AN ASSESSMENT OF AN INFORMATION SHARING TECHNOLOGY (ARJIS): EXAMINING ITS POTENTIAL CONTRIBUTION TO IMPROVED PERFORMANCE THROUGH THE EYES OF STREET LEVEL OFFICERS

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This study is based on the Doctoral Dissertation of Martin J Zaworski (2004), unpublished at this time. Significant portions of the dissertation are used in this work, with permission of the author.

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ABSTRACT

The purpose of this study was to examine the impact of the Automated Regional Justice Information System (ARJIS) on the performance of law enforcement officers. The officers in the San Diego County Sheriff's Office (SDSO) served as the focus of the study. The methodology consisted of surveys, interviews, and direct observation, the purpose of which was to assess attitudes and perception of the value of information technology to patrol officers and detectives. This was supplemented by a review of records. The comparison group, used as a control for this research, consisted of officers from a sheriff's office in the southeastern part of the United States who do not have access to regional information sharing technology on the scale of ARJIS. The survey sample consisted of 588 officers, split between agencies. This research determined if and how information-sharing technology helps law enforcement by examining the differences in perception of the value of IT between the law enforcement officers who have access to automated regional information sharing (i.e., the study group in San Diego) and those who do not (i.e., the comparison group). The study also examined whether the extent and type of computer training influenced the officers' perception of the value of information technology.

The results suggest that the information sharing technology contributes to the officers' productivity and assists them in clearing cases: some evidence exists to suggest that it could also contribute to officer safety. It also suggests that officers using information sharing technology are more satisfied with the data they get from their information systems. The information sharing technology did not seem to make a difference in the number of arrests made by officers. Several intervening variables were found to play a role in the findings. Management culture, i.e., the present of a strong management accountability system, appeared to be a greater factor in clearances and arrests in the comparison agency than the technology. Computer training also appeared to influence the officers' satisfaction with the technology.

This study finds that information sharing technology benefits patrol officers and detectives in the following ways. It assists officers in conducting investigations, provides information to assist in case clearances, and improves officer productivity. Evidence also exists to suggest that it improves officer safety. In addition, this study suggests that other variables such as computer training and management culture can affect the successful diffusion of technology and influence the street level officers' perception of the value of that technology to them in the performance of their daily tasks.

INTRODUCTION

Law enforcement is an information-intensive profession. Advances in transportation, communications, and technology have made society and the criminal element within society more mobile thus making it more difficult for police to track and apprehend offenders. The decentralized form of government and local rule in the United States fosters the use of local law enforcement operating within defined jurisdictional boundaries; unfortunately, those who commit crimes exploit these boundaries. Criminals operate within and throughout jurisdictions making it difficult for individual agencies to view crime and its perpetrators regionally. Law enforcement has recognized the need to share information among and between agencies, but has made little progress over the years to make this a reality. The movement by law enforcement officials toward automated sharing of information has taken on new importance since "911." A great deal money and effort are being expended to create systems to enable law enforcement to share information. There is an assumption that automated information sharing will be of value to officers and detectives. This assumption lies at the heart of this study and from which the question central to this research, is formulated.

Does automated regional information sharing improve the performance of law enforcement officers and does the addition of shared data improve the fit of the technology to the task?

BACKGROUND

Near the end of 1999, the National Institute of Justice (NIJ) partially funded the web enabling of the Automated Regional Justice Information System (ARJIS), to increase the information available to law enforcement officers throughout San Diego County. ARJIS is a network of criminal justice agencies that share information through a web based enterprise network. All municipalities in the County of San Diego are member agencies of ARJIS.

Through electronic interfaces with participating criminal justice systems, it enables 38 local, state and federal agencies in the San Diego region to share information. Law enforcement officers in the participating agencies have access to the following information via ARJIS: [1]

- Crime cases
- Arrest citations
- Field interviews
- Traffic accidents
- Fraudulent documents
- Photographs
- Gang information
- Stolen property

ARJIS also links information from state, local and federal law enforcement agencies and pools it with information from "courts" and "corrections." Law enforcement officers from the San Diego Sheriff's Office (SDSO) who participated in this study have access to this regional information. What makes this unique is that the system delivers regional information directly to patrol officers and detectives.

Officers from a large southeastern U.S. Sheriff's Office serve as the control or 'comparison' group for this study. This comparison agency is a large metropolitan law enforcement agency, which has similar systems to those found in the SDSO. One of the major differences between agencies is that the comparison agency does not have a regional information sharing system, like ARJIS. Comparison agency officers have access to information similar to the information shared via ARJIS, but [2] that information is mostly local in nature, and emanates from within the agency. They do not have access to information directly from all other County law enforcement agencies.

Implicit in the rationale for developing ARJIS, is the belief that providing access to shared regional crime information via information technology will improve the utility or usefulness of that technology in helping patrol officers and detectives to do their jobs; therein lies the problem and subject of this research.

METHODOLOGY

This study employs a non-experimental, survey design, including both an associational and comparative research approach. It focuses on officers and detectives from two law enforcement agencies. The SDSO, a participant agency in the ARJIS project, is the subject of this study. A weakness in this design is that it assesses the impact of an intervention (the ARJIS technology) after-the-fact and is absent pre-implementation observations employing the same instrumentation for use as a baseline. Since random assignment of the ARJIS technology is not possible, this study uses a control, or comparison group. The use of control groups is an accepted method of creating a comparison base when random assignment is not possible (Bickman et al., 1997) Officers from a second agency were used as the 'comparison group' as part of the design. The comparison agency is a large County Sheriff's Office in the southeastern United States with characteristics similar to the SDSO; it does not use information sharing technology similar to the ARJIS.

This research examines differences in perception of the value of information technology, between the two groups of law enforcement officers. It seeks to determine whether information sharing technology makes a difference in the officers' assessment of the value of technology in the following areas: *individual effectiveness, job performance, productivity, investigative support, arrests, and clearances*. It also examined the affect of potential intervening variables such as computer training.

In addition to employing both quantitative and qualitative methods, this study triangulates data collection methods within each. Triangulation is a way to reduce distortions and validity threats inherent in single-method studies (Maxwell, 1997). The quantitative methods involve gathering data from the surveys and conducting statistical analyses as described in the 'analytical techniques' section of this document. It also involves gathering information from each agency regarding arrests and clearances for the 3-year period post - ARJIS (web based) implementation. The qualitative portion involved interviews of 38 law enforcement officers to gain insight into their use of information technology and its impact on their daily performance. Supplementing the interviews is the direct observation (ride-along) of eight patrol officers, and four detectives during which their activities were observed while they worked a normal shift.

Instrumentation

The primary data gathering method is a survey. Surveys, like other data gathering methodologies, have inherent strengths and weaknesses. A survey's major weakness emanates from the error caused by faulty question design (Fowler, 1997). Among a survey's strengths are the ability to collect data from a very large sample (Ioimo, 2000) and to ask people about their first hand experiences, i.e., their current situations, feelings and perceptions (Fowler, 1997). The latter is important in this study because of the difficulty in developing a cause-effect relationship between information technology and productivity (Danziger and Kraemer 1985, Goodhue and Thompson 1995, Goodhue 1995, McCune 1998). The instrumentation used in this dissertation capitalizes on the survey's strengths while minimizing the potential weakness.

Dale L. Goodhue Ph.D. has extensively researched the area of user-evaluation of information technology. Surveying the literature from 1985 through 1991, Goodhue found at least 35 empirical articles employing some form of user evaluation construct in MIS research (Goodhue, 1998). He quickly recognized the need for valid instruments to capture user-evaluations of information technology (Goodhue, 1998). Through this research, Goodhue developed a theory he calls Task-Technology-Fit (TTF) which suggests that the ". . . correspondence between information systems functionality and task requirements leads to positive user evaluation and positive performance impacts" (Goodhue, 1998, p. 105). He constructed a survey instrument that includes questions for 16 dimensions of TTF. He tested the measurement validity of the instrument using a sample of 357 users in 10 companies and found it to have excellent validity for 12 dimensions of TTF and strong predictive validity.

Survey Instrument

This study builds upon the work done by Goodhue (1995, 1998) and Ioimo (2000) by triangulating it with the work done by Northrop, et al (1995). The instrument used and developed for this study borrows from the three sources cited above and adds several dimensions, important to this study. It consists of eight core parts, and 7 measures of user characteristics.

Instrument validation began with the field pre-test. Management staff, key members of the information technology staff responsible for supporting the technology, and law enforcement field officers reviewed the instrument preceding the pretest. This was useful in ensuring that any references made to technologies are clear and appropriate within the organizational frame and readily understood by respondents.

Pretests usually consist of administering the instrument to 20 -50 respondents drawn from a population the same as or similar to the population to be included in the survey (Fowler, 1993). The actual pretest consisted of administering the survey to 40 law enforcement personnel. They were randomly selected from the population of interest; 21 were from San Diego County and 19 from the 'control' agency. In an attempt to identify ambiguous or confusing questions and instructions, the researchers administered the questionnaire to each participant individually and interacted with the participant during the process to ensure that he/she clearly understood each question.

Reliability testing was accomplished using the Cronbach's Alpha statistic. Cronbach's Alpha is widely accepted for use in social research and well suited for the group being tested: it has a history of being successfully used with the core of this survey by Goodhue (1998) and Ioimo (2000). Table 1 provides the results of the Cronbach's alpha tests on all ordinal questions including the additional questions relating to information sharing.

Table 1 Survey Instrument Reliability Testing

Dimension of Task-Technology Fit	*Questions*	*Cronbach's Alpha*	*Final Status*
Task Interdependence	4,5 (2)	.51	Dropped
Data at Right Level of Detail	6,7 (2)	.75	Kept
Ease of Use and Ease of Information Access	8,9,19,20 (4)	.76	Kept
Data Comprehensiveness – re. information from other departments or agencies	10 -12 (3)	.69	Dropped
Data Compatibility	13-15 (3)	.91	Kept
System Reliability	16-18 (3)	.84	Kept
Performance Impact - systems	21,22 (2)	.87	Kept
Information Richness – re. information from other law enforcement agencies[1]	44-47 (4)	.79	Kept
Performance impact – re. information from other law enforcement agencies[2]	48-51 (4)	.91	Kept

Sampling Strategy

The discussion of the sampling strategy begins with the sampling frame. A sampling frame is the group of people that have a chance of being selected (Fowler, 1993). In this case, the sampling frame consists of all patrol officers and detectives in the SDSO and the comparison sheriff's office, assigned to non-administrative functions.

Stratified random sampling is the sampling strategy employed to select study participants. Stratification will ensure that the sample group contains the same proportion of detectives to patrol officers that appears in the sample frame. Stratified random sampling will structure the sample process to reduce normal sampling variation and produce a sample more reflective of the population (Fowler, 1993).

The following procedure was used to construct the sample group:

1. The names of all officers and detectives along with their departmental ID numbers were gathered and loaded into a statistical program.
2. The random selection utility of that program selected the appropriate number of deputies and detectives and made them part of the sample.

This procedure gives everyone in the entire population of interest an equal chance of being included in the selection.

[1] This is an added dimension to TTF, an important construct and significant to this research.

[2] This construct is an extension of the TTF construct "performance Impact" which relates to the impact of systems in general on individual performance. This construct intends to improve the TTF construct "performance Impact" making it more precise by relating it to the impact of information sharing - between law enforcement agencies - on individual performance; it is a key construct in this study.

Sample size

The sample size is generally a function of the desired confidence level and the amount of error that can be tolerated (Meier and Brudney, 1992). Increasing the sample size increases statistical power and decreases the potential for errors (Bickman and Rog, 1997; Fowler, 1993; and Meier and Brudney). The key is determining the appropriate size that is both reasonable and economical.

