FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

ASSESSING AN AUTOMATED, INFORMATION SHARING TECHNOLOGY IN THE POST "9-11" ERA - DO LOCAL LAW ENFORCEMENT OFFICERS THINK IT MEETS THEIR NEEDS?

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

PUBLIC ADMINISTRATION

by

Martin J. Zaworski

2004

To: Dean Ronald M. Berkman
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This dissertation, written by Martin J. Zaworski, and entitled Assessing an Automated Information Sharing Technology in the Post "9-11" Era - Do Local Law Enforcement Officers Think It Meets their Needs?, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

I dedicate this dissertation to my wife Regina whose patience, understanding, and unwavering support have enabled me to accomplish this formidable task: to my children, Tina, Marty, and Chris for their subtle but obvious "knowing" that I could do this. To my very close friend Martin, whose belief in me and whose frequent words of encouragement helped me to reaffirm my belief in myself during the more trying times. Finally, to my mother Marie, whose daily prayers for my success provided me with help from a greater power.

ACKNOWLEDGMENTS

I would like to thank my committee members for their support, assistance, and encouragement during this journey. Dr. James D. Carroll, my committee chair, provided the oversight and guidance to help me stay focused on the 'big picture.' Dr. Lance Dehaven-Smith was my sounding board in formulating the topic and general direction of this dissertation. Dr. Dian Weddle, whose expertise from outside of the Public Administration discipline was particularly helpful in providing a fresh perspective and helping me to clarify many of the more detailed aspects of the dissertation. Finally, my special thanks to Dr. Howard Frank for giving unselfishly of his time and for being my mentor and guide along the way. Dr. Frank planted the seed and encouraged me to apply for the Ph.D. program: without him, I would not be on this path.

I also wish to thank the following people affiliated with the National Institute of Justice (NIJ). Dr. John Hoytt, former NIJ program manager, for his interest in the topic of this dissertation and for his assistance in getting NIJ sponsorship and support. Mr. Richard Baker, Program Manager at the Space and Naval Warfare Systems Command, US Department of Defense, for his support and assistance as part of the NIJ sponsorship. Sara Hoback, working on behalf of the NIJ, for her efforts in facilitating and coordinating activities with the San Diego County Sheriff's Office and for her field assistance during this study.

Finally, I would like to thank the law enforcement officials who helped to make this study a success. Mrs. Pam Scanlon, ARJIS Program Manager (San Diego Police

Department), for sharing her insights, and providing assistance in San Diego. From the San Diego County Sheriff's Office, Commander Robert Apostolos, for his work in coordinating this effort, and for ensuring cooperation from police officers in the field. My thanks to Sheriff Ken Jenne and Under-Sheriff Tom Carney, from the Broward County Sheriff's Office, for granting permission to use BSO as a site. And to Major John Carroll, for his work in coordinating the BSO activities. In closing, I would also like to acknowledge the police officers from both agencies who completed surveys, participated in interviews and allowed the researcher to observe them in their work environment.

ABSTRACT OF THE DISSERTATION

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by

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In the wake of the "9-11" terrorists' attacks, the U.S. Government has turned to information technology (IT) to address a lack of information sharing among law enforcement 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 law enforcement officers who have access to automated regional information sharing and those who do not. It also examined the effect of potential intervening variables such as user characteristics, training, and experience, on the officers' evaluation of IT. The sample was limited to 588 officers from two sheriff's offices; one of them (the study group) uses information sharing technology, the other (the comparison group) does not. Triangulated methodologies included surveys, interviews, direct observation, and a review of agency records. Data analysis involved the following statistical methods: descriptive statistics, Chi-Square, factor analysis, principal component analysis, Cronbach's Alpha, Mann-Whitney tests, analysis of variance (ANOVA), and Scheffe′ post hoc analysis.

Results indicated a significant difference between groups: the study group perceived information sharing technology as being a greater factor in solving crime and in increasing officer productivity. The study group was more satisfied with the data available to it. As to the number of arrests made, information sharing technology did not make a difference. Analysis of the potential intervening variables revealed several remarkable results. The presence of a strong *performance management imperative* (in the comparison sheriff's office) appeared to be a factor in case clearances and arrests, technology notwithstanding. As to the influence of user characteristics, level of education did not influence a user's satisfaction with technology, but user-satisfaction scores differed significantly among years of experience as a law enforcement officer and the amount of computer training, suggesting a significant but weak relationship.

Therefore, this study finds that information sharing technology assists law enforcement officers in doing their jobs. It also suggests that other variables such as computer training, experience, and management climate should be accounted for when assessing the impact of information technology.

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CHAPTER 1
INTRODUCTION

The first section of this chapter provides an overview of the research problem, followed by the research question. Sub-questions, included to clarify the research problem, provide a foundation for the development of hypotheses. The final section, 'Significance to the Field of Public Administration' discusses 'why' philosophically, this work is important and how it can contribute to the body of knowledge. This entire chapter contains references to theory and literature, which serve as the foundation for this inquiry.

Research Problem

Sparse empirical evidence exists to support the claims of the positive impact computers have on the professional workplace, including law enforcement (Danziger and Kraemer 1985; Rocheleau 1993). Research suggests that computers do assist law enforcement officers to a degree, but not to the extent believed by many (Ioimo 2000; Nunn and Quinet, 2002). Mobile computing technology, for example, has been attacked as being of limited value in improving the jobs of patrol officers (Nunn 1993, 1994). Recent research in the area of mobile computing suggests a lack of concordance between the technology and the tasks field officers are required to perform (Ioimo 2000).

Beyond mobile computing, lie the entire realm of information technologies and the question of their value to law enforcement. A major issue raised in a number of studies has been the information made available to officers, which might improve work productivity, e.g., arrests, number of crimes solved (Brown, 2001; Nunn, 1993; Northrop

1995). This dissertation shifts the focus from the technology itself to the information the technology provides to law enforcement officers.

A concept important to this dissertation, 'how well a given technology fits the task at hand,' is embodied in Goodhue's (1995, 1998) theory of task technology fit (TTF). Goodhue suggests that information technology will result in better performance by system users only when system functionality directly supports the tasks that users are required to perform. In other words, a high TTF rating means that the system is viewed as being useful in the user's everyday work. Goodhue (1998) developed an instrument useful in measuring TTF, which I will use in this study to test both the comparison and information sharing groups.

The Study and Comparison Groups

The info-sharing group will be composed of law enforcement officers randomly selected from San Diego County Sheriff's Office. The rationale for choosing these officers is their access to unique information sharing technologies. Near the end of 1999, the research and development arm of the National Institute of Justice (NIJ) partially funded an initiative to increase the technology-driven information available to law enforcement officers throughout San Diego County. Officers from the San Diego County Sheriff's Office can access and use this technology, which is called the Automated Regional Justice Information System (ARJIS). ARJIS is a network of criminal justice agencies (predominately law enforcement) that share information through a web based enterprise network. All municipalities in the County of San Diego are member agencies of ARJIS (See Glossary in Appendix A. for a definition of certain terms).

Through electronic interfaces with participating criminal justice systems, ARJIS 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:

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

ARJIS also links information from state, local and federal law enforcement agencies and pools it with information from "courts" e.g., judicial system, and "corrections" e.g., jails and detention centers.

Law enforcement officers from the San Diego Sheriff's Office who were chosen as part of the info-sharing group for this study has access to this regional information. What makes this unique is that the system delivers regional information directly to patrol officers and detectives.

Officers from the Broward County (Florida) Sheriff's Office (BSO) will serve as the comparison group for this study. BSO is a large metropolitan law enforcement agency, which has similar systems to those found in the San Diego County Sheriff's Office. One of the major differences between agencies is the lack of regional information

sharing technologies in Broward County. BSO officers have access to information similar to that, which is shared via ARJIS. The major difference is, BSO only has access to local information. In other words, it is predominantly BSO-originated information. They do not have access to information directly from other Broward County law enforcement agencies.

Implicit in the rationale for developing ARJIS, is the belief by both the NIJ and law enforcement leadership, 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 dissertation.

Research Question

Does automated regional information sharing, impact the performance of law enforcement officers?

Sub Questions

1. Does access to automated regional information sharing technologies contribute to the effectiveness and overall performance of law enforcement officers?
2. Does automated regional information sharing technology provide law enforcement officers with information that improves their productivity, as defined by arrests, case clearances, and investigations conducted?
3. Does the presence of automated regional information sharing technology influence officer-evaluations of the data available through department computer systems?

4. Do individual characteristics play a role in how law enforcement officers perceive and assess available technology (TTF)?
5. Is there a relationship between training received, as perceived by those receiving the training, and their assessment of TTF?

Significance to the Field of Public Administration

This dissertation examines an important but neglected issue in contemporary public administration scholarship. Simply stated, this issue relates to the extent to which information technology, driven by the data it provides, impacts the performance of public sector employees, i.e., those characterized by Lipsky (1980) as 'street-level bureaucrats.' For mnemonic purposes, I will refer to this issue as *Data-driven Technology and Individual Performance* (DTIP).

Information technology has clearly become a force in both the private and public sectors. Those at the highest levels of government in the U.S. and abroad recognize the potential of information technology to effect change in society including many aspects of how people live, work and play (NSTC, 1999; CEC, 2002). These changes permeate and influence public governance (Hargreaves, 1998) and thus the field of public administration.

Danziger and Anderson's (2002) recent research covering 14 years (1987-2000) of key academic articles concerning the impacts of information technology on public administration, provides findings that support the direction of this dissertation. Their research suggests that information technology is ". . . penetrating deeper into every aspect of public administration . . ." and that the clearest positive impacts have been ". . . in the

areas of efficiency and productivity of government performance, in both internal operations and service functions" (Danziger and Anderson, 2002, p. 13). Another area highlighted by Danziger and Anderson as having impacted public administration has been the improvement in information quality i.e., data access, most of which has been in the area of finance: unfortunately only a few of these articles apply to law enforcement. In reviewing the literature for this dissertation, including the extensive review done by Danziger and Anderson, this researcher found a number of empirical articles touching upon data access by law enforcement officers (i.e., Danziger & Kraemer, 1985; Nunn, 1993, Rocheleau, B., 1993; Northrop, Kraemer, & King, 1995; Ioimo, 2000; Brown, 2001; Nunn, 2001; Nunn & Quinet, 2002). Beyond suggesting that additional data would be helpful, none of these articles addressed information sharing or its impact on street level officers.

