the management technologies to be used.

The transition management structure

There are a variety of common management structures to use in the transition process. The most appropriate structure for this change appears to be that of the project manager, a staff member removed from normal duties and given temporary executive power to manage the change.

There are many political issues with which to contend, and major financial obstacles to overcome. There are extensive communication and coordination needs to meet. There is extensive research to be conducted, and a tremendous amount of planning and validating. There are many decisions to be made and a clear direction to be set. A committee could

not discuss, agree, and act in a timely fashion. A chief or regular staff member could not carry out his or her normal obligations if saddled with this task. Therefore, a project manager will be used.

The project manager must have broad experience in police work and management, familiarity with departments, some knowledge of computers and expert systems, a creative imagination, respected leadership skills, good analytical skills, diplomacy, perseverance, energy, objectivity, and good humor.

While a civilian could meet these general criteria, there is a concern for additional salary expense, selecting candidates, a familiarization process, trust building rituals, and retention or replacement considerations that weigh against selection of an "outside" civilian. In this instance, John Doe, a 42 year old lieutenant was selected as the project manager. His staff consists of an experienced sergeant, one experienced investigator, and a computer programmer. He will, also, be aided by a criminal justice professor and several students from the local university.

The critical mass

While hundreds of people are important to implementation, there are a handfull of key individuals whose actions will dictate the outcome of the change. These key individuals compose the "critical mass". While each key player is a stakeholder, not all stakeholders are part of the

critical mass. The key players are those who control the actions of others, thereby determining the outcome.

The critical mass of this transition plan consists of: the city manager, the chief of police, and the project manager.

The City Manager

The city manager is the chief's boss. He or she makes the primary decisions on allocation of city funds for police budgets. Projects that lack his or her approval and support will not last. He or she is the one who will have to help bring the City Council to continued support of the program.

This is a long-term project. It will involve amending the traditional police budget. The city manager has to assure the city council that this project is worthwhile. He or she may have to make this sales pitch on a regular basis for as many as six or seven years. The city manager walks the "bottom line" between cost and quality of service.

City Manager White has been with the city of Santa Cogitas for 15 years, the last seven as City Manager. He and his family are well established and happy in the community. He wants to serve another ten years, and remain in town after retirement. He supports the concept, but worries that the project could become costly in the future and become a political campaign issue, causing disruption in city operation and jeopardizing his long range personal plans.

The Chief of Police

The chief controls the direction and resources of the department. His approval and commitment make things happen.

This program can delay or cut some future manpower costs and improve levels of service internally and externally. He will be under close scrutiny from the city manager. His continued employment may hinge on the results of the project.

Chief Brown is a "go getter". He came to Santa Cogitas three years ago, after serving five years as chief with a smaller department in the next county. He is well regarded inside and outside his department. He tends to be a bit autocratic in his leadership, though he shows a constant regard for the welfare of all department personnel. His staff is sometimes overwhelmed by his enthusiasm for new ideas. He knows he can make this expert system program work.

The Project Manager

The project manager is a proven leader and problem-solver, though he lacks the degree of political expertise of The chief and city manager. While his career opportunities will be improved by success, there is no threat of job loss for failure. He is motivated by the job itself. He is energetic and pushes himself and those around him very hard.

The commitment plan

It is necessary to determine both the current and

appropriate level of commitment of each of these individuals on the issue. Each of the key players must be brought to the right level of commitment, if the plan is to succeed. Figure 10 shows the current and needed level of commitment to the change strategy.

Fortunately there is no one who wants to block this project. But, all parties must make some adjustment in their current posture, if the plan is to succeed.

KEY PLAYER	LEVEL OF COMMITMENT			
	block change	let change happen	help change happen	make change happen
Manager White		X -------> O		
Chief Brown				O < X
Project Manager			X ---------> O	

X = current Position O = Needed Position

Figure 10

COMMITMENT CHART

City Manager White wants to let it happen. He must be negotiated to a position of helping it happen. While he is supportive, he is reluctant to take on the complex task of developing expert systems for police and other departments. He feels that his energetic Police Chief will hound him for support and decisions.

He must be convinced that the tasks will not consume too much of his time, that his city will be a better place to live, and that he will have considerable support in his efforts.

Chief Brown must move only slightly, to a lower degree of making it happen.

He must curb his enthusiasm where it could interfere with thorough planning and coordination of efforts. He has a leadership role in this project, yet he must not think of himself as the sole or principal leader.

Project Manager Doe must move from his traditional position of helping things happen to making them happen.

He will still be subordinate to the chief, yet he must make the crucial decisions that the chief will publicly support. The power and responsibility of his new position will be greater than he has had in the past.

His personal reputation is on the line. With the support of the chief, he can take on this new position.

Responsibility charting

The "critical mass" is based on power and authority. The corollary to authority is responsibility. There are many responsibilities that accompany this transition. Responsibility charting is a means of concisely displaying who is responsible for decisions and actions that affect the transition. The chart can then be used to keep key players on course and inform the rest of the organization about each

party's responsibility and authority.