Researchers generally consider alpha = .05 (95%) acceptable (Bickman and Rog, 1997), thus it is used in this study. It represents the probability of a Type I error (i.e., finding statistical significance when in fact there is no effect). The sample size should consist of about 300 from each of the two groups the info-sharing (SDSO) and comparison groups. This will result in a desired confidence interval of .03, (or less). Since stratified random sampling was used, the sampling error should be smaller (Fowler, 1993). Thus, we can be sure that estimates made based on this sample are ± 3% accurate. The sample size for the survey was 588 law enforcement officers divided between the two agencies.

QUALITATIVE ANALYSIS

The qualitative portion of this study involves interviews of 38 law enforcement officers to gain insight into their use of information technology and its impact on their daily performance. Supplementing the interviews is the direct observation (ride-along) of eight patrol officers, and four detectives during which their activities were observed while they worked a normal shift. The activities were recorded, noting their use of automated systems. This section presents an overview of the findings of these interviews and direct observation, beginning with the interviews.

Table 2 Responses to Interview Questions: Chi-Square Statistic

Questions and Response Categories (N=38)	Chi-Sq.	*P*	Cramer's V	Comparison	SDSO	Total
Q.1 Estimated daily computer usage (in hours)	8.72	.013*	.479			
2 hrs or less				40.0%	11.1%	26.3%
3 to 5 hrs				30.0%	11.1%	21.1%
6 to 8 hrs				30.0%	77.8%	52.6%
Total				100%	100%	100%
Q.2 Do computers contribute to off safety?	17.07	.001*	.670			
Yes				40.0%	83.3%	60.5%
No				25.0%	.0%	13.2%
Somewhat				.0%	16.7%	7.9%
Hesitant				35.0%	.0%	18.4%
Total				100%	100%	100%
Q.3 Data query vs. data entry	1.26	.532	ns			
Less than 50% Query				45%	50%	47%
50% Query - 50% Entry				25%	11%	18%
Greater than50% Query				35%	39%	35%
Total				100%	100%	100%
Q.4a Top 3 tasks for which you use a computer	.07	.782	ns			
Reported as number 1 task: Report Writing				60.0%	55.6%	57.9%
Accessing Data				40.0%	44.4%	42.1%
Communicating				0%	0%	0%
Total				100%	100%	100%
Q.4b Top 3 tasks for which you use a computer	.038	.981	ns			
Reported as number 2 task: Report Writing				20.0%	22.2%	21.1%
Accessing Data				75.0%	72.2%	73.7%
Communicating				5.0%	5.6%	5.3%
Total				100%	100%	100%
Q.4c Top 3 tasks for which you use a computer	.181	.913	ns			
Reported as number 3 task: Report Writing				20.0%	16.7%	18.4%
Accessing Data				60.0%	66.7%	63.2%
Communicating				20.0%	16.7%	18.4%
Total				100%	100%	100%

Questions and Response Categories (N=38)	Chi-Sq.	*P*	Cramer's V	Comparison	SDSO	Total
Q.5 No. of times you access information, per day	4.92	.09	ns			
20 or less				33.3%	70.6%	51.4%
21 - 50				44.4%	17.6%	31.4%
Greater than 50				22.2%	11.8%	17.1%
Total				100%	100%	100%
Q.6 Info. you receive from Outside your agency	1.26	.532	ns			
Less than 50%				45.0%	50.0%	47.4%
About half (50%)				25.0%	11.1%	18.4%
Greater than 50%				30.0%	38.9%	34.2%
Total				100%	100%	100%
Q.7 Amount of info. obtained from other Law Enforcement Agencies (LE) via the Computer	12.5	.006*	.626			
Most				5.6%	.0%	3.1%
A lot				5.6%	50.0%	25.0%
Small Amount				33.3%	42.9%	37.5%
None or hardly any				55.6%	7.1%	34.4%
Total				100%	100%	100%
Q.8 Is info. you get from other LE agencies helpful?	12.21	.001*	.567			
Yes				50.0%	100%	73.7%
I don't get info from other LE agencies				50.0%	0%	26.3%
Total				100%	100%	100%
Q.9 Satisfaction w/info from other agencies	11.77	.001*	.557			
Desire access to more				95.0%	44.4%	71.1%
Satisfied with current info				5.0%	55.6%	28.9%
Total				100%	100%	100%
Q.10 Opinion of LE info sharing	.897	.344	ns			
Very important to Street cops				85.0%	94.4%	89.5%
Not sure				15.0%	5.6%	10.5%
Total				100%	100%	100%
Q. 14 Is management attuned with your needs (re. the information systems you are provided with)?	1.54	.462	ns			
Yes				47.4%	66.7%	56.8%
No				31.6%	16.7%	24.3%
Somewhat				21.1%	16.7%	18.9%
Total				100%	100%	100%

** Significant at p<.05*

Interview Summary

The findings proved to be significant in several areas. The first area relates to the amount or extent of computer usage. The extent of system usage is important in increasing the benefits of computing to work performance (Danziger and Kraemer,

1985). "Routine usage" is among the elements of computer usage cited by Danziger and Kraemer (1985) as important to productivity gains. The data suggest a statistically significant difference between the groups' estimates of the amount of computer usage. Since the SDSO officers' estimates are much higher than the estimates of their counterparts from the comparison agency, the researchers expected to see differences in productivity related to computer usage. The quantitative results support these findings: differences were observed between groups in the extent to which computers assist in making officers more productive.

Officer Safety

The difference in perception between groups concerning whether the computer systems contribute to officer safety proved to be an unexpected finding. The SDSO officers were unequivocal in their belief that systems contribute to officer safety. The comparison agency officers were not quite as positive. The differences were statistically significant and relatively strong which suggests a relationship between officer safety and the type of computer technology. This area definitely deserves further research related to law enforcement information sharing.

Computer Usage and Routine Tasks

Several questions addressed the type of tasks and activities the officers routinely accomplished using computers. The data suggest no significant differences between groups, as their usage was similar.

Information Availability via Computers

Five questions dealt with the information officers are able to get from their computers. As expected, significant differences were found between groups. While the data suggest no difference concerning the amount of information officers are able to get from outside of their agency, the differences between groups were significant and mildly strong in responses to questions that addressed the amount of information officers are able to get (through their computer system) from other law enforcement agencies. As expected, SDSO officers report getting more information from other law enforcement agencies than did the comparison agency officers. Significant differences were found in both the extent to which officers believed the information from other agencies is helpful to them, and their corresponding satisfaction level with this information. Again, SDSO officers' comments were more favorable for both questions. The responses to several of these questions support the survey responses. These findings are reflected in the 'Summary and Conclusion' section of this report.

Direct Observation

The goal of direct observation is to corroborate and explain other findings, i.e., interview results and survey response data. A researcher worked and rode along with law enforcement officers from both the SDSO and comparison agency after the surveys were completed and the data were analyzed. The researcher observed the officers during their normal workday and documented exactly how they used their computers. An important part of these observations was to discover the steps officers take to gain access to information, especially from other law enforcement agencies, and to pinpoint exactly

what types of information they are able to receive from other agencies. Table 3 outlines the salient observations, by group.

Table 3 Synopsis of Direct Observations of Officers

Comparison Group Deputies	San Diego County Sheriff's Deputies
There is a danger of too much information - BOLO's would be more effective if sent via CAD instead of verbally;	ARJIS is used by officers and by all accounts, is helpful in decreasing crime, increasing clearance rates;
Management culture, i.e., the Compstat approach, appears to be a variable in decreasing crime and increasing clearance rates; MOST OF THE OFFICERS MENTIONED THIS;	ARJIS is not as user-friendly as it could be;
It takes a significant amount of time to train less computer-savvy colleagues;	It takes a significant amount of time to train less computer-savvy colleagues;
There are too many passwords to remember;	There are too many passwords to remember;
The systems overall are not user-friendly;	The systems overall are not user-friendly;
Officers complained about the report writer program;	Officers complained about the report writer program;
Officers had to navigate through a number of systems to find the right information;	Officers had to navigate through a number of systems to find the right information;
Adherence to policy – not using the computer while driving- was a factor in limiting the usage of computers by patrol deputies;	Officers seemed to be able to easily navigate through the systems;
Officers complained about the amount and type of information provided via the criminal history report. It is difficult to interpret and there is an abundance of irrelevant information to look through;	Officers complained about the amount and type of information provided via the criminal history report. It is difficult to interpret and there is an abundance of irrelevant information to look through;
Officers are spending a lot of time doing data entry;	
Officers spent much less time on the computer and lot more time observing and interacting with events in their districts (preparation for the Compstat session);	Officers spend most of their time with one hand on the computer;
NCIC/FCIC reports return too much information for an officer to scan through;	Officers went to the community storefront access centers to access ARJIS information;
Officers are more involved with neighboring law enforcement officers (face to face) to gain information.	Officers supplement computerized information with telephone calls to follow-up on investigations.

Each officer was informed that the researcher was there to observe how he/she used the computer during the tour of duty and that the information was part of a larger study on computer usage by law enforcement officers, partially sponsored by the National Institute of Justice. When asked, they were also told that the information gathered might be used to improve law enforcement technology in the years to come. All officers were assured of their anonymity.

Selection Criteria

Twelve law enforcement officers were selected from each department, four deputies and two detectives. The selection criteria were simple but specific: only officers who are computer literate and willing to allow a researcher to ride along during a working shift were chosen. Those chosen were characterized as personable, critical thinkers, and highly computer literate by their supervisors.

Direct Observation Summary

Key observations of officers during the 'ride along' are noted in Table 3. The most salient of these observations were that SDSO officers and detectives used the ARJIS system quite a bit. It appears to support and strengthen the investigative function. One of the major differences between groups was that the comparison group officers were more focused on events occurring within their patrol zones, spending less time on their computers than did the SDSO officers. In summary, the direct observation of officers served the purpose of supporting the findings of the interviews and survey responses. A number of observations provided insight and clarification of other data.

QUANTITATIVE ANALYSIS

This section begins with *Descriptive Statistics*, which provide an overview of certain data about the study population. It includes relevant user-characteristic and demographic data, crime, arrest, and clearance data as well as the results of the statistical tests to determine if significant differences exist between the SDSO and the comparison (Comp) group. Next, the *Factor Analysis* discusses in detail, the methods used to reduce the large number of variables to core constructs for ease of reference and explanation. Finally, the *Statistical Testing* section discusses the salient constructs, the results of the analysis of the survey data to determine their strength and statistical significance.

Descriptive Statistics

Surveys were sent to 660 randomly selected law enforcement officers, evenly divided between the Comparison agency and the SDSO. From SDSO, surveys were completed by 300 officers (n=300) and from the comparison agency 288 officers (n=288). Altogether, 588 law enforcement officers participated in this study resulting in a survey response rate of 89%.

User-characteristics/demographic data were gathered as part of the survey process. These data presented in Table 4, are examined to determine if significant differences exist between the two groups of officers (SDSO and Comparison). In addition to user characteristics, a measure of the officers' satisfaction with computer training is included (Table 5). Finally, certain Uniform Crime Report (UCR) data was gathered from the records of each agency. It included arrests, clearance rates, and crime rates for the period 2000 through 2002, inclusively. The crime data are presented in Table 6.

Using the Chi-square statistic, the observed and the expected frequencies were compared to determine if the observed differences between groups are statistically significant. The Cramer's V statistic is used to measure the strength of association, especially when one or more of the variables is nominal (Miller et. al, 2002).

The first portion of the Chi-Square analysis deals with user characteristics or demographic data to determine if differences exist between the comparison and study group (Table 4). The user-characteristics or demographics data gathered from these surveys are examined to determine if significant differences exist between the two groups of officers (SDSO and Comp) which could suggest possible rival explanations of the study findings.