The focus of this dissertation is on difficulties being encountered today in the deployment and use of data-delivery technologies within law enforcement agencies. Recent studies have found disappointing levels of computer utilization by investigators and officers despite agency efforts to stay abreast of the evolving technology (Northrop et al., 1995; Ioimo, 2000; Nunn & Quinet, 2002). Researchers have tended to blame the underutilization of computers on the poor degree of fit between the new technology and the mission of its users (Goodhue, 1995; Goodhue, 1998; Ioimo, 2000). However, in a law enforcement environment, it is much more likely that the kinds of information being made available through the new technology are at fault rather than the hardware, software, or other aspects of the information delivery system. I say this because information is a key element in criminal investigations conducted by street-level law

enforcement officers. Technology that does not deliver the proper information is less likely to be utilized and thus fail to deliver improvements in areas such as productivity and efficiencies (Rocheleau, 1993; Northrop et al., 1995; Ioimo, 2000; Nunn & Quinet, 2002).

This study is important to the field of Public Administration for several reasons. First, it builds upon theoretical concepts espoused by luminaries in the field such as Simon, Goodhue, Danziger, Northrop, Nunn, Brown, etc. Second, it continues where certain other studies have left off (see Chapter 2, Conceptual Framework, p.16). Lastly, it fills a gap in the literature concerning the value of automated information sharing to street level bureaucrats. When viewed in light of the Federal Government's emphasis on automated information sharing by law enforcement in its quest to combat terrorism, coupled with the absence of research in this area, this study is particularly relevant to one of the most salient issues facing American governance today – safeguarding the public from crime and acts of terrorism.

At the heart of the study are law enforcement officers who frequently make decisions that could translate into some type of enforcement or preventive action. Within this context, Ioimo (2000) notes, "Police detectives and patrol officers are both faced with high degrees of uncertainty and voluminous amounts of data to analyze. This makes the use of computers critical to improving field officer productivity" (Ioimo, 2000, p. 127). Ioimo's observation embodies two issues that are part of this study: the information available to officers and detectives and the effective delivery of that information via technology that could/should aid them in making decisions.

While decision-making is not the focus of this study, the quality of decisions is likely to be related to the availability of information. Back in the early years of computing, Herbert Simon saw computers as a vehicle for gaining greater insight into and improving decision-making (Augier and March, 2001). Thus from a theoretical standpoint, Herbert Simon's (1976) work, especially his theory of *bounded rationality and satisficing*, serves as an important point of reference and is at the heart of bureaucratic decision-making. Simon's work is also pertinent to this dissertation in that it addresses decision-making in the context of information availability. Information availability in the form of information sharing is at the heart of this dissertation.

Since law enforcement officers, like other bureaucrats, make decisions constrained by *bounded rationality*, they can be said to be *satisficing*, i.e. seeking alternatives that are adequate rather than optimal (Simon, 1976). The following quote from Simon's more recent writings serve as a beginning point to illustrate the connection to Simon's work. About 'bounded rationality' Simon (1997) notes, "The term 'bounded rationality' is used to designate rational choice that takes into account the cognitive limitations of the decision maker – limitations of both knowledge and computational capacity" (Simon, 1997, p. 291). Automation (i.e., computerized systems) comes into play in providing the law enforcement officer with the "computational capacity" in terms of aggregating and quickly accessing the information. The mere presence of automation does not imply maximized or optimized decision-making, nor does it enable the decision maker to choose the best possible alternative under all circumstances. Simon made this point when he noted the following about 'satisficing':

> In many (most?) real word situations, however, genuine optima (maxima or minima) are simply not computable within feasible limits of effort (see Bounded Rationality). This is especially true when decisions are made without the benefits of a computer, but it is frequently true when powerful computing facilities are available. The complexity of the world is not limited to thousands or even tens of thousands of variables and constraints, nor does it always preserve linearities and convexities that facilitate computation.
>
> p. 295.

On the surface, Simon appears to be arguing against computers. Simply stated, Simon's comments (above) suggest that it is difficult, if not impossible, to have the maximum amount of information available in making a given decision, the presence of computers notwithstanding. His comment also implies, albeit subtly, that one is better off making decisions with additional computerized information than without.

The "knowledge" mentioned by Simon and used within the context of this study, should be a by-product of access to richer information provided in the form of automated regional information sharing. Thus, building upon Simon's theory, this dissertation will examine the impact of providing law enforcement officers with greater or "more perfect" information specifically through regional information sharing technologies. It is not meant to assess decision making per se, which could stand alone as a topic of a dissertation: it seeks to learn how law enforcement officers view the 'value added' aspect of information sharing data.

A positivist attitude about the value of automated information sharing exists among management-level bureaucrats in law enforcement today. This attitude suggests

that better information will lead to better decisions, the result of which should be manifest in some measure of performance. As mentioned earlier, Ioimo (2000) discussed the high degree of uncertainty faced by law enforcement officers in the decision making process, noting, "Police officers make decisions on limited information on a daily basis and almost on every call . . ." (Ioimo, 2000, p. 12). This study will attempt to answer the question "what happens if we provide law enforcement officers with better or more perfect information?" Will the alternatives sought by the officers be better than "good enough"? If so, how will it affect their performance?

The implications of this study to the field of public administration become even clearer when examined within the context of Lipsky's work regarding the role of public service workers who directly interact with citizens. Lipsky (1980) recognized the importance of public service workers like police officers, who have a great deal of discretion and whose jobs require them to interact directly with citizens; he coined the phrase *street-level bureaucrat* to describe them. The aggregate of the individual decisions made by *street-level bureaucrats* ultimately shapes (street level) public policy by directly influencing the delivery of goods and/or government services to the public (Lipsky, 1980). Given that street-level bureaucrats' decisions affect public policy, anything that might influence the decisions they make and the work they do is important to the field of public administration.

Concerns with productivity and effectiveness are important in this era of "the New Public Administration," which can be characterized as a time of budgetary constraints, increased accountability and fiscal responsibility. Since the 1970's downsizing, deregulation and devolution have been terms used to describe the movement

of the new Public Administration (Newland 1996). During the 1970's and 1980's these sentiments have been espoused in response to the public's growing concern with a government that was growing quickly, or as Frederick C. Mosher described it (as cited in Newland, 1996, p. 19) as "exploding . . . in virtually all functional fields." Skepticism about government and politicians had begun to grow during the Nixon administration. The Ford administration added fuel to the fire of discontent: he ended his term with unemployment at a "perilously high" rate, and as Berman (2000, p.434) notes: ". . . the twin specters of stagflation and the growing Federal deficit now began to haunt the U.S. political landscape." This continued skepticism and discontent lead to the election of Jimmy Carter who "ran against Washington" (Newland, p.19). Then came the Reagan years, which were marked by ". . . one of the longest sustained periods of expansion in American history" (Pious, 2000, p.456). Reagan's term was also accompanied by enormous budget deficits, a huge national debt, and an increase in government spending (Pious, 2000). This continued through the G. H. W. Bush administration, even though he ran on a platform of no new taxes and improved fiscal policy: during his term in office the economy had gotten worse with high unemployment (7.8%) accompanied by a record high Federal deficit (Parmet, 2000). It can be argued that Clinton won the election largely because of anti-incumbency sentiments of the population, which was symptomatic of general dissatisfaction with Washington (Newland, 1996).

One of the issues that seemed to bother many Americans was the growing budget deficit. Controlling debt and government spending became a ". . . political rallying point by the early 1990's" (LeMay, 2002, p. 291). The Republican controlled congress, in response to the concerns of the populace, sponsored the balanced budget amendment in

1995. In fact, among President Clinton's early acts was the push for passage of the Omnibus Budget and Reconciliation Act of 1993, increasing taxes and reducing expenditures. By 1995, both Clinton and congress wanted to cut taxes. To do this they used reduced expenditures through retrenchment and a more efficient government, not to mention a proposed balanced budget amendment (Newland, 1996).

This led to two of hottest issues of the 1990's for the Federal Bureaucracy: the Government Performance and Results Act of 1993 (GPRA) and the National Performance Review (NPR).

The GPRA, passed in 1993, was implemented on October 1, 1997. The GPRA, through the budgeting power of Congress, requires agencies to ". . . set strategic goals, measure performance, and report on the degree to which they were met" (GAO, 1996).

A residual of this movement was the Information Technology Management Reform Act of 1996. Sec. 5113 of this act requires the OMB Director to:

> (1) encourage performance-and results-based management in fulfilling his responsibilities; and (2) evaluate the information resources management practices of the executive agencies with respect to the performance and results of investments made in information technology.

Subtitle C: "Executive Agencies" requires the head of each executive agency to design and implement in such agency a process for maximizing the value and assessing and managing the risks of information technology acquisitions. It also directs agency heads to utilize the same performance- and results-based management practices as encouraged by the OMB Director, and to prepare an annual report to the Congress concerning progress in achieving such goals (U.S. Congress, 1996).