Often described as a RASI chart, this chart serves as a foundation for delegation of authority and responsibility for various tasks or decisions that arise during the project. It breaks down the tasks needed to accomplish the goal and states who has responsibility, who must approve, who must support, and who must be kept informed. Table 4 shows the functions of the key players in this transition.

Table 4

Responsibilities

Tasks	Actors				
	City Mgr.	Chief	Proj. Mgr.	Expert Workers	Other Workers
Development	S	A	R	S	I
Prioritizing	I	A	R	S	I
Job Analyses	-	S	R	S	S
Integration	I	A	R	S	I
Financing	A	R	S	I	-

R = Responsibility (not necessarily authority)
A = Approval (right to veto)
S = Support (put resources toward)
I = Inform (to be told or consulted)
- = Irrelevant to this item

Table 4 shows the project manager has responsibility for all tasks, except financing. The chief is responsible for finances and has primary approval on most tasks.

Technologies and methods to be employed

The first step in managing the transition is to establish a temporary management structure. Lt. Doe will be provided with one sergeant, one detective, and one computer programmer as staff. These people have a broad range of police experience and will be aided in analytical tasks by local university students. They have authorization to draw upon resources throughout the department as needed for the pilot project.

The next step is to communicate the coming change to all employees. This will be done through confrontation meetings (confronting the issue). The first of these meetings will be with management staff. The direction must be clearly explained, and any concerns about the project must be brought to the surface and fairly dealt with at this time. The long- and short-range goals must be understood by all. The operational strategy and policies must be reinforced by the Chief and project staff. The responsibilities of all staff members in relation to this project must be clearly delineated. A written responsibility chart and general time-table will be completed.

This same confrontational meeting technique will then be used with all members of the department on a divisional basis. The chief will introduce the issue and the project manager, describe previously noted concerns and how they were dealt with, display the responsibility charts and rough time

tables. The project manager will respond to as many of the questions, concerns, and suggestions as possible. This will help solidify his role as leader of the project and ensure proper regard for all issues.

The third step is the pilot project itself. This will be an expert system for burglary investigation, selected for several reasons. First, such systems exist in other departments and may be easily copied and modified to meet specific needs of the department. Second, the system can be tested amongst resident experts. Third, it will use the existing PC in the detail. Fourth, there is a substantial data base and a manageable number of decision-making "rules". Finally, it promises the quickest results.

Following this pilot project, an expert system will be developed for sex crime investigations. Success of a sex crime program will be news-worthy and garner needed public and political support for expansion of efforts.

Simultaneously, the project team will encourage "wildcat" experiments in any area where employees show the desire and ability to develop an expert system. This will encourage employee participation and foster fresh ideas.

The next phase will be a major project for an embedded expert system in the records computer. This will be coordinated with a professional consultant and outside contractor.

The project management team will be meeting with the chief on a weekly basis to keep him abreast of progress and

setbacks. Team members will also be contacting neighboring police agencies and other city departments who share an interest in improving their automated systems. When useful results have been achieved, the Chief will call for educational meetings with employees. These are designed to promote confidence in and understanding of expert systems by demonstrating their applied benefits. It will encourage employees to think of useful applications in their jobs. These meetings will serve to reduce anxiety by providing employees with up-to-date information, and show the department's ongoing commitment to the expert system project. Information bulletins may be used in lieu of meetings when appropriate.

Employees' contributions to the effort will be encouraged and promptly rewarded. Involving as many of the workers as possible in thinking about expert system applications serves to promote useful ideas and desire to change the current operating methods.

The entire transition to a largely expert system enhanced operation is expected to take four to eight years. The variable here is availability of project funding. Delays of less than one year will cause some anxiety, but no permanent damage. Stretching the project time frame will reduce the city council's anxiety about capital outlay and may result in better equipment becoming available at lower prices.

Organizationally the changes will be small and swift.

They will be spaced by plateaus of research and experimentation by small groups, while the remainder of the organization maintains the status quo. This assumes the secondary priority of expert system development to primary police functions. It allows the program to be sidetracked if necessary without risking derailment.

While the funding and time frame for this transition do not match the usual decisiveness of police operations, it holds a distinct advantage over ordinary organizational change. Change in police organizations is most often generated by internal and/or external politics and brings out distracting political posturing within the department. This transition is predicated on new technology, not old politics. As Steven Kolodney (1990:23) has noted, "Because information technology is an agent of change in most organizations, it can be used as the reason to rethink the government operations without being critical of past performance."

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This paper dealt with the issue question: To what extent may expert systems be used to aid line police officers by the year 2000? The study was further focused by three sub-issue questions:

How would utilization of expert systems impact the financial planning of the police department?

Will the cost of AI technology come within reach of local government?

What circumstances will dictate the demand for expert systems in the near future?