Table 4 User Characteristics, by Agency - Chi-square Statistic (Crosstab)

Variable	n	SDSO	n	Comp	df	Chi-Sq.	*P*	Cramer's V
Age	284		298		3	21.76	.000	.193
21-29 years		5.4%		15.8%				
30-39 years		50.3%		49.3%				
40-49 years		36.2%		25.0%				
50 + years		8.1%		9.9%				
Total		100.0%		100.0%				
Gender	281		297		1	.123	.726	.015
Female		7.7%		8.5%				
Male		92.3%		91.5%				
Total		100%		100.0%				
Education	287		299		5	11.55	.041	.140
High School Grad		6.4%		13.2%				
Some college		48.2%		42.2%				
2 year degree		16.7%		16.4%				
4 year degree		24.1%		21.6%				
Some graduate credits		3.3%		3.1%				
Master degree or higher		1.3%		3.5%				
Total		100.0%		100.0%				
Shift	283		300		3	22.37	.000	.196
Day		60.3%		45.9%				
Afternoon		10.7%		23.7%				
Midnight		19.0%		23.0%				
Other		10.0%		7.4%				
Total		100%		100.0%				
Years as police officer	297		285		5	39.60	.000	.261
Less than 1 year		2.0%		8.8%				
1-2 years		2.0%		9.1%				
3-5 years		10.8%		17.2%				
6-10 years		27.9%		18.9%				
11-20 years		41.4%		30.9%				
21 or higher		15.8%		15.1%				
Total		100%		100.0%				
Time in position	277		298		3	9.29	.026	.127
Less than 1 year		14.8%		21.7%				
1-2 years		19.1%		20.9%				
3-5 years		23.8%		26.4%				
6 or more years		42.3%		31.0%				
Total		100.0%		100.0%				
Years with this agency	286		299		5	131.4	.000	.474
Less than 1 year		.0%		8.7%				
1-2 years		.0%		15.7%				
3-5 years		12.4%		28.0%				
6-10 years		32.4%		11.5%				
11-20 years		43.1%		28.3%				
21 or higher		12.0%		7.7%				
Total		100%		100.0%				

Demographics

While no group differences were found in *Gender*, the data suggest statistically significant differences in the following demographic categories: *Age* (Chi-sq.=21.76, p<.05), *Education* (Chi-sq.=11.55, p<.04), *Shift* (Chi-sq.=22.37, p<.05), *Years as a police officer* (Chi-sq.=39.6, p<.05), *Time in position* (Chi-sq.=9.29, p<.05), and *Years with this agency* (Chi-sq.=131.4, p<.05). In other words, extrapolating from the random sample selected, the comparison agency has a higher percentage of younger officers, more officers who have fewer years of law enforcement experience, and a greater number of officers who reported high school as their highest level of education. As to the strength of association, the Cramer's V scores for *Age* (.193), *Education* (.140), *Shift* (.196), *Years as a police officer* (.261), and *Time in position* (.127) are low. These low values for the test statistic Cramer's V suggest that any relationship is weak.

Demographics Summary

The low measure of association discussed above, suggests that differences in demographics between the two groups of officers are not likely to be an influencing factor in the findings. The one exception is the Cramer's V=.474, for *Years with this agency*, which suggests that the relationship is moderate and could be an influencing variable in the findings. It merits further testing to rule out or confirm the existence of a rival explanation.

Computer Training and Computer Experience

Nine questions on the survey deal with computer training. These questions address the following dimensions of training:

- Number of Hours,
- Adequacy (amount),
- Timing
- Quality
- Frequency of training
- Source of training

The final dimension of training, 'Source of training,' was divided into three questions: 1) Frequency of training by a co-worker, 2) Frequency of training provided by someone other than a coworker, or self, and 3) Frequency and amount (hours) of Self-training. Using the Chi-square statistic, the observed were compared with the expected frequencies for each variable associated with training to determine if any differences observed between groups were statistically significant. The Cramer's V statistic was also used to assess the strength of any existing relationships.

Table 5 provides an overview of the responses to the computer training questions, by agency.

Table 5 Computer Training by Agency - Chi-Square Statistic

Variable	n	SDSO	n	Comp	df	Chi-Sq.	*P*	Cramer's V
Hours of Formal Training	296		285		3	8.70	.034	.122
0		14.5%		13.3%				
1-2		30.1%		34.7%				
3-10		37.5%		42.1%				
11+		17.9%		9.8%				
Total		100%		100.0%				
Amount of Training	297		284		1	37.44	.000	.254
Not enough		72.4%		47.4%				
About right		27.6%		52.3%				
Too much		.0%		.4%				
Total		100%		100.0%				
Timing of Training	294		284		3	31.71	.000	.234
Too soon		15.6%		5.6%				
About right		42.5%		61.6%				
Too late		24.8%		14.4%				
N/A		17.0%		18.3%				
Total		100%		100.0%				
Training Quality	297		286		3	6.92	.074	.109
Low		18.9%		15.7%				
Medium		54.2%		48.6%				
High		16.8%		25.5%				
N/A		10.1%		10.1%				
Total		100%		100.0%				
Training frequency	297		284		1	31.89	.000	.262
Not enough		81.5%		57.2%				
About right		18.5%		42.5%				
Too much		.0%		.4%				
Total		100%		100.0%				
Training Source: Self	299		285		1	2.73	.098	.068
Yes		63.9%		57.3%				
No		36.1%		42.7%				
Total		100%		100.0%				
Training Source: Co-worker	299		286		1	.766	.381	.036
Yes		40.1%		43.7%				
No		59.9%		56.3%				
Total		100%		100.0%				
Training Source: Other	299		286		1	.629	.012	.104
Yes		3.0%		7.7%				
No		97.0%		92.3%				
Total		100%		100.0%				
Hours of Self Training	296		285		3	33.31	.000	.239
0		1.0%		4.2%				
1-2		22.0%		35.8%				
3-10		28.0%		32.3%				
11+		49.0%		27.7%				
Total		100%		100.0%				

Source and Quality of Computer Training

The three questions associated with 'source of training' and the question concerning 'quality of training' suffer from either low Pearson Chi-Square scores (Chi-Sq.<.8) or high significance test scores (p>.05). This suggests the lack of a significant relationship between groups associated with these variables.

Hours of Computer Training

The Pearson's Chi-Square=8.7, p<.05, df=3 for the question concerning 'hours of formal training,' suggests the existence of a relationship in the population. The low value for the test statistic, Cramer's V =.122, suggests that the relationship is weak and will not influence the findings.

Adequacy, Timing, and Frequency of Computer Training

The four remaining questions associated with training 'adequacy,' timing,' 'frequency,' and 'hours of self-training,' produced a Pearson Chi-Square statistic >30, and p<.001. This suggests the existence of a relationship among the population associated with each of these variables, independently. The Cramer's V<.230 for each of these variables suggests that the strength of the relationship is weak. It is appropriate to conclude that differences in survey responses between the two groups are unrelated to these training variables.

Crime Data, Arrests and Clearances

Table 6 displays the crime data for both agencies from 2000 through 2002, inclusive. These data reflect the crime and arrests per 1000 population. It also shows clearances rates for crime classified using the national standard (UCR) as 'Crimes against Persons,' and 'Crimes against Property.'

Table 6 Three Years of Crime, Clearance, and Arrest Rates - Mann-Whitney-U Test Statistics

	n	SDSO Mean	sd	n	Comp Mean	sd	Mann-Whitney U	*p*
Violent Crime	3	3.39	.490	3	4.29	.500	1.000	.127
Property Crime	3	21.10	2.01	3	18.54	2.46	1.000	.127
Violent Clearance Rate	3	61%	.070	3	64%	0.10	4.000	.827
Property Clearance Rate	3	12%	.010	3	40%	0.46	.0000	.050
Arrest Rate	3	21	1.01	3	72	1.28	.0000	.050

The data show differences between groups, with the largest being the Property Crime clearance rates and the Arrest rates. While the comparison agency and SDSO solve a similar number of Violent Crimes at 64% and 61% respectively, the comparison agency solves 40% of the Property Crimes, which is more than triple the amount cleared by SDSO (12%). At an average of 72 arrests per 1,000 (population), the comparison agency also has a much higher arrest rate than the SDSO rate of 21 arrests per 1,000 population.

As to crime rates, the comparison agency's violent crime rate, at 4.29 per 1,000 population, is higher than the SDSO 3.39 per 1,000 population. The reverse is true for Property Crime rates; the SDSO Property crime rate, at 21.10 per 1,000 population, is higher than the comparison agency's 18.54 per 1,000 population.

The Mann-Whitney U non-parametric statistical test procedure is better suited than most other tests (e.g., t-test) for comparing the crime data described here because of the small sample size (Camer, 1998; Roscoe, 1969). Table 6 contains statistics associated with the Mann-Whitney U test for two independent samples. The Mann-Whitney U[3] (ranking) = .000, $p<.05$ for property clearances rates and arrest rates indicate significant differences between Broward and San Diego. In other words, comparison group officers clear (solve) significantly more Property Crimes and make significantly more arrests than their peers in San Diego. No significant difference exists between agencies, in violent crime clearance rates, $p>.10$, or crime rates in general (i.e., violent crime rate = $p>.10$ and property crime rate $p>.10$).

Factor Analysis

This section discusses the methods used to reduce the large number of variables (measured as part of this study) into core constructs. Factor analysis is used to identify clear and substantial relationships between the survey questions and underlying constructs. This section also discusses how the variables making up each factor group together conceptually and are consistent with theory. Finally, statistical analyses are presented suggesting that the model and factors are reliable.

Core Constructs

Three major and independent constructs serve as the core of this study. *Task-Technology Fit (TTF)* (Goodhue 1988, 1995, 1998) represents the first of the three core constructs of the survey instrument, which was validated and administered in this study. Goodhue (1988, 1995, and 1998), Goodhue, and Thompson (1995) have provided the foundation for the use of TTF as a conceptual basis in creating a user evaluation instrument to assess information systems. Goodhue's instrument measures user-satisfaction for 12 separate dimensions of TTF. Because of the proven reliability of TTF, this study borrowed a significant portion of the Goodhue instrument: it served as the foundation for the survey used in this study. Some manipulation of the instrument was necessary to ensure wording appropriate to a law enforcement environment. This TTF instrument is comprised of three major areas, *Data*, *Systems*, and *Performance*, which are outlined in figure 1.

[3] A Mann-Whitney U of 0 represents the greatest difference possible between two samples (Roscoe, 1969).

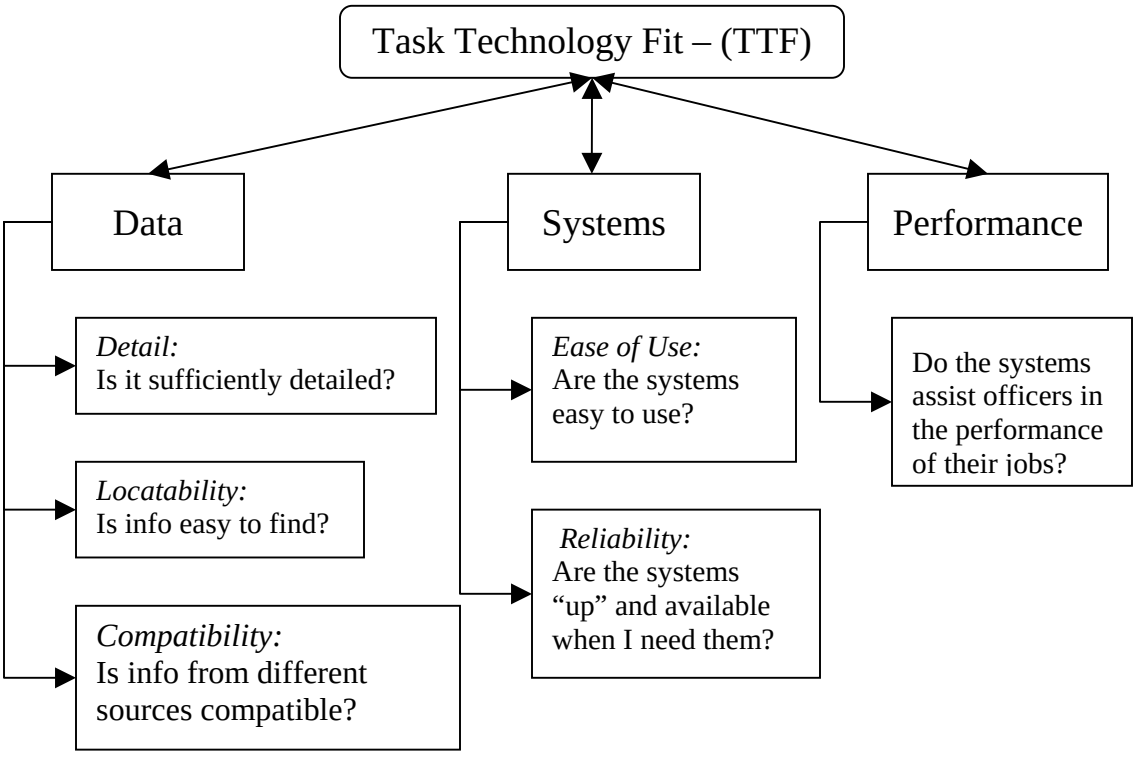

Figure 1 Task Technology Fit (TTF)

A second and important concept associated with the survey instrument used in this study is *Individual Performance Measures*. Expanding upon Goodhue's (1985) and Ioimo's (2000) survey instrument, the researcher added 7 questions to measure individual performance. The underlying concepts for these questions emanated from the work of Danziger and Kraemer (1985) who examined the relationship between computerized data based systems and the productivity of law enforcement officers. These questions seek to determine how much the system assists officers in the following areas: arrests, investigations, and clearances as depicted in Figure 2.