This brief historical overview as discussed above, illustrates the shift in philosophy. The implication of purchasing and using this type of expensive information technology in the public sector makes it an important matter for public administration, especially in light of the Federal Government's past initiatives to fund local law enforcement technology projects. Jennifer Jones, in an article in Civic.com (1997) noted the following:

> The Clinton administration's plan to put 100,000 additional police officers on U.S. streets by 2000 is generating some healthy technology funding opportunities for local law enforcement agencies. That's because a chunk of the funds from the Justice Department's $1 billion Community Oriented Policing Services (COPS) program is being earmarked for projects to move existing police staff out from behind precinct desks and back on the beat. The funds -- $223 million in 1996 and $450 million in 1995 - were awarded under the COPS Making Officer Redeployment Effective (MORE) program for projects designed to make *police departments more efficient.*

Many of the local police agencies that obtained these technology grants used them to fund mobile computing projects. As I examined the available research and other literature I find sparse information on the effectiveness of information technology in law enforcement, even though the Federal Government has funded over $1.3 billion in information technology grants for law enforcement through the year 2002 (DOJ, 2002). Northrop et al. (1995) in their research on *Police Use of Computers* made a similar but more pointed observation. They noted that among the different research in the areas of technology and crime fighting over the past thirty years some attention focused on:

> . . .challenges and controversies involved in major efforts to develop and implement complex systems for support of prosecution and maintenance of criminal history information (Weimer, 1980; Lauden, 1986). Less attention has been paid to the practical effects of these information systems on those who wage the fight against crime at the street level – the police (Colton, 1978, 1979; Leonard, 1980).
>
> The extensive investments made in computerized information systems for police use over the past two decades have not been accompanied by systematic assessments of these systems. P. 260

In the post-911 era, information technology has assumed a more prominent role in law enforcement, specifically in its potential to promote information sharing among agencies. The results of a recent survey of the American public, published by the Council for Excellence in Government (CEG, 2002), suggest that the population believes that information technology will be a tool in the fight against terrorism by enabling the sharing of information among local, state, and Federal agencies. Implicit in this belief by the American public is that information-sharing technology will somehow be an enabler for law enforcement officers in their quest to track criminals, i.e., terrorists. I could find very little empirical evidence in the form of scholarly literature, addressing the role of information-sharing technologies in assisting law enforcement officers. This dissertation examines information sharing technologies used in a law enforcement setting through the eyes of street level officers and seeks to determine whether they believe this technology makes a difference in their performance.

Introduction - Summary

This study is important to the field of Public Administration because it relates to improving the effectiveness of information technology in law enforcement through automated information sharing. It provides insight into how the actors perceive this 'improvement,' and how changing the technology might affect the performance of the *street-level* bureaucrat and thus, public policy at the grass roots level. It has the potential to expand theory and knowledge of the impact of information-sharing technology on the performance of patrol officers and detectives; it could inform future information-sharing efforts, nationally.

CHAPTER 2
CONCEPTUAL FRAMEWORK AND THEORETICAL ORIENTATION

This Chapter begins with a discussion of the phenomena under inquiry followed by justification for studying them. Conceptually, this study will assess the impact of automated regional information sharing on the jobs of patrol officers and detectives. It will test the theory of "Task Technology Fit" (TTF) within the context of a law enforcement environment that has access to automated, regionally shared crime data. The goal is to determine, through the use of TTF, if patrol officers and detectives working in an environment that provides access to automated regionally shared information perceive the data provided by the technologies as meeting their needs any differently than officers and detectives working in an environment that does not share information regionally. While this seems fairly straightforward and simplistic, it involves a number of logically related abstract ideas and theories that are central to the research problem.

Technology Acceptance

The first abstraction is the concept of technology acceptance. Davis et al. (1989) developed the technology acceptance model (TAM) to learn more about why people accept or reject a specific technology. Davis et al. theorized that the user's attitude and intention dictate the extent to which he/she uses an information system. A key element in forming attitude, especially among inexperienced computer users, is whether the user of the technology believes that the technology will improve his/her job performance (Taylor

and Todd (as cited in Ioimo, 2000)). This concept is important to this study in that a users' perception of the usefulness of technology is a variable in actual usage.

The extent of system usage is important in increasing the benefits of computing to work performance (Danziger and Kraemer, 1985; DeLone and McLean, 1992; Goodhue and Thompson, 1995). "Routine usage" is among the elements of computer usage cited by Danziger and Kraemer as important to productivity gains. System utilization is necessary if it is to have an impact on individual performance (Goodhue and Thompson, 1995): professional workers will derive greater benefits from a computer system if they routinely rather than selectively use the system (Danziger and Kraemer, 1985);

Sedon and Kiew (1995) point to the need for additional research in this area, suggesting that researchers wishing to further explain overall satisfaction consider information quality as one of three causal constructs suggested in their model. Information quality is an important element of this study based on the assumption that the quality and usefulness of the information to which law enforcement officers have access, increases in direct proportion to its comprehensiveness. If, for example, a law enforcement officer is searching for a robbery suspect driving a red Honda she will normally search the automated files of her agency to see if any red Hondas had been stopped around the date and time of the robbery. If that robbery suspect was stopped in a bordering jurisdiction by another agency, the officer would not have normally known it. However, if the agency shared information using computerized systems, the officer would have been able to make the connection and further her investigative efforts. Thus, the quality of the information should improve with its comprehensiveness. If as posited by my hypothesis, detectives and officers value automated regional information sharing,

their attitudes toward the technology should be positive and they will be more likely to use the technology.

Task Technology Fit (TTF)

The next important concept, 'how well a given technology fits the task at hand' is embodied in Goodhue's theory of task technology fit (TTF). Goodhue (1995) suggests that information technology will result in better performance by system users only when system functionality directly supports the tasks that they are required to perform. In other words, a high TTF rating means that the users view the system as being useful in their everyday work.

Goodhue (1995) developed four propositions related to TTF, which I will outline below and relate each to the subject matter of this dissertation.

"Proposition 1. Characteristics of information systems/services will affect the UE [user evaluation] of TTF" (Goodhue, 1995, p.1832).

The element of *Proposition 1* that is most important to this study relates to "Integrated Common Systems [ICS]." ICS implies that users are presented with common systems with standard, shared access routines, linked to integrated data. Since this should make it easier to access and retrieve data, users should give ICS technology higher evaluations on a number of TTF dimensions (Goodhue, 1995).

"*Proposition 2. Task characteristic will affect UE [user evaluation] of TTF"* (Goodhue, 1995, p.1833).

Goodhue discusses three dimensions of task characteristic:

Variety and difficulty – relates to the tasks users are required to perform. It suggests that those who deal with routine tasks might not recognize the weaknesses in the systems; they find ways to compensate for system weaknesses. In contrast, those whose tasks are non-routine and who deal in more variety and/or complexity will find themselves searching for different and perhaps unfamiliar data thus making them more aware of system weaknesses.

Within the context of this dissertation, this relates to the work of patrol officers and detectives and the extent to which they view their tasks as routine or non-routine. The jobs of patrol officers and detectives differ. Patrol officers work mostly from their cars. Since their cars are their offices, they get only limited access to systems and databases via mobile computers (Ioimo, 2000). Given that they must be mobile and available for calls-for-service most of the time, they have less opportunity than detectives do to peruse the specific databases that are accessible only from computers inside a building.

Danziger and Kraemer (1985, p.196) note ". . . detective work is information intensive in theory and practice . . ." Database systems are particularly important for detectives since they spend time personally using the computer to query and analyze data (Danziger and Kraemer). They also have more latitude in being able to spend time at a police facility using a computer since they are not responsible for responding to calls for service.

Interdependence – these tasks require users to identify, access, and integrate data from a variety of sources. It highlights the dissatisfaction with incompatibilities

among both data and access routines. This dimension of TTF is at the heart of this dissertation. It relates to data sharing among law enforcement agencies, which without "integration from a variety of sources" would be impossible. Information sharing as used within the context of this study implies overcoming incompatibilities among data and access routines. This concept is central to this dissertation: in the San Diego region, data from a variety of law enforcement agencies is integrated for access via standard routines across participating agencies. In this study, I explore law enforcement information sharing in greater depth than has been found in previous research in the hope of recognizing it as an independent concept of TTF.

"Hands on" Tasks – This is indicative of users who deal with the technology and data directly. All officers who participate in this study engage the systems, "hands on."

Proposition 3. Individual skills and abilities will affect UE [user evaluation] of TTF (Goodhue, 1995, p. 1834).

Goodhue suggests that individual competence, training, and familiarity with information systems are important in affecting user evaluations of TTF. In this dissertation, I will assess individual characteristics beyond those mentioned by Goodhue in an effort to isolate variables among individual characteristics that might affect user evaluations of TTF and perhaps individual performance.

Proposition 4. The interaction between task and technology (and individual) will affect the UE [user evaluation] of TTF (Goodhue, 1995, p. 1834).

> In this proposition, Goodhue suggests an interdependent relationship among and between task, technology, and individual. This supports my main question and methodology in which I will "operationalize" all three constructs (characteristics) within the context of officers that access shared information via automated systems and those that do not. This is important in ruling out rival hypotheses given that my goal is to determine the impact of information sharing technologies on individual performance, which could be affected other variables such as training and experience.

Information Sharing

The only empirical application of TTF theory to technology in the law enforcement environment has been in the area of mobile computing by Ioimo (2000). A number of studies relating to mobile computing in law enforcement suggest that this technology has been of limited value in helping patrol officers to do their jobs (Nunn, 1993, 1994; Rocheleau, 1993 and Nunn, S. and Quinet K. 2002). Key in these studies and of particular relevance to this dissertation is the issue of lack of access to information. Nunn (1994), in his study of patrol officers' use of mobile computers, noted that these computers lacked accessibility to data beyond wanted persons, property and vehicle information. The data mentioned by Nunn are only a small part of the information available to assist law enforcement officers in the performance of their jobs

(Drescher & Zaworski, 2000). I could find no research data applying the theory of TTF to law enforcement computing beyond mobile computers.

Building upon the research mentioned above, is the relationship between TTF and information sharing, which is the third and most important concept under investigation in this study. Nunn (1993, 1994) set the stage for this study by pointing out that patrol officers' need to have access to more information. This dissertation transcends what Nunn examined – mobile computing technology and the job of patrol officers. It examines technology available throughout the law enforcement enterprise for use by both patrol officers and detectives. While their jobs differ in a number of respects, they both play an important role in assuring public safety.

Brown (2001), in her study of the implementation of systems in a law enforcement agency, identified three barriers to getting and using data: training, fragmented databases, and lack of information sharing across lines. In the San Diego experiment, they have overcome two of these barriers: many of the previously fragmented databases are linked, thus losing their "fragmented" qualities, and information is shared across jurisdictional lines and delivered directly to patrol officers. Brown's research also suggests that officers believed that information pertaining to felonies, misdemeanors, and calls for service were most relevant to performing their jobs effectively. Her conclusions have not been tested.