The advances in computer technology associated with expert systems are likely to exceed the estimates in this study. It has been noted by technological forecasters that experts consistently under-estimate developmental advances. Based on the forecasts and this caveat, we will see fully voice interactive computers by 1995. At the same time, parallel processing computers using silicon chips will be affordable to most cities.

Expert systems in lap top or hand-held computers will guide field officers through their investigations, insuring that the best available information is gathered and transmitted immediately to the central data base. An expert system embedded in the main computer would link events to

provide useful leads to investigating officers. Pertinent information from each crime report would be automatically cross-referenced with similar crimes, all proximal events in time and location, known criminals and suspicious persons, pertinent modus operandi, vehicles used or targeted, weapons or tools used, etc. This information will be available immediately to a field officer via his mobile computer, or waiting on line for the investigator on his office computer, where more special expertise systems are available.

While the derived estimate of the economic future does not promise significant funding for police departments, pilot programs in expert systems, employing proven technology, that cut long-term costs are quite probable. With reductions in military spending by the federal government, many manufacturers may turn their attention to providing new labor-saving products to local government.

Police budget practices will change to accommodate the acquisition and use of computer technology. The computers will receive priority on a par with facilities and vehicles. Asset forfeiture money is available now and should be used now.

All the technological requisites for expert systems are already within financial reach of local government. Most of local government's existing computer hardware and programs can accommodate AI. The parallel processing computers needed for advanced AI operations are on the market now and their prices are continuing to decline as new methods of

manufacture are discovered.

Police must look to expert systems to aid growing information processing demands. Automated field reporting systems with direct input to records systems are in use today in several states. Coupling these with embedded expert systems in main frame records computers which sort, analyze, and deliver useable information to users, is the only viable means of dealing with this information increase.

Recommendations for further study

Two primary considerations for future research arose during this study. The first, is the use of voice interaction to speed the operation of current police Mobile Data Terminals or their lap top computer replacements, dictate reports, or access information files.

The second, regards financing police technological improvements in a slowing economy. Is it possible to strike a balance between laws, etnics, and costs in joint development ventures between police agencies and technology vendors. Or to consider state funded and controlled development of expert systems and other technology for use by all law enforcement agencies.

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Livermore, CA

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Appendix A

Candidate Trends

Computer Literacy of Future Employees

Ability of Local Government to Finance Public Service Demands

Availability of Expert Police Officers

Use of Non-Sworn Employees to Conduct Police Work

Developments in Computer Technology

Public Concern for Their Right to Privacy

Public Confidence in Police Computer Systems

Police Communication with the Public

Use of Expert Systems in Law Enforcement

Amount of Information that Must be Processed by Police

Level of Crime in the Community

Police Involvement in Non-Traditional Activities

Extent to Which Computers Are Used by the Public

Complexity of Legal Issues Involved in Police Work

Police Personnel's Demand for High Technology

Cost of Police Labor

Availability of Qualified Police Applicants

Level of Education of New Employees

Rate of Ethnic Change in California

Appendix B

Candidate Potential Events

Major Economic Depression

Police Budget Cuts

Special Government Funding for Development of Expert Systems in Law Enforcement

Voice Operation of Computers at Affordable for Local Government

Low Priced "Super" Computers

Public Safety Satellite Communication Network

Small Voice Interaction Personal Computers Marketed

National/State Identity Cards Required for all Persons

Municipal Police Forced to Merge into Regional Forces

State-wide Linkage of all Police Computers

Nation-wide Epidemics of Computer Viruses

State and Federal Aid to Local Law Enforcement

Police Applicant Pool Drops by more than 50 Percent

Legislation Restricts the Use of Personal Data by Government

Legislated Restrictions on Replacement of Employees by Computers

U.S. Borders Closed to Immigration

California Experiences a Catastrophic Earthquake

Nation-wide Sabotage of Government Computers

Funding for Law Enforcement is reduced by Legislation

Government Adopts Plan for Paperless Work Environment by 2000

Robots Carry out Routine Police Report Functions

Trade Restrictions Raise Computer Prices 100%

Appendix C

CAPABILITY ANALYSIS

Strategic Need Area:

Police Department capabilities related to development and integration of expert systems in routine functions.

Items were evaluated on the following criteria:

1. Superior. Better than others. Beyond present need.
2. Better than average. Suitable performance. No problems.
3. Average. Acceptable. Equal to others. Not good, not bad
4. Problem area. Needs improvement. Deteriorating.
5. Poor. Needs improvement now. Crisis.

Category:	1	2	3	4	5
Personnel Adequacy				X	
Technology				X	
Equipment			X		
Facility			X		
Money				X	
Service Demands				X	
Response Time			X		
Management Skills		X			
Police Officer Skills		X			
Non-sworn Skills			X		
Training		X			
Morale			X		
Image		X			
Council Support			X		
City Manager Support		X			
Justice System Support		X			
Community Support		X			
Pay Scale			X		
Benefits			X		
Turnover			X		
Citizen's Complaints			X		
Enforcement Index			X		
Traffic Index			X		