The third concept associated with the survey instrument is *Information Sharing*, which is a critical element of this study. Little evidence of research regarding the impact of information sharing in the law enforcement environment could be found. The available literature suggests that law enforcement officers use information and need more of it in the performance of their daily activities. The terrorist attacks of "911" have made government officials and law enforcement in particular, more sensitive to the need to share intelligence and other information as Wise and Nader (2002, p.46) note: ". . . fire and police chiefs often complain their lack of access to sensitive information hampers their ability to address terrorists threats." Three questions, outlined in Table 7 and aligned with Factor 3, were included in the survey to determine the extent to which street-level officers perceive information sharing as a benefit in their daily jobs.

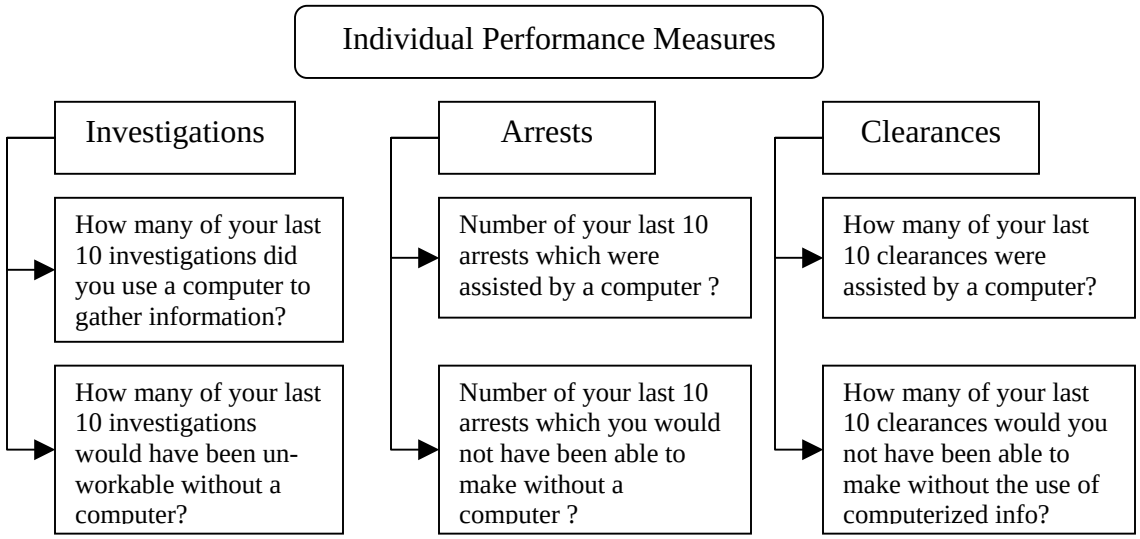

Figure 2 Individual Performance Measures

Table 7, outlines the survey questions, and links them to Factors/constructs. Using the Principal Component Analysis extraction method, the researcher analyzed the responses to the 23 survey questions to determine if a more manageable number of underlying constructs account for the main sources of variation.

Table 7 Factors and Survey Questions

Factors/Constructs	Survey questions	Factor Loading
1. Ease of use	It is easy to learn how to use the computer systems I need.	.856
	The computer systems I use are convenient and easy to use.	.836
2. Individual Productivity Measures	Number of your last ten actively investigated cases or calls handled where you used a computer to gather more information about the call or case	.512
	Number of your last ten actively investigated cases which would have been unworkable without the use of the computer	.619
	Number of your last ten arrests which were assisted by computing	.804
	Number of your last ten arrests which you probably would have not been able to make without the use of computerized information	.736
	Number of the last ten cases you cleared by arrest or by the investigation of subjects held in-custody which were assisted by computing	.828
	Number of the last ten cases you cleared which probably would not have been cleared without the use of computerized information	.809

Factors/Constructs		Survey questions	Factor Loading
3.	Impact of information sharing	The information I am able to get from other law enforcement agencies is a big help to me in my job	-.915
		The information I am able to get from other law enforcement agencies makes me more productive	-.939
		The information I am able to get from other law enforcement agencies makes me more effective	-922
4.	Data Compatibility	Equivalent information from two sources is inconsistent.	.852
		Difficult or impossible to compare data from two different sources because	.864
		When it is necessary to compare or consolidate information from different sources I find that there may be unexpected or difficult inconsistencies	.886
5.	System Reliability	I can count on the systems to be "up" and available when I need them.	-.603
		The computer systems I use are subject to unexpected or inconvenient down times	.908
		The computer systems I use are subject to unexpected or inconvenient down times	.862
6.	System's Impact on Performance	The computer environment has a large, positive impact on my effectiveness and productivity in my job.	.877
		The computer systems and services are an important and valuable aid to me in the performance of my job	.912
7.	Data Detail and Locatability	The data available through the computer systems I use at work is maintained at the appropriate level of detail (quantity) for my group's tasks.	.893
		Sufficiently detailed information is available through the computer systems I use at work.	.911
		It is easy to find out what information the computer systems maintain or provide access to, on a given subject.	.651
		It is easy to locate computerized information that I need even if I have not used that information before.	.506

It is desirable to account for at least 70% of the variance Stevens (1996): the Eigenvalues loaded to 7 factors accounting for 74% of the variance. The Oblimin Rotation with Kaiser Normalization was used to properly identify and interpret the factors. As expected, the survey questions 'loaded' to factors that represent constructs important in this study (see Table 7). The questions associated with the factor groupings were easy to interpret and made sense, conceptually.

Reliability Testing

The researcher examined the data of the seven factors individually, to test their reliability and interrelatedness. The Cronbach's Alpha was used to test the reliability and internal consistency for the series of questions representing each of the 7 factors. These scores suggest that the model and factors are reliable. The analysis of each of the seven factors, are presented in Table 8.

Table 8 Reliabilities Results

FACTOR	QUESTIONS	Cronbach's Alpha
1. System's ease of use	19, 20	.81
2. Individual productivity	24-29	.83
3. Impact of Information Sharing	48,49,51	.92
4. Data Compatibility	13-15	.84
5. System Reliability	16-18	.74
6. System's Impact on Performance	21,22	.87
7. Data Detail and Locatability	6-9	.86

SURVEY DATA ANALYSIS

In the following pages, the basic research questions are presented along with their underlying constructs. These constructs, operationalized as survey questions, are analyzed to determine their strength and statistical significance. The statistical tests are based on the survey response values associated with the relevant constructs. Unless otherwise noted, the values represent scores from 1 – 7 on the Likert Scale with 1 = 'strongly disagree', 7 = 'strongly agree', and 4 = 'neither agree nor disagree.' Figure 3 depicts the salient constructs, their operationalized variables, and their interactions as measured in this study.

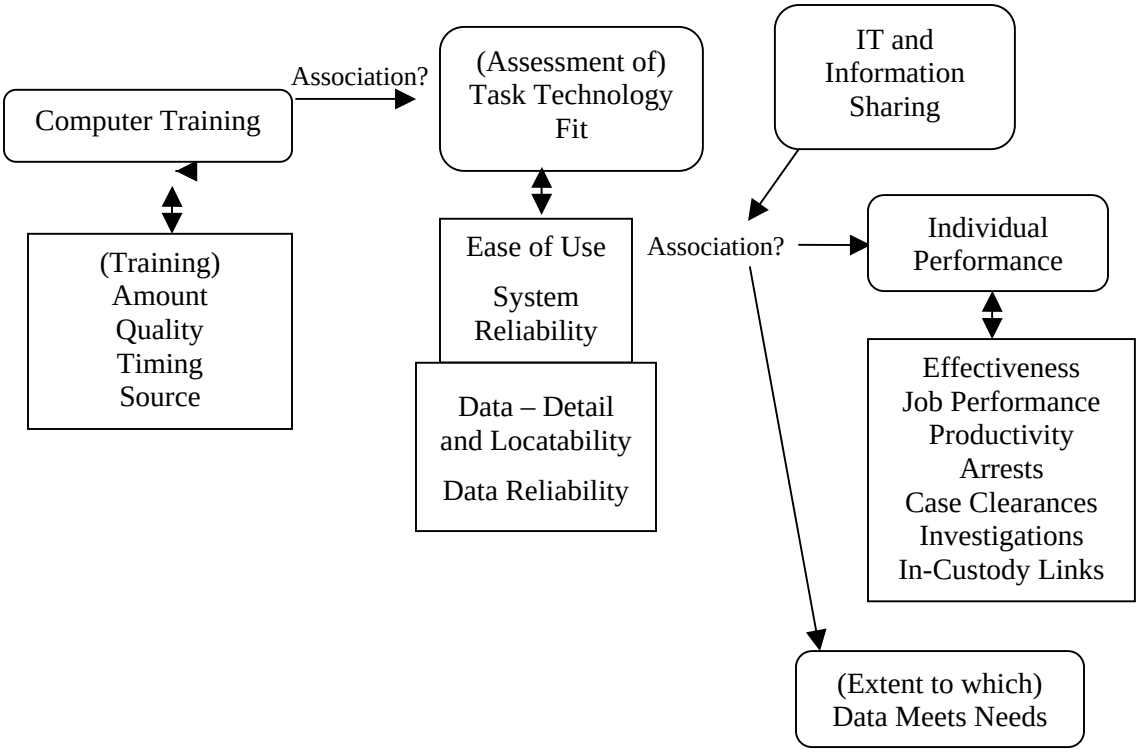

Figure 3 Interactions of Constructs and Variables

This section begins with an overview of statistical analysis of the responses to the research questions. The ANOVA is traditionally used to test whether difference exist in mean scores of independent samples (Smithson, 2000). The ANOVA statistical procedure was used to assess differences in scores by agency (San Diego vs. Comparison agency). The results of the statistical tests are presented in Table 9, below.