Simon's (1997) work addresses an important concept tangentially related to information richness and automated information sharing. He discusses the constraints, which make it impossible to optimize decision-making, forcing the decision-maker to choose a 'satisfactory' alternative. Viewing the search for the optimal alternative as

analogous to finding a needle in a haystack, Simon (1997, p. 296) noted, "The attractiveness of the satisficing criterion derives from this independence of search cost from the size and complexity of the choice situation." Simon (1955) and Stigler (1961) elaborated on this issue early on when they discussed ". . . taking into account the cost of the search and only searching up to the point where the expected gain derivable from another minute of search is just equal to the opportunity cost of that minute" (Simon, 1997, p. 296).

Law enforcement officers need access to a variety of information from a number of sources (Brown, 2001). Automated information sharing such as that occurring in San Diego, links the sources of information from law enforcement agencies throughout the region making it available to individual officers and detectives. The linking and automating of these data should reduce the search time required by officers to gain information. Instead of having to make telephone calls to other agencies to determine what information they have available about a given person, crime, etc, officers can simply access their computers and instantly view all information available within the region. This implies less search minutes, reduced opportunity cost, and should improve 'satisficing' behavior, bringing it closer to optimal. This study will focus neither on the decisions made nor on the potentially satisficing behavior, but on the potential performance benefits derived by street level bureaucrats.

There are risks associated with providing access to more information or data. Levine et al. (1990, p.374) suggest that more information is not necessarily better. They were concerned with the ". . . perils of [information] overload . . ." Herbert Simon (1997, p. 172) had a similar concern when he posed and answered the question "What is scarce

when info is plentiful? – Time to attend to it. Attention is the scarce factor in an information rich society." Dave DeLong at Ernst & Young's Center for Business Innovation suggests that "peoples attention" is one of the "perils" of information overload which he translates into the "tyranny of the urgent but unimportant" (McCune, 1998, p.3).

Characteristics of Users

A number of studies have cited "characteristics" of users as important in the diffusion and effective use of technology. Segars and Grover (1993) suggest that both task and user characteristics could influence the nature and importance of perceptions that explain technology use. Goodhue's (1995) work suggests that characteristics of the user play a role in user evaluation of TTF. People who are more competent and better trained or more familiar with automated systems will be more successful in accessing and interpreting data. Computer literacy appears to be associated with higher evaluations of systems (Goodhue 1995, Montazemi, 1988, Rivard and Huff 1988). Delone's study (1988) does not support this contention. It is plausible that people who are generally more competent will perform most tasks better than the less competent, technology notwithstanding. Perhaps it is "understood."

The following studies deserve more attention because they relate to effects of computing in a law enforcement environment. Danziger and Kraemer (1985) surveyed a randomly selected sample of detectives from 40 American cities on their use of computers in the course of their duties. They tabulated and analyzed the results from 374 surveys. The purpose of the study was to determine if the use of database systems

contributed to the productivity of the detectives. An important element of the Danziger and Kraemer study was "personal traits" or characteristics of the user; they wanted to determine if differences of the impact of computing on productivity among individuals could be explained by user characteristics, which they called personal traits. Their findings revealed that "personal traits" of the user was one of the contextual elements most associated with a positive impact of computing on arrests and clearance levels (Danziger and Kraemer, 1985).

Northrop et al. (1995) using a quasi-experimental design consisting of quantitative and qualitative methods, studied the effectiveness of police use of computers. The measures used, depended on self-reports and recall of survey respondents. In addition, the researcher did follow-up interviews with more than 100 officers in the survey cities. They looked at police officers' use of computers and the impact of this usage on their jobs, i.e., effectiveness and productivity (albeit, neither was well defined). This study identified several variables important to the successful use of computer technology in law enforcement and categorized them as "characteristics of innovation" and "characteristics of the user."

The first, "characteristics of innovation" relates to how easy the system is to use (user-friendly) and how technically stable and reliable the system is. The second, "characteristics of the user" relates to the level of computer literacy of the officer and the amount of formal training given on the specific system. Both were deemed important and associated with the extent of system use. The highest correlation exists between effective use of the system and training, with lesser but significant correlations between literacy, technical stability, and ease of use.

I chose "characteristics of the user" as a construct in this study because of its potential to influence the extent of use and thus outcomes or performance (Goodhue and Thompson, 1995). In addition, it will help to control for the rival hypothesis (Bickman & Rog, 1997) that "the effect is related to individual characteristics and not information sharing technologies." This research project will further explore the nature and specific influences of factors that may alter the user's "perception-of-usage" equation in law enforcement computing.

Individual Performance

A causal relationship between performance and information technology is difficult to prove (Danziger and Kraemer 1985, Goodhue and Thompson 1995, Goodhue 1995, McCune 1998). A number of studies suggest a relationship between performance (in the form of productivity) and information technology, but many qualify this relationship through controlling variables.

Using a quasi-experimental design and ex-post facto methods, Brynjolfsson and Hitt (1998) looked at the relationship between productivity (i.e., the performance of the firm) and the firm's investment in information technology. The results of their study demonstrate that, contrary to what some authors have described as ". . . the big lie of the information age . . . computers are pulling their weight" (Brynjolfsson and Hitt, 1998, 50).

McCune (1998) suggests that technology has increased companies' productivity and efficiency. An interesting aspect of the relationship between information technology

and productivity is the finding that computers improve the quality rather than the quantity of work. This makes it difficult to establish a direct link to productivity (McCune, 1998).

Mukhopadhyay et al. (1997) found that measuring and understanding the impact of information technology on productivity presented researchers with a significant and difficult problem. Their findings led them to believe that one must look beyond the immediate and analyze the information process level to understand the impact of information technology on productivity.

Orman's (1998) research suggests that the implementation of information technology can lead to gained efficiencies. The extent of these efficiencies corresponds to the degree to which business process reengineering occurs. This is not a simple matter; Orman's (1998, 210) notes, the ". . . precise nature and direction of reengineering efforts are not well established."

Kar Yan (1988) using a quasi-experimental, ex post facto design, studied productivity of three nations in the Pacific Rim. Kar Yan's study suggests that the differences in the relationship between IT and productivity are related to the existence of a government IT policy.

Goodhue and Thompson's (1995) TTF model suggests a relationship between the fit of the technology to the task, and performance; its weakness lies in how performance impact is measured. They used an eight-factor survey of which three questions captured self-reported performance impacts *as perceived by users* in lieu of objective measures of performance. While their rationale for doing so was sound, (i.e., "objective measures of performance were unavailable in this context, and at any rate would not have been compatible across individuals with different task portfolios" Goodue and Thompson,

1995, p.223) it leads this researcher to question whether the users' perception requires support from some objective measure of performance.

Danziger and Kraemer (1985) found a positive impact of computerized databased systems on the productivity of law enforcement detectives. Their findings were remarkable. Of the last 10 cases worked, the detectives report the following:

- 37% reported that the technology made some cases workable
- 63% reported that the technology assisted in arrests
- 66% reported that the technology assisted in clearances
- 45% reported that the technology assisted in linkages between persons in custody and un-cleared [unsolved] cases.

Danziger and Kraemer's work offers encouraging evidence to support the value of computerization to the performance of law enforcement detectives; the data they gathered, although self-reported, is more specific. Their rationale for using self-report data seems sound, as was the case with Goodhue and Thompson. They offer the following explanation:

> Valid empirical measures of productivity are a difficult challenge in the social sciences, and this is particularly true for something as complex as the role of a particular mode of information over a period of time. Despite some promising exploratory work on quite simple effects of computing, precise measures remain a desirable goal of research. . . . p. 208

Goodhue and Thompson (1995) recognized the importance of going beyond users' perception of performance impacts and suggested, as part of "implications for future research," that measures of performance that are more objective be constructed.

This dissertation will not create a lab experiment to isolate and develop causal relationships between performance variables and perception; it will advance the body of knowledge by observing and examining certain aspects of performance and comparing them to the responses to survey questions.

It is important to note that I do not attempt to demonstrate an absolute causal relationship; I will be assessing the TTF from two different groups of users: those using regional information sharing technologies (info-sharing group) and those not equipped with regional information sharing technologies (comparison group). The normative theory is that law enforcement officers need more information (Danziger and Kraemer, 1985; Nunn, 1993, 1994; Brown 2001). If this is fact, the measure of TTF should be different between the groups. If differences in perception of TTF do exist between the two groups, I will compare it to data gathered through observation to determine if one data source supports the other. More work will need to be done to test such relationships. This study could set the stage for and suggest such work.

CHAPTER 3
METHODOLOGY/PROCEDURES

This chapter provides an overview of the research problem, the associated research questions and related hypotheses. A discussion of the constructs, including a definition of the variables of interest and their association with the hypotheses follow. The instrumentation section then presents an in depth overview of the quantitative and qualitative data collection methods, their reliabilities, and related theory. The chapter closes with a detailed description of the quantitative and qualitative methods used in this study.

Given that the research procedures or methodologies employed are dependent upon the conceptual framework and related research question, I will start this chapter with an overview of the research problem. 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. Our decentralized form of government and local rule fosters the use of local law enforcement operating within defined jurisdictional boundaries; those who commit crimes do not respect 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 done very little 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 share information. One of the major initiatives of the newly created Homeland Security Office is to promote the creation of such systems at all levels of law enforcement. The assumption is that information sharing will be of value to officers and detectives.

This problem is at the heart of my *research question*:

Does automated regional information sharing improve the performance of law enforcement officers and does the extent of computer training or individual characteristics influence how users' evaluate technology i.e., TTF?

Null Hypotheses

Null hypotheses are tested in this study. As outlined below, they arise out of the research question and are related to the theoretical orientation. To address the research question, I developed several sub-questions from which the null hypotheses evolved. Below are the sub questions accompanied by the relevant null hypotheses.

1. Does access to automated regional information sharing technologies contribute to the effectiveness and overall performance of law enforcement officers?

   Ho_1: No 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*.

Ho_2: No significant difference exists between the study and comparison group's assessment of the role automation plays in enhancing *individual performance.*

2. Does automated regional information sharing technology provide law enforcement officers with information that improves their productivity?

   Ho_3: No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity*[1].

   Ho_4: No significant difference exists between the study and comparison group's assessment of the role automation plays in providing information, which directly assists officers in making arrests.

   Ho_5: 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 clearing cases.

3. Does the presence of automated regional information sharing technology influence officer-evaluations of the data, available through department computer systems?

[1] While Hypotheses 4 and 5 measure two specific and important aspects of an officer's productivity, arrests and case clearances, the Individual productivity referred to here is measured by the officers' perception of the aggregate of all activities, many of which are beyond arrests and clearances. These are the activities that are part of the normal patrol and investigative day; they are too numerous to capture as part of this study. This hypothesis attempts to capture an officer's perception of the extent to which technology makes them more productive, in a general sense.

Ho_6: No 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.

4. Do individual characteristics play a role in how law enforcement officers perceive and assess available technology (TTF)?

   Ho_7: Level of education does not influence user-satisfaction with available technology.

   Ho_8: Experience does not influence user-satisfaction with available technology.

5. Is there a relationship between training received, as perceived by those receiving the training, and their assessment of TTF?

   Ho_9: Neither the amount nor the type of computer training influences user satisfaction with available technology.

Research Design

This study employs primarily a survey methodology, but includes both an associational and comparative research approach. This (mixed) approach was used for several reasons. First, the investigator could not randomly assign participants and had no control over the independent variables, thus it does not strictly meet the criteria of experimental and quasi-experimental approaches (Cook and Campbell, 1979; Gliner and Morgan, 2000), and thus the survey design was used. Second, the associational approach is suggested when the purpose is to find associations but not to examine causality (Gliner and Morgan, 2000): this is part of what this dissertation seeks to accomplish. Lastly, this

dissertation also seeks to determine whether differences in the perception of the value of information technology exist between two groups of law enforcement officers: when the purpose of a study is to compare groups, the comparative approach is appropriate (Gliner and Morgan, 2000).

A weakness in this study is that it assesses the impact of an intervention after-the-fact; it is therefore devoid of pre-implementation observations employing the same instrumentation for use as a baseline. Since random assignment of the "treatment" is not possible, I will use a comparison group of non-users to mitigate this flaw. The use of non-equivalent control groups is an accepted method of creating a quasi-experimental comparison base when random assignment is not possible (Bickman and Rog, 1997)

A second and important mitigating factor is the triangulating of methodologies. Triangulation is a way to reduce distortions and validity threats inherent in single-method studies (Maxwell, 1997). In addition to employing both quantitative and qualitative methods, this study will triangulate data collection methods within each. The quantitative involves gathering the 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 a 3-year period i.e., that period three years post-implementation of the ARJIS web-based system.

The qualitative portion involves interviewing 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 working a

normal shift. The activities were recorded, noting their use of automated systems. During this direct observation, questions were asked to inform the observations.

A third mitigating factor in this design weakness is the instrumentation and methodology employed. Using Goodhue's (1998) TTF survey instrument as a basis to assess perception should enhance reliability and validity. Goodhue's instrument demonstrated strong reliability and discriminant validity for 12 dimensions of task-technology-fit (See Table 3).

A fourth factor, mentioned earlier as part of triangulation of methods and expounded upon here, is the use of departmental records. It involves the examination of departmental records of arrests and clearances over the past four years for both the comparison and the info-sharing groups. It is important to note that these data are not used to show an absolute causal relationship between the technology and productivity. Establishing valid empirical measures to discern the role of information technology in productivity is recognized as an extremely difficult but desired task (Danziger and Kraemer, 1985). Surrogate measures of IT impact [such as those employed in our survey instrument] are often resorted to because it is difficult to measure the performance impacts of information technology (Goodhue and Thompson, 1995). In the final analysis, I use the arrest and clearance performance data from the agency's records to validate and inform other data collected. It is reasonable to assume that if officers believe that technology assists them in making arrests and clearing cases, and information sharing plays a major role, we could see evidence of increases in actual clearances and/or arrests to support the officers' beliefs or perceptions. This is not an absolute, as other variables could explain differences.

Site Selection

While the push toward information sharing is relatively new, a few agencies have already established the necessary infrastructure and begun to do so. The County of San Diego has taken the lead in this area. Under the oversight of a regional governance, they have established the technology infrastructure, which enables 43 criminal justice agencies to share crime-related data.

The San Diego County Sheriff's Office (SDSO) was chosen for several reasons. First, they are among the leaders in using automated regional information sharing. Secondly, the National Institute of Justice (NIJ) funded the development of the web-based version of ARJIS deployed in San Diego. Lastly, the NIJ partially sponsored this dissertation so that they could determine how effective this technology is in assisting law enforcement officers in performing their everyday tasks. This sponsorship facilitated the necessary access and cooperation in gathering the data.

The comparison group is from the South Florida region. The Broward County Sheriff's Office (BSO) was chosen primarily as a convenience. While like SDSO, BSO is a large metropolitan Sheriff's Office, it was chosen partially as a convenience because the researcher formerly worked for the Sheriff of Broward County and has maintained affiliations with key agency officials (including the Sheriff) through whose help cooperation from field officers was assured.

Variables

The dependent and independent variables used as measures in this study are presented in Tables 1 and 2.

Table 1 Dependent Variable Definitions and Constructs

CONSTRUCT	DEPENDENT VARIABLE	DEFINITION
Individual Performance Impact	Effectiveness	User's perception of the extent to which the technology make him/her more effective
	Job performance	User's perception of the extent to which the technology enhances job performance
	Individual Productivity	User's perception of the extent to which the technology enhances individual productivity, i.e., investigations, case clearances and arrests
	Arrests	The number of arrests that were made based on or assisted by information obtained from a computer system
	Case Clearances	The number of crimes solved (cases cleared) which were facilitated or assisted by information obtained from a computer system
	Investigations	User's perception of the extent to which the technology assists in conducting investigations
	In-custody linkages	The number of crimes solved (cleared) by linking them to a person currently in custody for another offense, using information obtained from a computer system
Task Technology Fit (TTF)	Level and detail of data	Level and detail sufficient to support user tasks (i.e., patrol and detective functions)
	Locatability of data	Ease in determining what data are available on a given topic
	Data accessibility	Ease of locating specific data
	Consistency among sources of data	The degree to which data from different sources are consistent
	Data synthesis	The degree to which data from different sources can be compared, consolidated for use

CONSTRUCT	DEPENDENT VARIABLE	DEFINITION
	System Reliability: Computer down time	The extent to which the computer system is subject to outages which interfere with access to data
	System problems	Problems that interfere with access to data
Data Meets Needs	Data adequacy	Extent to which users believe the data to which they have access meets their needs

Table 2 Independent Variable Definitions and Constructs

CONSTRUCT	INDEPENDENT VARIABLE	DEFINITION
Computer Training	Amount of training	The degree to which users are getting a sufficient amount of training
	Timing of training	Is the timing of the training in accord with system availability?
	Quality of training	User's perception of the overall quality of training received
	Source of training	Self, co-worker, or 'other'
Computer Experience	Computers training not needed	Does not rely on computer training. Can learn most computer applications without training
	Resource for co-workers	Is frequently called upon to assist co-workers with computer problems because of his/her knowledge of computers
User Characteristics	Education	Highest level achieved
	Experience[1]	Time in current position
	Experience[2]	Time with current agency
	Experience[3]	Years as an officer
IT and Information Sharing	ARJIS	Access to IT and regional information sharing technologies
	Non-ARJIS	Access to IT but does not have access to regional information sharing technologies

The variables in this study emanate from the study's key constructs. Tables 1 and 2 (above) provide a definition for each variable and link it to important constructs. Table 1 refers to independent variables while Table 2 refers to dependent variables.

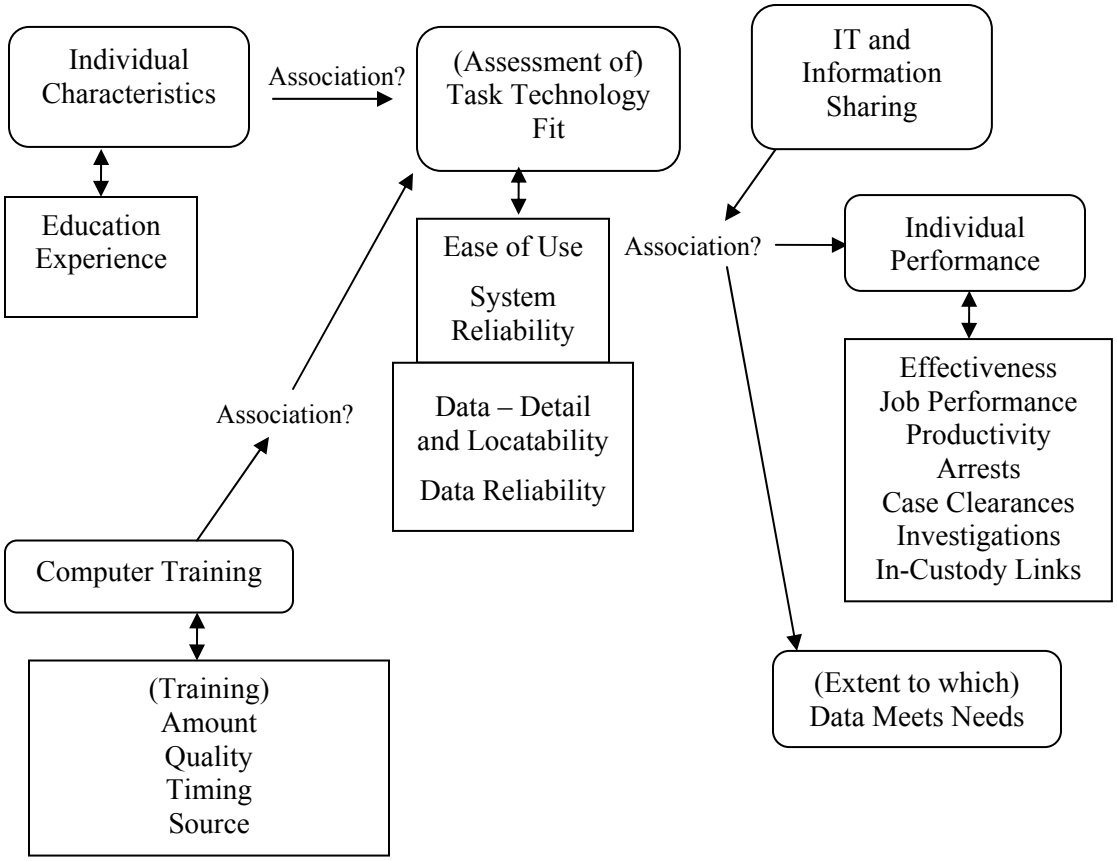


Figure 1 Interaction of constructs and variables

Figure 1 shows the hypothesized interaction of the constructs (in the rounded boxes) as operationalized by the associated variables (in the rectangular boxes).