Table 9 Statistical analysis (ANOVA) of responses to survey questions

Research Questions	SDSO n	SDSO Mean	SDSO sd	Comp n	Comp Mean	Comp sd	F	*p*
IT and effectiveness	297	5.66	1.18	287	5.41	1.49	5.30	.022*
Info sharing and effectiveness	291	4.94	1.29	285	4.87	1.39	.372	.542
IT and Performance	296	5.90	1.04	287	5.61	1.33	8.28	.004*
Info Sharing and Performance	291	4.89	1.18	285	4.76	1.27	1.71	.192
IT and Individual Productivity Measures	297	4.97	2.69	287	4.47	2.61	5.22	.023*
Info Sharing and productivity	291	4.86	1.22	285	4.64	1.38	4.13	.043*
Computer Assisted Arrests	297	4.88	3.00	287	5.08	3.04	.680	.410
Computer Assisted Case Clearances	297	3.36	2.58	287	2.92	2.46	4.30	.039*
Data Meets User's Needs								
Level of Data Detail	299	4.82	1.33	286	4.54	1.46	5.99	.015*
Data Locatability	299	3.88	1.40	286	4.37	1.36	18.27	.000*
Data Compatibility	298	3.81	1.08	286	3.81	1.10	.000	.982

System's Impact on Effectiveness

This research question seeks to determine the extent to which automation makes law enforcement officers more effective and if there are differences between groups that could be attributable to information sharing technology.

> *Does a difference exist between the San Diego officers and the comparison group officers assessment of the role automation plays in enhancing effectiveness?*

This construct was operationalized by two survey questions as shown below. Question 21 deals with the impact of information technology, in general, on effectiveness, while question 51 deals with the impact of information sharing technology, specifically, on effectiveness.

21. The computer environment has a large, positive impact on my effectiveness and productivity in my job.
51. The information I am able to get (via computer) from other law enforcement agencies makes me more effective.

The ANOVA on question 21 differed by agency, F (1, 582) = 5.31, $p < .05$, indicating a statistically significant difference between groups. Examination of the group means for question 21 reveals that San Diego officers had greater scores (M=5.66, sd=1.18) than Comparison group officers (M=5.41, sd=1.49).

Examination of the means for question 51 shows that San Diego (M=4.94, sd=1.29) had slightly greater scores than Broward (M=4.87, sd=1.39). These scores suggest that both groups of officers 'somewhat agreed' that the information they are able to get from other law enforcement agencies makes them more effective; San Diego scores were slightly more favorable. The ANOVA on question 51 (Table 9) suggests the responses did not differ at a statistically significant level, by agency: F (1, 574) = .372, *ns*. The scores on this question suggest no significant difference between groups in the degree to which the *information from other law enforcement agencies* makes officers more effective.

System's Impact on Performance

This research question seeks to determine whether automation impacts the job performance of law enforcement officers and if there are difference between groups that could be attributable to information sharing technology.

> *Does a difference exist between the San Diego officers and the comparison group officers assessment of the role automation plays in enhancing job performance?*

This construct 'Computing Impact on Performance' was operationalized by questions 21 and 22, which deal with the impact of information technology, in general, on overall performance. The construct 'Impact of Information Sharing on Performance' is operationalized as the composite of the scores for questions 48, 49, and 51, which deal specifically which deal specifically with information sharing and performance.

21 The computer environment has a large, positive impact on my effectiveness and productivity in my job.

22 The computer systems and services are an important and valuable aid to me in the performance of my job.

48 The information I am able to get from other law enforcement agencies is a big help to me in my job.

49 The information I am able to get from other law enforcement agencies makes me more productive.

51 The information I am able to get from other law enforcement agencies makes me more effective.

The ANOVA on 'Computing Impact on Performance' differed by agency, F (1, 581) = 8.28, $p < .01$, indicating a statistically significant difference between groups. The 'direct observations' of the officers support these findings, as indicated earlier, the SDSO officers appeared to rely more on their computer systems in general, to support their job functions and thus job performance.

The ANOVA on 'Information Sharing Impact on Performance' suggests the responses did not differ at a statistically significant level, by agency: F (1, 574) =1.71, ns. The scores on this question suggest no difference between agencies in the officers' perception of the degree to which information sharing affects an officer's job performance.

A significant difference exists between San Diego and the comparison group officers' assessment of the impact of information technology (all available systems) on

job performance, but not on their assessment of the impact of information sharing technology (information sharing systems) on job performance. Both groups of officers feel that information technology has a positive impact on their job performance; San Diego officers had significantly stronger feelings about this. When the questions were modified to apply only to information sharing the responses were not quite as positive for either group and were not significantly different.

Technology and Individual Productivity

The next research question relates to the extent to which information technology improves individual productivity and if there are difference between groups that could be attributable to information sharing technology.

> *Does a difference exist between the San Diego officers and the comparison group officers assessment of the role automation plays in enhancing individual productivity?*

The construct 'individual productivity' was operationalized by combining questions 24 through 29 (below). The underlying concepts for these questions emanated from the work of Danziger and Kraemer (1985) who examined the relationship between computerized data based systems and the productivity of law enforcement officers (Detectives).

Individual Productivity Measures

24 Number of your last ten actively investigated cases or calls handled where you used a computer to gather more information about the call or case

25 Number of your last ten actively investigated cases which would have been unworkable without the use of the computer

26 Number of your last ten arrests which were assisted by computing

27 Number of your last ten arrests which you probably would have not been able to make without the use of computerized information

28 Number of the last ten cases you cleared by arrest or by the investigation of subjects held in-custody which were assisted by computing

29 Number of the last ten cases you cleared which probably would not have been cleared without the use of computerized information

In validating the construct 'Individual Productivity Measures,' the researcher conducted a factor analysis (See 'Factor Analysis' section for details) and found high factor loadings for each question (.512, .619, .804, .736, .828, and .809, respectively). The construct was found to be highly reliable with a Cronbach's Alpha score of .83 for factor 2, 'Individual Productivity Measures.'

Question 49 was included to address the extent to which information sharing makes an officer more productive, as such it has face validity.

49 The information I am able to get from other law enforcement agencies makes me more productive

Examination of the mean scores for 'Individual Productivity Measures' finds San Diego (M=4.97, sd=2.69) with higher scores than the comparison agency (m=4.47, sd=2.61). These scores suggest that the San Diego officers perceive the computer systems as being more helpful in an aggregate of activities related to investigations, case clearances, and arrests. Examination of the mean scores for the responses to the question 'Info from other agencies makes me more productive' indicates that San Diego officers (M=4.86, sd=1.22) also had slightly higher scores than the comparison agency (m=4.64, sd=1.38). These scores suggest that the San Diego officers 'somewhat agree' that information from other agencies (information sharing) makes them more productive, while Comparison agency officers did not agree as strongly.

The analyses reveal that a statistically significant difference between group scores exists. Not only do San Diego officers score significantly higher on 'Individual Productivity Measures,' as mentioned earlier, they more strongly perceive an increase in productivity due to having access to information sharing systems than do the officers in the comparison agency.

Technology and Arrests

The next research question relates to the extent to which information technology assists each group of officers in making arrests.

Does a difference exist between the San Diego officers and the comparison group officers' assessment of the role automation plays in making arrests?

The construct 'Arrests' was operationalized by using a composite score of questions 26 and 27. Danziger and Kraemer (1985) developed and tested these questions as part of their study in which they examined the relationship between computerized data based systems and the productivity of law enforcement officers. These questions, listed below, deal specifically with the extent to which computing assists the officers in making arrests and thus have face validity.

26. Number of your last ten arrests which were assisted by computing

27. Number of your last ten arrests which you probably would have not been able to make without the use of computerized information

Examination of the mean scores for the responses to 'arrests' indicates that comparison agency officers (M=5.08, sd=3.05) reported higher scores than San Diego (m=4.88, sd=3.0). These scores suggest that comparison agency officers perceive computing as assisting in 51% of the arrests that they make while officers in San Diego perceive computing as assisting in 49% of their arrests. Table 9 displays the descriptive statistics for the construct 'arrests.'

These results were unexpected based on the researcher's assumption that a law enforcement agency with access to regional information (i.e., information sharing) would be better equipped to make more arrests and thus would report more arrests. This leads to a critical question of significance. Are the differences in scores significant? While comparison agency officers did have slightly higher mean scores, the ANOVA F (1, 582) =.680, ns (Table 9) reveals that the difference between groups is not statistically significant.

The data presented suggests that computing is perceived as a factor in slightly more than half of the arrests made by officers in the comparison agency and slightly less than half of the arrests made by officers in San Diego. While the mean scores differed slightly between groups, the difference was not significant. This suggests that no difference exists between groups of officers in their assessment of the role automation plays in providing information that directly assists officers in *'making arrests.'* It also implies that the presence of information sharing technology might not make a difference in the number of arrests made by officers, assuming all other things are equal.

Technology and Case Clearances

This research question relates to the extent to which information technology assists each group of officers in clearing cases.

> *Does a difference exist between the San Diego officers and the comparison group officers' assessment of the role automation plays in clearing cases?*

A composite of questions 28 and 29 was used to operationalize the construct 'case clearances.' These questions, listed below, deal specifically with the extent to which computing assists the officers in clearing cases and thus have face validity.

28. Number of the last ten cases you cleared by arrest or by the investigation of subjects held in-custody which were assisted by computing

29. Number of the last ten cases you cleared which probably would not have been cleared without the use of computerized information

These questions were originally developed and tested by Danziger and Kraemer (1985) in their effort to examine the relationship between computerized data based systems and the productivity of law enforcement officers. Table 9 displays the descriptive statistics for the construct 'Case Clearances.' Examination of the mean scores for 'Case Clearances' indicates that San Diego officers (M=3.36, sd=2.58) reported higher scores than the Comparison group (M=2.92, sd=2.46). Extrapolating the results from these scores suggest that San Diego officers perceive computing as assisting in 34% of the crimes they solve (case clearances) while comparison agency officers perceive computing as assisting in 29% of their case clearances. The ANOVA F (1, 582) =4.30, $p<.05$ (Table 9), indicates that this difference between groups is significant.

The data presented reveal that San Diego officers perceive computer systems as being is more of a factor in case clearances. The statistical strength of those data suggests that a difference exists between the groups, suggesting that computing is more instrumental in case clearances in San Diego than in the comparison agency.

Data Meets Officers' Needs

This research question seeks to determine how well the data provided by the available information technology meets the needs of the officers.

> *Does a difference exist between the San Diego officers and the comparison group officers' assessment of the degree to which the data available to them meets their needs?*

To answer this question the researcher used the responses to seven questions (as presented below), which represent three dimensions of Task-technology Fit (Goodhue, 1998) and are related to data. Each of these three dimensions relates specifically to data. Questions 6 & 7 relate to "Level of Detail," questions 8 & 9 relate to [data] Locatability, and questions 14-16 relate to [data] "Compatibility." Goodhue (1998) tested and validated these questions and found them to be highly reliable. Ioimo (2000) tested these questions in a law enforcement environment; he also found them to be highly reliability.

Data meets officers' needs

Level of Detail

6. The data available through the computer systems I use at work is maintained at the appropriate level of detail (quantity) for my group's tasks.
7. Sufficiently detailed information is available through the computer systems I use at work.

Locatability of Data

8. It is easy to find out what information the computer systems maintain or provide access to, on a given subject.
9. It is easy to locate computerized information that I need even if I have not used that information before.

Compatibility of Data

14. Equivalent information from two sources is inconsistent.
15. Difficult or impossible to compare data from two different sources because
16. When it is necessary to compare or consolidate information from different sources I find that there may be unexpected or difficult inconsistencies

Composite scores (mean) for each of the three dimensions relating specifically to data were calculated: Questions 6 & 7 - "Level of Detail", questions 8 & 9 - [data] Locatability, and questions 14-16 - [data] "Compatibility." The analysis of variance

statistical procedure (ANOVA) was used to discern whether variation of the group means around the overall mean exists at a statistically significant level. Table 9 provides the scores for each of the three dimensions.