Instrumentation

In this study, I triangulated data collection methods. Triangulation lessens the potential threats to validity, strengthening the study design (Patton, 1990). 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 dissertation 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).

A number of studies suggest a relationship between performance (in the form of productivity) and information technology, but many qualify this relationship through controlling variables. 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 that he calls task-technology-fit 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 task-technology fit (TTF). He tested the measurement validity of the instrument using a sample of 357 users in 10 companies and found it to be reliable and valid for 12 dimensions of TTF. Table 3 outlines the results of Goodhue's (1998) instrument reliability testing.

Table 3 Goodhue's (1998) Reliability Testing Results

Dimension of Task-technology fit	*Number of Questions*	*Cronbach's Alpha*	*Final Status*
Lack of Confusion	2	.73	Kept
Level of Detail	3	.85	Kept
Locatability	3	.77	Kept
Meaning	3 (2)	.78 (.77)	One question dropped
Accessibility	3	.84	Kept
Assistance	3	.87	Kept
Ease of Use	3	.77	Kept
System Reliability	3	.77	Kept
Accuracy	3	.83	Kept
Compatibility	4(3)	.82(.80)	One Question Dropped
Currency	3(2)	.73(.78)	One question Dropped
Presentation	2	.86	Kept

From Goodhue (1998, p. 116)

The research data suggest that this is a good instrument for assessing organizational information systems (Goodhue, 1998). Goodhue's survey instrument is the foundation upon which the survey instrument used in this study was developed. Table 3 displays the results of Goodhue's (1998) survey instrument reliability testing.

An issue and perhaps a weakness in the use of Goodhue's instrument in this study is that fact that Goodhue developed and tested the instrument for the use of managers. I considered several mitigating factors, which weighed in favor of using the core survey. The first was a consideration of the dimensions of TTF developed by Goodhue. Most of the dimensions accounted for by Goodhue have applicability to computer users in law

enforcement. Another plus is the successful adoption and use of this instrument to law enforcement officers by another researcher. Ioimo (2000) applied a modified version of the TTF model and instrument to the law enforcement environment to assess the fit of field mobile computing technology to the tasks of patrol officers. In modifying the survey instrument Ioimo added 8 questions to assess how mobile computers effected individual performance. Ioimo (2000) took a number of steps to validate his modified instrument as follows: his dissertation committee members reviewed and approved it; he presented it to three law enforcement information systems managers for review as well as two field mobile computing vendors. He also discussed his research with Dr. Goodhue. He also conducted reliability testing which is explained on the following page.

Having added personal data questions and others directed toward the field officer's use of mobile computing, Ioimo conducted a limited instrument reliability test. He issued a 43-question survey to a randomly selected sample of forty (n=40) field officers from the Puyallup, Washington Police Department. He conducted post-test interviews with each respondent to ensure the questions were clearly understood and that the 172 responses reflected that understanding. He then made the necessary modifications before administering the questionnaire in his final research (Ioimo, 2000).

To account for the modifications to the Task-Technology Fit instrument, as validated through Goodhue's (1998) research, Ioimo (2000) used Cronbach's Alpha to test its reliability. The results of his reliability testing on the modified instrument, including the eight added questions are outlined in Table 4: Results of Ioimo's (2000, p. 172-173) survey instrument reliability testing.

Table 4 Ioimo's (2000) Survey Instrument Reliability Testing

Dimension of Task-technology fit	*Number of Questions*	*Cronbach's Alpha*	*Final Status*
Level of Detail	2	.93	Kept
Locatability	2	.95	Kept
Training	2	-1.20	Dropped
Meaning	2	.71	Dropped
Ease of Use	3	.74	Kept
System Reliability	3	.24	Dropped
Compatibility	3	.91	Kept
Currency	2	-6.72	Dropped
Task Complexity	3	.86	Kept
Task interdependence	2	.97	Kept
Performance impact	2	.83	Kept
Individual performance measures	8	.97	Kept

From Ioimo (2000, p. 172-173)

Ioimo (2000) made an important contribution to the literature by gathering secondary data points concerning productivity of field officers and using them to do a pre and post-implementation analysis. While there are concerns with suggesting a causal relationship between outputs and the use of information technology, I believe that Ioimo's effort was worthwhile in that it sheds some light on areas that need more research.

A third and important point of reference and source of survey questions comes from the work of Northrop, Kraemer and King (1995) and their research on "police use of computers." Northrop et al., using a survey research design consisting of quantitative and qualitative methods, studied the effectiveness of police use of computers. The measures depended on self-reports and recall by survey respondents. They triangulated data

gathering by supplementing the surveys with follow-up interviews with more than 100 officers in the survey cities.

They looked at police officers' use of computers and the impact of this usage on their jobs, i.e., effectiveness and productivity. Northrop, et al. (1995) identified several variables important to the successful use of computer technology in law enforcement. I borrowed eight questions from their research to provide additional information regarding individual performance. While Goodhue (1998) and Ioimo (2000) validated questions which capture a user's perception of the relationship between computer systems and individual productivity, only Ioimo attempted to gather more quantitative performance measures to support his findings. Northrop, et al. gathered performance information that was more specific and quantifiable, i.e., number of arrests and case clearances. Although it depends on user-perception and thus suffers from the same flaw as Goodhue (1998) and Ioimo's (2000) work, it has the advantage of quantifying how the technology helps officers' productivity.

Survey Instrument

This dissertation 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 developed for this study borrows from the three sources cited above and adds several dimensions, which I believe important to this study. It consists of eight core parts, composed of 55 questions and 7 measures of user characteristics.

The survey, found in Appendix C, begins with a measure of user characteristics (Part A). These elements, taken from Ioimo's instrument, capture the following

respondent-information: Gender, age, education, shift, ranks, assignment, and law enforcement experience.

Part B, *Task/Job Characteristics* consists of questions 1-5 and measure *Complexity and Uncertainty* and *Task Interdependence*. Goodhue (1995) developed these questions; Ioimo modified them slightly to fit the law enforcement setting. I modified the questions based on feedback from law enforcement officers during the validity-testing phase of this study. After further consideration of the feedback provided by the officers and the limited value these questions offered in support of hypothesis testing, I opted not to use them in this study.

Part C (questions 6 – 9), *Data Quality* and *Locatability* originated with Goodhue (1998), as modified by Ioimo (2000) and which I modified to focus more on data available through the department's computer systems as opposed to data maintained by the department. This is an important change which aligns the questions with information access from any source (this includes regionally shared data) as opposed to information access from only the department's files.

Data Comprehensiveness is a new section I developed to explore the importance of data obtained from other agencies. It consists of questions 10 -12 and seeks to measure user-satisfaction with the level of access to information from other agencies in the County.

Included in Part C are questions 13 - 20, *Compatibility, System Reliability and Ease of Use,* which measure rather generic aspects of systems. Ioimo (2000) used them as originally developed by Goodhue (1995), and validated them in a law enforcement environment.

Part D*, Individual Performance Measures,* consists of questions 21 and 22, which measure the *Performance impact of computer systems*. I use these questions as developed by Goodhue (1995) and slightly modified to fit the law enforcement environment by Ioimo (2000). Also in part D are questions 23-31, *Individual performance measures,* borrowed from Northrop et al. (1995). These questions capture information regarding the use of computers in investigations, case clearances, arrests, and vehicle and person stops.

Question 32 captures exactly which systems most influenced the answers that the officers provided; it should provide insight regarding the role that specific information systems play in the officers' perception of system utility and their assessment of TTF.

Questions 33-39 found in Part E, *Computer Training*, were also borrowed from Northrop et al. These questions assess the level of training provided and user satisfaction with the training received. I added to and modified the questions to capture more detail concerning the source of training. My rationale for adding questions is to be more specific and to collect certain information as informed by feedback from law enforcement officers during instrument validity testing. In the *training* section, I added two questions (40 & 41) to assess computer experience and knowledge of computers.

Part F, questions 42 & 43, *Hardware Availability*, is included to gather information regarding the extent of access to computer hardware. These questions are used exclusively in the San Diego survey and were not included in the Broward survey. My reasoning is that all Broward deputies have (take home) mobile computers, thus I know the answer and did not want to burden respondents with unnecessary questions. In San Diego, not all deputies have (take home) computers.

Part G, is added as an open-ended question to allow respondents to discuss information which they need to do their jobs and to which they currently do not have access.

To capture the level of automated information sharing, which is part of *data comprehensiveness,* I added Part H consisting of questions 44 - 51. These questions explore several areas important to this study:

- Frequency-of-use of the information obtained from other law enforcement agencies;
- Extent of access to information from other law enforcement agencies;
- The need for and importance of access to information from other law enforcement agencies;
- Perceived impact of access to information from other law enforcement agencies on productivity, quality and effectiveness.

Questions 52 & 53 relate to the source of information respondents obtain from other agencies. Question 54, used only in the San Diego survey, was included to assess the extent of usage of the ARJIS system for information purposes collected for NIJ. The final question (55) lists all systems available to the respondents. It asks the respondents to rank the top ten automated information sources in order of importance to them in performing their jobs.

Table 5 (page 48) aligns the research questions with the appropriate hypotheses and links each hypothesis to its supporting survey question(s).