Level of Detail

Providing data at a level of detail that is consistent with the task is an important aspect of computerized information and a key element of assessing user satisfaction (with the technology). This section tests one aspect of that satisfaction, i.e., level of detail. The mean scores suggest that officers in San Diego (M=4.82, sd=1.34) 'somewhat agree' that the data's level of detail is sufficient for their needs while officers in the comparison agency (M=4.54, sd=1.46) did not feel as strongly about it. Further analysis was conducted using the ANOVA to determine if the differences between the groups are significant. The ANOVA F (1, 583) =11.66, $p<.05$ (Table 9), indicates that a significant difference exists between the groups. The San Diego Officers more strongly agree that the data detail is at the appropriate level for their tasks.

Ease of Locating Data

Officers must have the ability to locate the data they need in a timely manner if they are to be effective. The survey questions addressing this construct seek to determine if officers can easily locate computerized information. The mean scores indicate that officers in San Diego (M=3.88, sd=1.41) 'somewhat disagree' that it is easy for them to locate data, while the scores for the Comparison group officers (M=4.37, sd=1.36) indicate that they 'somewhat agree.' Further analysis was conducted using the ANOVA to determine if the differences in satisfaction between the groups are significant. The ANOVA F (1, 583) = 34.97, $p<.01$, indicates that a significant difference exists between the groups. The data presented suggests that the Comparison group officers are more satisfied with the ease in which they can locate their data.

Data Compatibility

Data compatibility is the third construct related to data and part of Goodhue's (1985) TTF theory. The three questions (14-16) asked whether officers 'agreed' or 'disagreed' that incompatibilities or inconsistencies exist among the data to which they have access. This construct serves to highlight the extent to which data from different sources are consistent among the sources and thus meaningful to the officers.

The mean scores indicate that officers in San Diego (M=3.81, sd=1.08) and officers in the Comparison group (M=3.81, sd=1.10) both 'somewhat disagree' that it is difficult to compare data from different sources or that inconsistencies exist among data from different sources. The scores were remarkably close, suggesting that data compatibility is not a problem for officers from either group. The ANOVA F (1, 582) = .00, $p>.10$, strongly confirms the above and indicates that no significant difference exists between the groups.

In summation, the tests to determine if there exists a difference between groups in the extent to which data meets the officers needs reveal the following. Responses to two of the three dimensions relating specifically to data: questions 6 & 7 - "Level of Detail", questions 8 & 9 - [data] Locatability, suggest that a significant difference exists between the groups. Analysis of the final dimension, 'compatibility,' suggests that neither group

has a problem with data compatibility; no significant difference exists between the groups. The data presented suggests that differences do exist between the groups of officers in the extent to which the data meets their needs. The direction of those differences notwithstanding, there is evidence to suggest that a significant difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.

Computer Training and User-satisfaction with Technology

This research question seeks to determine whether computer training influences an officer's level of satisfaction with technology.

> *Does the amount or the type of computer training influence user-satisfaction with available technology?*

This question does not attempt to compare mean scores between groups (SDSO and Comparison). It seeks to determine whether the level of satisfaction with technology (TTF score) is influenced by 'computer training.' To answer this question the researcher examined the level of satisfaction with technology (mean TTF scores) of the entire population (both the Comparison agency and SDSO), by amount and type of computer training and compares the TTF scores of each level of training to determine if an association exists between different aspects of computer training and TTF score.

Table 10 provides the mean scores of the 'TTF Measure' (level of satisfaction with the technology) for each dimension of training. The ANOVA statistical procedure was used to examine differences in the TTF assessment score by amount and type of computer training received.

Table 12 ANOVA: User Satisfaction (TTF Measure) * Computer Training

	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
Training Hours Received				3	5.58	.001	.028
0	81	4.39	.818				
1-2	188	4.53	.801				
3-10	231	4.74	.775				
11+	81	4.76	.751				
Total	581	4.63	.796				
Amount of Training				1	74.40	.000	.114
Not enough	350	4.41	.793				
About right	231	4.96	.675				
Total	581	4.63	.794				
Timing of Training				3	17.39	.000	.083
Too soon	62	4.32	.742				
About right	300	4.84	.709				
Too late	114	4.37	.801				
N/A	102	4.45	.880				
Total	578	4.63	.796				
Training Quality				3	11.70	.000	.057
Low	101	4.27	.844				
Medium	300	4.67	.756				
High	123	4.86	.723				

	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
N/A	59	4.52	.835				
Total	583	4.63	.794				
Frequency of Training				1	42.59	.000	.069
Not enough	405	4.49	.802				
About right	176	4.94	.684				
Total	581	4.63	.795				
Source of Training				2	2.75	.065	.009
Self	326	4.57	.841				
Co-Worker	227	4.69	.714				
Other	24	4.88	.809				
Total	577	4.63	.795				
Hours of Self Training				3	.345	.793	.002
0	15	4.68	.858				
1-2	167	4.67	.790				
3-10	175	4.58	.798				
11+	224	4.63	.796				
Total	581	4.63	.795				

The 'Computer Training' questions used in this study are outlined below; they were borrowed from Northrop et al. (1995), with minor modifications. These questions assess the level of computer training received and the user's satisfaction with that training.

Hours of formal training: ☐ 0 ☐ 1-2 ☐ 3-10 ☐ 11 or more

33. Amount of training: ☐ Not enough ☐ About right ☐ Too much

34. Timing of training: ☐ Too soon ☐ About right ☐ Too late ☐ N/A

35. Quality of training: ☐ Low ☐ Medium ☐ High ☐ N/A

36. Frequency of training: ☐ Not enough ☐ About right ☐ Too much

37. Main source of computer training: ☐ Self ☐ Co-worker/supervisor ☐ Other

38. Hours of self training: ☐ 0 ☐ 1-2 ☐ 3-10 ☐ 11 or more

Training Hours Received

The mean average score for the 'TTF Measure' is 4.39 for respondents who report "0" hours of training and 4.76 for respondents who report "11+" hours of training. The mean scores show that the level of satisfaction with the technology (TTF Measure) increases with the number of training hours received. The ANOVA (Table 10) suggests a significant difference in 'TTF Measure' scores among groups of 'Training hours received,' $F(3, 577) = 5.58$, $p < .01$.

The ANOVA Post Hoc procedure was used to determine the source of the significant *F-value*. The scores on the 'TTF Measure' differed significantly between respondents who received no training ('0' hours) and those who received from three to 10 hours of training, and more than 11 hours of training. The significance levels for these

groups were p<.01 and p<.05 respectively. This suggests a significant difference in user satisfaction with technology between those with no training and those with three or more hours of training.

Amount of Training

The mean average score for the 'TTF Measure' is 4.96 for respondents who report that the amount of training was 'about right' and 4.41 for respondents who report that the amount of training was 'not enough.' The mean scores suggest that the level of satisfaction with the technology (TTF Measure) is greater for respondents who felt that the amount of training was adequate. The ANOVA (Table 10) indicates a significant difference in 'TTF Measure' scores among groups (Amount of training), F (1, 579) =74.40, p<.01. This suggests that officers who felt that the amount of training was adequate were also more satisfied with the technology in general.

Timing of Training

The mean average score for the 'TTF Measure' is 4.84 for respondents who felt that the timing of the training provided was "about right,' 4.32 for those who felt the training was given 'too soon,' 4.37 for those who felt the training was given 'too late,' and 4.45 for those who checked N/A. These scores indicate that user-satisfaction (TTF Measure) is greater for those who felt that timing of the training was 'about right' than for all others. The ANOVA (Table 10) suggests a significant difference in 'TTF Measure' scores among groups (Training hours received), F (3, 574) =17.39, p<.01.

The ANOVA Post Hoc procedure was used to determine the source of the significant *F-value*. The scores on the 'TTF Measure' differed significantly between respondents who felt that the timing of the training provided was 'about right' and all others. The significance levels for "about right' is <.01 and ns for all others ('too soon,' 'too late' and 'N/A'). This suggests that officers who felt that the timing of the training was adequate were also more satisfied with the technology in general.

Training Quality

The mean average score for the 'TTF Measure' is 4.27 for respondents who felt that the quality of the training provided was 'low,' 4.67 for those who felt the quality of the training provided was 'medium,' 4.86 those who felt the quality of the training provided was 'high,' and 4.52 for those who checked N/A. These scores suggest that the user-satisfaction (TTF Measure) is greater for those who have positive feelings about the quality of the training. The ANOVA (Table 10) suggests a significant difference in 'TTF Measure' scores exist between groups (Training quality), F (3, 579) =11.70, p<.01.

The ANOVA Post Hoc procedure revealed that the scores on the 'TTF Measure' differed significantly between respondents who felt that the quality of the training provided was 'low' and those who felt that it was 'high' or 'medium.' The significance levels for the difference between 'low,' and 'high' or 'medium' is <.01. This suggests that officers who felt more positive about the quality of the training were also more satisfied with the technology in general.

Frequency of Training

The mean average score for the 'TTF Measure' is 4.49 for respondents who felt that the training frequency was 'not enough' and 4.94 for those who felt the frequency of the training was 'about right.' These scores suggest that user-satisfaction (TTF Measure) is greater for those who are satisfied with the frequency of the computer training received. The ANOVA (Table 10) indicates a significant difference in 'TTF Measure' scores between groups (Frequency of Training), $F(1, 579) = 42.59$, $p < .01$. These results suggest that officers who felt more positive about the frequency of the computer training were also more satisfied with the technology in general.

Source of Training

The mean average score for the 'TTF Measure' is highest (4.88) for those who identified the main source of computer training as 'other.' The next highest score was for those who identified 'co-worker' as the main source of training (4.68). The lowest score 'TTF Measure' score (4.57) was provided by respondents who identified themselves as the main source of computer training. The ANOVA (Table 10) suggests no significant difference in 'TTF Measure' scores exists among groups (Source of Training), $F(2, 574) = 2.75$, ns. These findings suggest that the source of computer training does not appear to be associated with user-satisfaction with the technology (TTF Measure).

Hours of Self Training

The mean average score for the 'TTF Measure' is 4.68 for respondents who report "0" hours of self training and 4.63 for respondents who report "11+" hours of self-training. The ANOVA suggests no significant difference in 'TTF Measure' scores exists among groups (Self-Training hours), $F(3, 577) = .345$, ns. These findings suggest no relationship between the amount of computer self-training and user satisfaction with the technology (TTF Measure).

To examine the strength of the association, or relationship, between scores for TTF Measure and groups within the training variables, the Eta^2 was used. Eta^2 reflects the proportion of variation in the dependent variable (TTF Measure) accounted for by the differences among groups. Eta^2 has an advantage over R^2 because it does not assume linearity, which makes it appropriate for this dataset.

The strength of the association is weak for all variables with 'amount of training' being the strongest, $Eta^2 = .114$. This score, for example, suggests that the differences between the amounts of training received, account for only 11% of the variation in user satisfaction (TTF Measure scores). The next highest is 'training timing,' $Eta^2 = .083$, which suggests that the differences between the users' assessment of the timing of the training account for only 8.3% of the variation in TTF Measure scores. The remainder of the variables, 'training hours,' and 'training quality' and 'training frequency,' while significant ($p > 05$), are weakly associated, having Eta^2 scores of .028, .057, .069, respectively.

The data suggest that scores for 'TTF Measure' differed significantly among groups within each the following training variables: 'training hours,' amount of training,' training timing,' training quality,' and 'training frequency.' While statistically significant, the strength of the relationships between the training variables and scores for 'TTF Measure' are weak. These results suggest that the existing significant relationship

appears limited in light of the low Eta^2 scores and may indicate a need for further delineation of the variables in question.

FINDINGS

This section presents a synopsis of the findings. It begins with an overview of the findings for each research question (Table 11). Next, an overview of the quantitative results are presented, followed by a brief discussion of the qualitative findings. Finally, the quantitative and qualitative are synthesized to provide a multidimensional overview of the analysis and results for each research question.

Table 14 Summary of Results

Research Questions	Results
Does a difference exist between the info-sharing group and the comparison group's assessment of the impact of information technology on *individual effectiveness*?	The info-sharing group scores were significantly higher re. the impact of information technology on *individual effectiveness.* No difference was found between group scores re. the impact of information sharing on *effectiveness.* The qualitative data support the existence of an association between information sharing technology and individual effectiveness.
Does a difference exist between the info sharing and comparison group's assessment of the role automation plays in enhancing *individual performance*?	The info-sharing group scores were significantly higher re. the impact of information technology on *individual performance.* No difference was found between group scores re. the impact of information sharing on *performance.* The qualitative data support the existence of an association between information sharing technology and individual performance.
Does a difference exist between the info sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity*?	The significantly higher info-sharing group scores suggest they believe more strongly that their information technology has an impact on *individual productivity.* A significant difference was found between group scores re. the impact of information sharing on *individual productivity.* The qualitative data support the existence of an association between information sharing technology and individual productivity.
Does a difference exist between the info sharing and comparison group's assessment of the role automation plays in providing information, which directly assists officers in *making arrests*?	No significant difference was found between groups scores in the number of arrests made which were assisted by information technology. The qualitative data failed to support the existence of an association between information sharing technology and the number of arrests an officer makes.
Does a difference exist between the info sharing and comparison group's assessment of the role automation plays in providing information, which directly assists officers in *clearing cases*?	The info-sharing group scores were significantly higher than the comparison group, suggesting that information technology plays a role in clearing more cases. The qualitative data support the existence of an association between information sharing technology and the potential for case clearances.

Research Questions	Results
Does a difference exist between the info sharing and comparison group's assessment of the degree to which the data available to officers meets their needs?	A significant difference was found between group scores. The info-sharing group believed more strongly that information was at the proper level of detail: the comparison group believed more strongly that information was easier to locate. The qualitative data support the existence of a difference in attitude between groups of officers in their level of satisfaction with the available data. The SDSO officers expressed a higher degree of satisfaction with the data and attributed much of that to the information sharing technology.
Does the amount or type of computer training influence user satisfaction with available technology?	A positive and significant association was found between: 'amount,' 'timing,' 'quality,' 'frequency' of training, 'number of training hours and user-satisfaction with technology as represented by TTF scores. The strength of the association was weak for all training categories. The qualitative data offer little information to support any association between information sharing technology and an officer's level of satisfaction with technology. It did find that officers were displeased with computer training in general and that they devised methods to learn 'on-the-job' through informal consultancy training.

Information Sharing and Effectiveness, Performance

- A significant difference exists between the info-sharing group (officers with access to automated regional information sharing technologies) and the comparison group's (officers without access to automated regional information sharing technologies) assessment of the impact of information technology on individual effectiveness.
- A significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual performance.

Quantitative results

The existence of a significant difference between groups (San Diego vs. Comparison officers), suggests that San Diego officers perceive computing, in general, as playing a greater role in making them more effective and in improving their performance. These findings receive support from the literature. There exists an "underlying notion" that improving systems in policing would lead to greater effectiveness (Nunn 2001, p.2).

Another question important to effectiveness is whether the differences between groups mentioned above, could be related to the presence of information sharing technology. Additional questions, developed and validated as part of this study, test this notion. Analysis of Variance (ANOVA) tests of the responses to these survey questions indicate no significant differences between groups in the degree to which officers

perceive *information sharing technology* as contributing to individual effectiveness or performance.

What does all of this mean? San Diego officers perceive their overall computing environment as playing a greater role in making them more effective and in improving their performance. It is important to note that the information sharing technology is but one part of the overall computing environment. Further tests revealed that the presence of information sharing technology does not appear to make much of a difference in perception between groups when it comes to performance and effectiveness. There is evidence to suggest that the information sharing technology is not the reason that San Diego officers perceive their overall computing environment as playing a greater role in making them more effective and in improving their performance.

Qualitative results

Direct Observation: The direct observations of both groups of officers using computers during their tours of duty suggest that San Diego officers make greater use of their computers. "Routine usage" is among the elements of computer usage cited in the literature as important to productivity gains; workers will derive greater benefit from a computer system if they routinely rather than selectively use the system (Danziger and Kraemer, 1985).

The observations also suggest that the San Diego officers use and rely on information sharing technology (ARJIS) as well. However, ARJIS is but one aspect of overall system usage. This could explain the San Diego officers' attitudes regarding its contribution to their effectiveness and performance.

Interviews: Interviews revealed a pattern of computer usage. Officers from San Diego felt that they use their computers more than the Comparison group officers do. The biggest difference was for usage estimated at 6 hours or more per day. Of the San Diego Officers, 78 % reported an estimated 6+ hours of daily usage compared to 30% of the Comparison group officers. If the extent of system usage is important in increasing the benefits of computing to work performance, as Danziger and Kraemer's work (1985) suggests, the interview results support a possible link between information sharing technology and both effectiveness and performance.

Effectiveness and Performance Summary:

Do differences exist between groups of officers in their assessment of the impact of information technology on individual effectiveness and performance? If so, is it due to the existence of automated regional information sharing technologies or differences in information technology (in general) between agencies?

Two concepts are important in answering these questions: differences in perception of the impact of information technology in general (all information technology) and differences in perception of the impact of information sharing technology (specific technology). Quantitative and qualitative findings are in agreement regarding the differences between groups in their assessment of the impact of information technology in general on individual effectiveness and performance: San Diego officers believe the technology is of greater value to them. The findings do not agree regarding the differences between group assessment of the impact of information sharing

technology on individual effectiveness and performance. The qualitative findings (observations and interviews) suggest that information sharing technology does contribute more to individual effectiveness and performance in San Diego while the quantitative findings suggest that it does not.

Information Sharing and Productivity

- A significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity*.

Quantitative results:

A significant difference in responses between groups suggest that San Diego officers perceive computing as playing a greater role in making them more productive. The scores also suggest that the San Diego officers perceive the computer systems as being more helpful in an aggregate of productivity measures (activities related to investigations, case clearances, and arrests). Not only do San Diego officers score significantly higher on these productivity measures, related to systems in general, they more strongly perceive information sharing as being a factor in making them more productive than do the officers in the Comparison group.

Qualitative results

Direct Observation: The San Diego officers spent a great deal more time on their computers and were able to accomplish more with their computers. To that extent, they were more productive. Being able to access the regional information sharing system, whether it is from a district station or a satellite office, appears to contribute to officer-productivity. The comparison group officers have to make telephone calls to gather much of the same type of information that San Diego officers can get via the information sharing system. It was obvious that the technology enabled the San Diego officers to do more.

Interviews: The interview findings offer indirect support. San Diego officers were more pleased with the amount and type of information they receive, especially in the form of information sharing. Prior research supports these findings. Productivity gains by law enforcement officers have been linked to computerized information and the use of information technology (Danziger & Kraemer 1985, Nunn 2001).

Productivity summary:

The quantitative and qualitative findings suggest that there is a difference between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual productivity. The ANOVA found significant differences between groups in aggregate productivity measures (arrests, clearances, and investigations). The results also reflect significant differences between group assessments of the impact of information sharing technology on productivity. The qualitative findings support these results; the San Diego officers use the systems to engage in the kinds of activities that support these productivity measures. During the interviews, the San Diego officers were quicker to extol the virtue of information sharing technologies and their importance to them in doing their jobs. In other words, it is not the information technology in general

that makes a difference in productivity, it is the inclusion of information sharing that appears to be largely responsible for this difference.

Information Sharing and Arrests

- No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in providing information, which directly assists officers in making arrests.

Quantitative results:

Statistical analysis (ANOVA) tests results are contrary to what was expected. The Comparison group officers perceive computing as assisting in 51% of the arrests while officers in San Diego officers perceive computing as assisting in 49% of their arrests; the differences were not significant.

Qualitative results: No support

Direct Observation: Both groups of officers use the types of computer systems that provide information in support of on-site or immediate arrests. The Comparison group officers use this type of system more exclusively than San Diego officers do. This could explain the slightly higher score reported by Comparison group officers. It is however, easy to understand why the difference between groups is not significant since both agencies have access to and use similar systems, which more directly support on-site or immediate arrests.

The management accountability system in place at the Comparison group agency is a variable that appears to impact performance. This management tool causes the officers to focus their efforts in areas that could produce measurable outcomes and outputs (i.e., arrests, clearances, and crime rates) with or without the support of information technology. Variables of this nature deserve further study as they have received little attention in the literature within the context of the impact of information technology in law enforcement.

Interviews: The interview findings reinforce the observations. Little difference between groups was noted in their responses to questions relating to the use of systems that support arrests.

Arrest summary:

The types of systems that support on-site or immediate arrests are available to both groups of officers and both use these systems for the same purpose. Both groups of officers believe information technology provides information that directly assists them in making arrests – no significant difference exists between groups.

What is troublesome about these results is the arrest statistics for the past three years. Comparison group officers made significantly more arrests[4] each year - from 2000 through 2002 - than their counterparts in San Diego, technology notwithstanding (UCR, 2000 – 2002). The opposite should be true if information sharing technology played a

[4] Refers to arrests per 1,000 population; Arrest data obtained from each agency's UCR records. Population data was obtained from each agency. It pertains to the population of the areas for which the agency is responsible for providing law enforcement services.

significant role in arrest rate. The arrest statistics only speak at absolute numbers and do not address other important variables such as type and quality of arrests, etc. The qualitative findings offer the best clue; the difference could be due to the management philosophy and the performance management imperative in place at the Comparison agency. This performance management imperative mandates a different type of policing by Comparison group officers, which causes them to focus their energy more on outcomes and outputs. This difference in managerial climate - the presence of the performance management imperative - between groups seems to offer a better explanation than any differences in technology. This finding serves to illustrate a weakness in studies relying solely on an overall user-satisfaction or TTF assessment to examine the impact of information technology on different aspects of performance. It makes a good case for the use of objective and subjective measures of performance and the triangulation of methodologies.

Information Sharing and Case Clearances

- A significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in providing information, which directly assists officers in clearing cases.

Quantitative results:

Both groups of officers felt that information technology assisted them in clearing cases (solving crime). San Diego officers perceive computing as assisting in 34% of the crimes they solve (case clearances) while Comparison group officers perceive computing as assisting in 29% of their case clearances. The statistical tests (ANOVA) indicate a significant difference between groups, suggesting that San Diego officers do perceive computing as playing a greater role in case clearances.

Qualitative results:

Direct Observation: Both groups of officers use their computers to gain information that can help them to clear cases. Many of the SDSO officers attributed case clearances to ARJIS, suggesting that access to regional information played a prominent role in their ability to clear cases. That logic is sound, given that ARJIS supports investigative efforts more than most of the other available systems. The San Diego officers use ARJIS throughout their tours of duty. In addition, since investigations are the key to case clearances, one would expect this technology to offer greater assistance in that area. Comparison group officers, without this kind of technology, are at a disadvantage in terms of having technology that supports case clearances.

Interviews: Comparison group officers emphasized the use of systems that provide information leading to arrests but do not necessarily solve crime or clear cases. The emphasis of the SDSO officers was on checking the background information of people and using the information sharing system. The latter functions tend to support investigative efforts aimed at clearing cases. Responses to the interview questions also suggest that San Diego officers are obtaining and utilizing more information from other agencies; this type of information supports investigations and thus case clearances

Case clearance summary:

San Diego officers clearly have access to more automated information, which supports solving crime (clearing cases). They also actively use these systems in the course of their jobs. The logic that this should lead to more computer assisted case clearances in San Diego is reinforced by the San Diego officers' perception that their systems do give them an upper hand in case clearances. Prior research supports these findings; case clearances have been linked to computerized information (Danziger and Kraemer 1985, Northrop et al. 1995, Nunn, 2001).

Although the evidence suggests that the information technology in San Diego offers greater support for case clearances, as compared to the Comparison group's technology, the crimes statistics do not mirror these findings. For the three-year period 2000 - 2002, the clearance rates for violent crime were not significantly different between groups while the clearance rates for property crime were significantly greater for the Comparison group. This difference suggests that variables other than computers contribute to case clearances. One of those variables could be differences between groups in how cases are cleared. In addition, computers might still assist San Diego officers in more of their cases clearances, but the *performance management imperative* could be the driving force behind higher clearance rates for property crime by the Comparison group.