Table 5 Survey Questions Associated with Hypotheses

Research Questions	Hypotheses	Survey Questions
1. Does access to automated regional information sharing technologies contribute to the effectiveness and overall performance of law enforcement officers?	Ho_1: No 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.	Impact of computer systems on effectiveness: Ques. 21, 51 Performance impact of computer systems: Ques. 21,22 Information sharing and performance: Ques. 48, 49, 51
	Ho_2: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual performance.	
2. Does automated regional information sharing technology provide law enforcement officers with information that improves their productivity?	Ho_3: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual productivity.	Individual productivity and computers: Ques. 24 – 29 Information sharing and performance: Ques. 49 Arrests and computers Ques. 26 – 27 Case clearances and computers Ques. 28, 29
	Ho_4: No 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.	
	Ho_5: No 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.	

Table 5 continued

Research Questions	Hypotheses	Survey Questions
3. Does the presence of automated regional information sharing technology influence officer-evaluations of the data available through department computer systems.	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.	Data Quality - Maintaining data at the right level of detail Ques. 6, 7 Locatability – Ease of determining what data is where Ques. 8, 9 Compatibility – Information from various sources can be consolidated or compared without inconsistencies. Ques. 14 - 16
4. Do individual characteristics play a role in how law enforcement officers perceive and assess TTF?	Ho_7: Level of education does not influence user satisfaction with available technology. Ho_8: Experience does not influence user satisfaction with available technology.	Years of education: Part A (survey) Experience: Time in current position Time with agency Time as a law enforcement officer User satisfaction: Composite of TTF - Ques. 6-9,13-22
5. Is there a relationship between training received, as perceived by those receiving the training, and their assessment of TTF?	Ho_9: Neither the amount nor the type of computer training influences user satisfaction with available technology.	Computer Training: Ques. 33 – 39 User satisfaction: Composite of TTF - Ques. 6-9,13-22

Validation and Reliability Testing

Given that I modified and expanded the instrument to capture additional information (i.e., information sharing, information richness, specific performance measures), I validated the instrument for use in my population. An important consideration in using any instrument is the testing of its validity. Management staff, key members of the information technology staff responsible for supporting the technology, and law enforcement field officers from both the info-sharing and comparison groups, 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 (pilot tests) 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 Broward County. In an attempt to identify ambiguous or confusing questions and instructions, I administered the questionnaire to each participant individually, interacted with the participant to review the results, ensuring that he/she clearly understood each question and that responses reflected that understanding.

After the pre-test was competed, I conducted reliability testing. I used the SPSS program to capture the pre-test data (pilot). The first step in the process involved recoding questions 12 and 16, which were contradictory within a given dimension or conceptual frame. Cronbach's Alpha is the reliability test used for several reasons: it is

widely accepted for use in social research and well suited for the group being tested, and it has a history of being successfully used with the core of this survey by Goodhue (1998) and Ioimo (2000). The following Table (6) provides the results of the Cronbach's alpha tests on all ordinal questions including the additional questions relating to information richness and information sharing.

Table 6 Survey Instrument Reliability Testing

Dimension of Task-Technology Fit	*Questions*	*Cronbach's Alpha*	*Final Status*
Complexity and Uncertainty	1-3 (3)	.79	Kept
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
Performance impact – re. information from other law enforcement agencies[2]	48,49,51 (3)	.92	Kept

[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.

Instrument Limitations

The survey instrument referred to and used for this dissertation has limitations, as do most such instruments (Goodhue and Thompson, 1995; Ioimo, 2000). The first limitation is the age of the survey (Ioimo, 2000). Computer technology is evolving with breakneck speed. Moore's law, which has held true for over twenty years, suggests that computing power will exponentially increase every eighteen months (Gates, 1995). These advances have brought us computers that are more compact, faster, and more powerful. This increase in processing power coupled with advances in memory capacity and data storage have led to the development of highly sophisticated software which has changed the computer-user interface. Thus, one must question the validity of the instrument, in the face of today's environment.

Another issue is that the Goodhue (1998) ". . . instrument development was guided by a task model of managerial decision making using recorded organizational information" (Goodhue, 1998, p. 105). While this might appear to be a problem initially, Goodhue acknowledged that no one instrument can meet all needs and that the TTF instrument ". . . should be considered an attractive option for researchers and practitioners seeking to measure the effectiveness of organizational information systems" (Goodhue, 1998, p. 105). Ioimo (2000) helped to mitigate these concerns when he modified the instrument and more recently validated it for the population of law enforcement.

Sampling Strategy

The discussion of the sampling strategy will begin 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 Broward and San Diego County Sheriff's offices assigned to non-administrative functions and who use computers as part of their jobs.

The sampling strategy employed to select study participants is stratified random sampling. I used this method because the sample frame consists of detectives and patrol officers; stratification will ensure that the sample group will contain 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:

3.) The names and departmental ID numbers of all officers and detectives assigned to non-administrative law enforcement investigative and patrol functions were downloaded from the agency computer system.

4.) I loaded these names into SPSS and used the SPSS random selection utility to select the appropriate number of deputies and detectives to be included in the sample.

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

Sample size

The sample size should be large enough to test the Hypotheses. It 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 type II errors (Bickman and Rog, 1997; Fowler, 1993; and Meier and Brudney, 1992). 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 I will use it for this project. It represents the probability of a Type I error (i.e., finding statistical significance when in fact there is no effect). Characteristics of a given population influence sample size and statistical power; a homogeneous population will require a smaller sample size than a heterogeneous population to arrive at the same statistical power (Fowler, 1993). The population under study in this dissertation is somewhat heterogeneous, consisting of detectives and patrol officers. I use the term "somewhat" because the split of patrol officers to detectives is about 85/15%. Given the 85/15% split in population, with a desired alpha = .05, and assuming a simple random sampling technique, the sample size should consist of about 300 from each of the two groups, the info-sharing (SDSO) and comparison (BSO) groups (Fowler, 1993). This will result in a desired confidence interval of .03, (or less) given that I used stratified random sampling, which reduces the sampling error (Fowler, 1993). Thus, we can be sure that estimates made based on this sample are ± 3% accurate.

Interview Questions

The qualitative portion of this research begins with interviews of 38 randomly selected law enforcement officers, the Info-sharing group - n=18, (Detective n=8, Deputy n=10) and the Comparison Group - n=20, (Detective n=10, Deputy n=10) . The purpose of the interviews is to gain insight into their use of information technology.

Table 7 Interview Questions Mapped to Hypotheses

INTERVIEW QUESTIONS	NULL HYPOTHESES
1) How often do you use a computer in your work (how many hours during a given workday)?	Ho_2: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual performance. Ho_3: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual productivity.
2) Do you think the computer system you use contributes to officer safety?	Exploratory – no specific hypothesis
3.) In your normal workday, what percentage of your total computer usage involves entering information and what percentage involves extracting information (writing crime/incident reports, gathering information to support investigations, checking wants/wanted, etc.)?	Ho_4: No 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. Ho_5: No 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.
4) What are the top three (specific) tasks for which you use a computer?	Ho_4: No 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. Ho_5: No 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.
5) During the past five working days how many times per day did you use the computer to look up or access information (look up names, person involvements, check incidents, pawned property, F.I.'s, etc)?	Ho_2: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual performance. Ho_3: No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual productivity.

INTERVIEW QUESTIONS	NULL HYPOTHESES
	Ho_4: No 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. Ho_5: No 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.
6) When you use the computer to access or look up information, what percentage of the information do you get from sources outside of your law enforcement agency's databases?	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.
7) What percentage of the information is from other law enforcement agencies?	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.
8) Is the information that you are able to get (through the computer system) from other law enforcement agencies, helpful? If so please describe.	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.
9) Would you like to see it changed? If so, what changes would you like to see? (Refers to question 8)	Exploratory – no specific hypothesis; seeks to clarify or explain other responses and could relate to any of the hypotheses
10) Only a relatively few law enforcement agencies in the nation are able to use computer systems to share internally stored data and information. What is your opinion of the usefulness (and value) of information sharing to street level law enforcement officers?	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.
11) Do you have any complaints about the existing computer systems or data? If so, what is your major complaint?	Exploratory – no specific hypothesis; seeks to clarify or explain other responses and could relate to any of the hypotheses
12) Do you have any suggestions for improvements to existing computer systems?	Exploratory – no specific hypothesis; seeks to clarify or explain other responses and could relate to any of the hypotheses

INTERVIEW QUESTIONS	NULL HYPOTHESES
13) Do you have any suggestions for improvements to the information you are able to get using the computer systems?	Ho_6: No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.
14) When it comes to choosing systems for your use, do you think management is in tune with your needs? (please explain)	Exploratory – no specific hypothesis;

I created the interview questions to inform and clarify data gathered using the surveys. Table 7 links the interview questions to hypotheses. Below are the questions asked and rationale for each.

1) How often do you use a computer in your work (how many hours during a given workday)?

Davis et al. (1989) theorized that the user's attitude and intention dictate the extent to which he/she uses an information system. A key element in forming attitude, especially among inexperienced computer users, is whether the user of the technology believes that the technology will improve his/her job performance (Taylor and Todd (as cited in Ioimo, 2000)). This concept is important to this study in that a users' perception of the usefulness of technology is a variable in actual 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 as important to productivity gains. Professional workers will derive greater benefits from a computer system if they routinely rather than selectively use the system (Danziger and Kraemer, 1985).

This question therefore supports Ho_2 and Ho_3, which deal with individual performance and individual productivity respectively, as cited in the literature.

- Ho_2: No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual performance*.
- Ho_3: No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity*.

2) Do you think the computer system you use contributes to officer safety? (Please explain)

This question emanates from earlier research that suggests that mobile computing does very little for law enforcement officers. Nunn and Quinet (2002) investigated the effects of information technology on problem-oriented-policing and found little evidence to suggest that a specific type of mobile technology (CDPD)[3] offered any advantage to officers engaged in problem oriented policing. As part of their research they noted ". . . officer safety might be a real and critical longer term impact of CDPD . . . but more research needs to be done in this area" (Nunn and Quinet, 2002, p. 193). While it is not germane to any specific hypothesis, it could be an unexplained factor in system usage leading to further research questions.