Data Meets the Officers' Needs

- A significant difference exists between SDSO and the Comparison group's assessment of the degree to which the data available to officers meets their needs.

Quantitative results:

The statistical test (ANOVA) results support the fact that San Diego officers and Comparison group officers do not share the same level of satisfaction with the degree to which the data meets their needs. The two dimensions on which they differ are 'level of detail' and 'locatability'. Officers from San Diego felt more strongly that their data is at the appropriate level for their tasks, while the Comparison group officers felt that it was easier for them to locate the data that they needed. Neither group had any concerns with compatibility of data obtained from different systems.

Qualitative results:

Direct Observation: The most important aspect of the observations was the extent to which the officers used the systems and data available, especially ARJIS. To locate the information that they needed, the San Diego officers often went to a number of systems including ARJIS. The Comparison group officers used fewer systems but had to rely on phone calls or personal contact to gather information from other agencies. San Diego officers have access to more online information but have more difficulty in locating the automated information that they needed – at times moving from system to system. Comparison group officers have access to less automated information, which appears to be a factor in making it easier to find.

Interviews: The San Diego officers expressed a greater degree of satisfaction with the information that they are able to get as well as the usefulness of that information, especially from outside agencies.

Data Meets Needs summary:

The San Diego officers clearly enjoy access to a greater amount of automated information, especially information from other law enforcement agencies. They are also more satisfied with the information they are able to get and feel that it helps them more. However, their counterparts in the Comparison group felt that it was easier for them to find the information they were looking for when using automated systems.

This leaves more unanswered questions. Does access to more automated information naturally result in greater difficulty in finding information? Could the fact that the ARJIS system is not integrated with other internal systems increase the effort, and thus difficulty in going from one system to another to find information? Do these results suggest that systems integration should accompany information sharing among agencies to make data easier to locate? Is this more of a training issue?

Training and User-Satisfaction

- The amount and type of computer training influences user satisfaction (TTF score) with available technology.

Quantitative results:

The ANOVA test statistic revealed that user-satisfaction scores differed significantly among groups within each the following training variables: 'training hours,' 'amount of training,' 'training timing,' 'training quality,' and 'training frequency,' but the strength of the relationships between these training variables and scores for 'TTF Measure' are weak. These findings suggests that user-satisfaction (with available technology) is significantly but weakly associated with the amount or type of computer training received.

Qualitative results:

Direct Observations: The observations suggest that both agencies provide very little formal computer training. Many of the computer-savvy officers spent time assisting other officers and actually showing them how to use the systems. These findings suggest the strong presence of an informal, unstructured training program, which the officers themselves did not appear to recognize as a training modality at all.

Interviews: The officers from both agencies were dissatisfied with the amount of computer training received. Both groups thought that information needed to be easier to retrieve which could be a sign of either a lack of training or complexity of use.

Computer Training and User Satisfaction summary:

Is there a relationship between the computer training received and user-satisfaction with the technology (operationalized as assessment of TTF)? The quantitative findings suggest significant differences in TTF test scores associated with the training variables: 'hours,' 'amount,' 'timing,' 'quality,' and 'frequency.' While the relationships are weak, the qualitative analysis informs these findings and suggests that the significance, mentioned above, could be meaningful in the final analysis.

The presence of an informal, unstructured, training modality could be a factor in the weak but significant relationship between training and satisfaction with the

technology (TTF assessment). Because the officers themselves do not recognize this (informal training) as 'legitimate,' it could be unaccounted-for in their responses to the surveys. In other words, even though officers are getting this ad-hoc training, which could positively influence their TTF assessment, they do not account for it in their responses to the training questions on the survey. Thus, their training scores are lower than they should be which could make a difference in the strength of association with TTF satisfaction.

Prior research offers mixed support for these conclusions. Montazemi (1988) suggests that better trained individuals will perceive systems more favorably and will result in higher system evaluations. Delone (1988) conducted similar research, which did not support Montazemi's findings. Lakhanpal (1988) discussed the importance of consultancy-oriented training, which is similar to the informal training observed during the direct observation portion of this dissertation. Northrop et al. (1995) suggest a relationship between computer training and usage. Their results were similar to the findings in this study; the correlation was statistically significant but weak. Northrop et al. (1995) did not examine the influence of informal training.

The findings lead to a number of unanswered questions. Is there a minimal level of training that enables people to use systems on their own? Does a certain amount of on-the-job training make users proficient? Does informal training influence a user's satisfaction with the technology? Would the users in this study be less satisfied with the technology (TTF assessment) without it? Why do users see this consultancy training simply as assistance and not part of training? Is this concept of consultancy training a valid form of training, if so, how can its impact be assessed?

Limitations

Naturally occurring differences between agencies could influence the results of this study. The salient differences discovered during this study are:

- *Amount of computer usage* – The Comparison group patrol officers more strictly adhere to agency policy restricting mobile computer usage to when the patrol vehicle is not moving; their counterparts in San Diego used the computers freely when the vehicle was moving. This could be an influencing factor in the difference in usage reported by the patrol officers of both agencies.
- *Differences in information systems* - This study attempted to discover whether the officers' perception of the technology available differed between agencies and if differences were related to the presence of information sharing technology. Given the number and wide variety of information systems in use in law enforcement today, it is difficult if not impossible to find two large and complex Sheriff's Offices, such as those that were part of this study, with exactly the same computing environment. To control for these differences, survey questions specific to information sharing were used, certain interview questions focused on information sharing technology, and the direct observation looked for differences in usage related to information sharing technology.
- *Management culture and accountability* – Differences in management culture, especially the use of the management accountability program, influences the

policing methods of the street level officers in the Comparison agency. These differences appear to result in different outputs (i.e., arrests and clearances) between agencies, technology notwithstanding.

- *Uniform Crime Statistics* – Officers exercise a degree of subjective judgment in classifying crime and clearances. Differences in judgment and practices between groups could be a factor in UCR crime statistics.

It is difficult to associate direct measures of productivity and performance to information technology. Therefore, a significant portion of this study relies on user perception and self-reported data in lieu of actual performance measures. The accuracy of self-reporting is always an issue. While user perception and self-reporting (i.e., user evaluations) are considered acceptable methods for gathering this type of data (Danziger and Kraemer 1985; Goodhue and Thompson 1995; Nunn and Quinet, 2001) other research suggests that a disconnect exists between perception and reality (Rocheleau, 1993; Ioimo, 2000). Over the years, scholars have tried, but have not been able to resolve this problem (Treacy, 1985; Joshi, K., Perkins, W. & Bostrom, P.,1986; Melone, 1990; Goodhue, 1995).

POLICY IMPLICATIONS AND LESSONS LEARNED

Information Sharing and Performance

Government emphasis on anti-terrorism in this new millennium has provided the impetus for the move toward automated information sharing among law enforcement agencies (U.S. Senate, 2001). Unfortunately, empirical data establishing a link between information sharing and performance in the law enforcement environment is either extremely difficult to find or non-existent. This study takes a step in filling a gap in the literature by developing and validating 'information sharing' as an operationalized construct. It also associates this information sharing to quantitative measures of performance in the form of outputs i.e., investigations, arrests, and clearances, and in doing so, it established an important link between information sharing and certain aspects of productivity of street level officers.

- Post-implementation evaluation is an important aspect of gauging the success of information sharing technology modalities. Identifying and standardizing on the most effective information sharing technologies for use in local law enforcement can more readily be accomplished through the development of post-implementation technology assessment strategies.

Information Sharing and Data Locatability

- The findings of this study suggest that information sharing provides officers with a great deal of information to which they would not otherwise have access. Unfortunately, these officers have more difficulty locating the information they need. When implementing information sharing technologies, officials should obtain sufficient input from the street level officers or other users to ensure that the system delivers only the information appropriate to their tasks.
- These results suggest that it is not enough to share information among agencies. This sharing should occur in conjunction with systems integration across the enterprise, which could make data easier to locate. Greater emphasis should be placed on efficient methods of aggregating and delivering the information in order to overcome the problems of locating data.
- Future research should closely examine the problems associated with officers' inability to locate data in an information-sharing environment. The literature suggests two areas in which this search should focus; they are information overload (Simon, 1997; McCune, 1998) and non-integration of systems (Northrop, Kramer, and King, 1995; Brown, 2001).

Information Technology and Management Climate

The findings suggest no significant difference between groups in their assessment of the role automation plays in providing information that directly assists officers in making arrests. Taken at face value, it could lead the reader to believe that the presence of information sharing technology does not make a difference in number of arrests made. The qualitative findings suggest a different conclusion. The presence of the performance management imperative makes a difference in the way officers in the Comparison group

work. It suggests an alternate explanation for the differences between agencies in the number of arrests and clearances.

- Technology is not an end in itself; it simply facilitates process. Organizational variables such as the presence of the performance management imperative should, when coupled with effective information technology, result in improved individual and organizational performance.
- Policy makers should consider the adoption of performance measures as part of the process reengineering necessary for the diffusion of technology within an organization.

Officer Safety and Information Technology

This study discovered a potential link between the availability of automated information and officer safety. The San Diego officers were unequivocal in their belief that the information systems contribute to their personal safety; many officers attributed this measure of safety directly to ARJIS, the information sharing technology. The findings of this research suggest that officer safety is an aspect to consider in law enforcement information systems development and deployment. Public safety officials should begin to look more closely at the information delivered by these technologies and the policy implications beyond arrests, clearances, and crime rates.

If the officers interviewed are correct about the link between officer safety and information technology, what system-attributes or data contribute the most? Does information sharing really enhance officer safety? Future research should operationalize the construct 'officer safety' using qualitative and quantitative methods. Areas of inquiry should include variables such as the number of officers injured, assaulted, or killed, and the number of accidents in vehicles with computers verses those without.

- While additional empirical data is necessary to demonstrate a relationship between officer safety and specific information technology attributes, this study can serve as a primer for law enforcement officials to begin considering officer safety when making information technology-purchasing decisions.

Computer Training and User-satisfaction with Technology

Even though officers from both agencies report getting a similar amount of training, officers from SDSO are less satisfied with the amount of training. This could mean that the more elaborate systems, such those that provide information sharing, require a greater commitment of computer training for its officers. The lack of computer training is an issue for officers in both agencies: the results suggest that computer training is significantly but weakly associated with user-satisfaction.

The presence of informal consultancy training could make a difference in user-satisfaction with technology. Although more research is necessary to determine if this is true, the presence of this informal training suggests that the street level officers are attempting to fill the training void on their own volition. Policy makers might be able to bolster computer training and make it more efficient by formally recognizing the existence of this informal training and providing the 'trainers' with additional recognition, status, reward, etc.

User-satisfaction and Other Information Sharing Technologies

This study examined the implications of using one type of information sharing technology on the performance of law enforcement officers. Law enforcement agencies are beginning to adopt different forms of information sharing technologies. Advances in technology should make these systems more robust, enhancing their potential to impact law enforcement processes. The opportunity to improve the performance of officers will increase as these information-sharing systems are developed and implemented. As new systems are deployed in the field, further research opportunities will exist to assess the impact of the different information sharing technology systems across agencies types.

Accessibility to ARJIS Data

At the time of this study, ARJIS data was not accessible to SDSO officers via the mobile computers. SDSO patrol officers frequently stopped at satellite offices in the communities they patrolled to use ARJIS. The officers viewed the availability of ARJIS, via these satellite offices, as very positive. This unique way of providing ARJIS to patrol officers proved to be beneficial to the officers in the performance of their jobs and should be considered for use by other agencies where in-car access is not feasible.

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[MJZ1]Cite the ARJIS web site as a source for this
[MJZ2]Review this section