[3] CDPD – Cellular Digital Packet Data: A technology that enables mobile computers to send and receive data via the cellular phone system.

3) In your normal workday, what percentage of your total computer usage involves entering information and what percentage involves extracting information (writing crime/incident reports, gathering information to support investigations, checking wants/wanted, etc.)?

A number of studies relating to mobile computing in law enforcement suggest that this technology has been of limited value in helping patrol officers to do their jobs (Nunn, 1993, 1994; Rocheleau, 1993). Key in these studies and of particular relevance to this dissertation is the issue of lack of access to information. Nunn (1994), in his study of patrol officers' use of mobile computers, noted that these computers lacked accessibility to data beyond wanted persons, property and vehicle information. Brown (2001), in her work on law enforcement technology in general, suggested that law enforcement officers need access to a variety of information from a number of sources. This question therefore supports Ho_4 and Ho_5, which deal with the role automation plays in providing information that assists officers in investigations leading to both arrests and case clearances; it relates to the literature cited above, which suggests that law enforcement officers need access to more information. This question will help to clarify the context within which the officers are using computers and whether a difference exists between groups.

- Ho_4: 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*.

- Ho_5: 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 *clearing cases.*

4) What are the top three (specific) tasks for which you use a computer?

   This question is related to question three but asks for specifics concerning the tasks performed by the officers in using the computers. It seeks to illuminate the kinds of activities associated with the officers' use of computers and should identify whether these activities support Ho_4 and Ho_5.

5) During the past five working days how many times per day did you use the computer to look up or access information (look-up names, person involvements, check incidents, pawned property, F.I.'s, etc)?

   This relates to questions 1, 3, & 4 and homes in on the primary research question concerning the use of computers to access information. This question therefore supports Ho_2 and Ho_3, which deal with individual performance and individual productivity, and Ho_4 and Ho_5, which deal with the role automation plays in providing information that assists officers in investigations leading to both arrests and case clearances. It relates to the literature cited above, which suggests that law enforcement officers need access to more information (Nunn 1994, Brown 2001) and that the extent of system usage is important in increasing the benefits of computing to work performance (Danziger and Kraemer, 1985).

6) When you use the computer to access or look up information, what percentage of the information do you get from sources outside of your law enforcement agency's databases?

Question 6 is central to the concept of information sharing. It seeks to discern the extent of access and usage of information obtained from sources outside of the home law enforcement agency's databases. It supports and informs Ho_6, which deals with the role automation plays in providing information from external databases.

- Ho_6: No 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.

7) What percentage of the information is from other law enforcement agencies?

Question seven, like question 6, is central to the concept of information sharing. It is a follow-up to question 6 and is more specific in that it seeks to determine whether the information that officers are seeking beyond their home agency databases is from other law enforcement agencies. It is at the heart of regional information sharing. It supports and informs Ho_6, with more specificity than question 6.

8) Is the information that you are able to get (through the computer system) from other law enforcement agencies, helpful? If so please describe. If not, why.

Information quality is an important element of this study based on the assumption that the quality and usefulness of information used by law

enforcement officers increases in direct proportion to its comprehensiveness. A number of studies as mentioned above suggest that certain technologies have been of limited value in helping patrol officers to do their jobs (Nunn, 1993, 1994; Rocheleau, 1993). The issue concerning the lack of access to information is cited as a problem (Nunn (1993, 1994). The need for information sharing among jurisdictions is also mentioned (Brown, 2001). It supports and informs Ho_6, and adds specificity to question 7.

9) Would you like to see it changed? If so, how would you like to see it changed?

This question is related to question 8 and seeks to further qualify the answers provided. It supports and informs (null)Ho_6.

10) Only a relatively few law enforcement agencies in the nation are able to use computer systems to share internally stored data and information. What is your opinion of the usefulness (and value) of information sharing to street level law enforcement officers?

Question 10 elicits the opinion of officers regarding the value of information sharing. It supports and informs Ho_6.

11) Do you have any complaints about the existing computer systems or data? If so, what is your major complaint?

This open-ended question provides officers an opportunity to discuss their concerns or issues regarding the systems they use. This question is exploratory. It

supports no specific hypothesis but seeks to clarify or explain other responses and could relate to any of the hypotheses.

12) Do you have any suggestions for improvements to existing computer systems?

Question 12 relates to question 11 and provides the officers an opportunity to suggest improvements in the systems they use. Like question 11, question 12 supports no specific hypothesis but seeks to clarify or explain other responses and could relate to any of the hypotheses.

13) Do you have any suggestions for improvements to the information you are able to get using the computer systems?

Question 13 relates to questions 11 and 12 but is more specific to information provided via computers. It is germane to this study and supports Ho_6.

- Ho_6: No 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

14) When it comes to choosing systems for your use, do you think management is in tune with your needs? (please explain)

This question relates to and seeks to illuminate prior research. Rocheleau (1993) through his research in the area of law enforcement mobile computing suggested that a difference of opinion existed between upper level management's view of the value of field computing and the view of the field officer. This

question seeks to determine if a difference in perception exist between groups.

Table 7 illustrates the link between the interview questions and hypotheses.

Quantitative Methods

Using SPSS, I conducted several quantitative analyses. The first step was to test the survey instrument for reliability. I used Cronbach's Alpha to determine which questions to keep and which to drop. This procedure is explained in detail in the 'Instrumentation' section of this study.

I used a number of procedures to analyze the survey data. The first was the 'Descriptive Statistics' report of SPSS to view the distribution of user characteristic variables for both groups. I then used a Chi-square procedure to determine if significant differences exist between the two groups of officers (info-sharing and comparison group). This step is important in ruling out rival hypotheses (Bickman & Rog, 1997). Chi-Square is the appropriate test to use when testing for independence of two variables when category or frequency counts are used rather than raw scores (Gliner and Morgan, 2000, p. 204).

The next step was to conduct an exploratory factor analysis to assess the overall fit of the data and determine which factors to retain for further examination. Rotation helps to interpret and identify the factors (Kline, 1993). I accounted for 74% of the variance; at least 70% of the variance should be accounted for (Stevens, 1996). I validated the factors against externally proven constructs as well as other observations of data.

The final statistical procedure was an Analysis of Variance (ANOVA). I used it to assess differences between group responses to the survey questions. This procedure provides 'Between Group' scores, which represent variation of the group means around the overall mean, and 'Within Group' scores, which represents variation of the individual scores around their respective group means. It also indicates the significance level of the F-test. I examined the data for small significance values (<.05) as an indicator of group differences.

A number of different statistical tests and methods are employed in this study. This is supported by Everitt and Wykes (1999, p. 125) who note: "No single test statistic in the multivariate case is optimal in all situations."

Methodology - Summary

This chapter takes an important step in clarifying the links between the research questions, Hypotheses, constructs and variables. The research of others, cited throughout this chapter, serves as a foundation for the constructs, and paves the way for this research. Chapters Four and Five, which follow, discuss the methodology in detail and provide the results of the hypotheses testing.

CHAPTER 4

QUALITATIVE ANALYSIS

In this study, I triangulated data collection methods. Triangulation lessens the potential threats to validity inherent in single-method studies, strengthening the study design (Patton 1990, Maxwell 1997). In addition to employing both quantitative and qualitative methods, this study will triangulate data collection methods within each. The qualitative portion, presented in this chapter, 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 working a normal shift. The activities were recorded, noting their use of automated systems. This chapter presents an overview of the findings of these interviews and direct observation, beginning with the interviews.

Interviews

This section provides the results of the interviews conducted as part of the triangulation of methodological approaches to gathering information. I interviewed 38 law enforcement officers. Interviewees were randomly selected from both agencies representing a number of different districts and shifts within each jurisdiction. The interviewees selected were detectives and patrol deputies as follows:

- Comparison Group (Broward) - n=20, (Detective n=10, Deputy n=10)
- Info-sharing group (San Diego) - n=18, (Detective n=8, Deputy n=10)

Table 8 presents a cross tab of responses to the interview questions, by agency, along with the Chi-Square statistics for each question.

Table 8 Responses to Interview Questions * Agency (Crosstab) and Chi-Square Stats

Questions and Response Categories (N=38)	Chi-Sq.	*P*	Cramer's V	BSO	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 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%
Q.5 No. of times accessing 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%

Questions and Response Categories (N=38)	Chi-Sq.	*P*	Cramer's V	BSO	SDSO	Total
Q.6 % of Info. received 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. 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*

Question 1. How often do you use a computer in your work (how many hours during a given workday)?

The Pearson Chi-Square value = 8.72, p<.05, and df=2 suggests that a relationship can be inferred in the population of interest. The values for the test statistic, Cramer's V=.479 informs us that the association is moderate, not strong. Given this moderate

relationship, it is appropriate to conclude that differences in responses between the two groups may be a mildly influencing factor and considered in support of other quantitative (survey results) and qualitative (observations) findings .

As indicated earlier, the empirical data suggest that the amount of computer usage is relevant and important in increasing the benefits of computing to work performance (Danziger and Kraemer, 1985). Given the reported extent of usage by both groups, one would expect to find differences in user satisfaction as measured by the survey instrument using Task Technology Fit (TTF) survey questions.

Question 2. Do you think the computer systems you use contribute to officer safety?

One of the more interesting observations made during the interviews was the manner in which the law enforcement officers responded to this question. Beyond the obvious differences in responses between groups, the BSO officers were more hesitant in answering "yes" to this question. The SDSO officers did not hesitate in their responses; they believe that their computer systems contribute to officer safety.

The overwhelming responses of the SDSO officers suggest that the information provided by the computer systems does contribute to officer safety, with 83% responding with an unequivocal 'yes' and 17% responding with 'somewhat.' BSO officers were less enthusiastic in their responses to the officer safety question. Face-to-face interviews offered the interviewer the opportunity to observe how the interviewee gives the responses. The biggest difference observed between the two groups of officers was the hesitancy on the part of 35% of the BSO officers in answering "yes" to this question. None of the SDSO officers hesitated in responding "yes" nor did any answer "no."

The individual responses to this question provided insight into the officers' perception of how computers, and specifically the information provided by those computers, contribute to officer safety. The following are noteworthy comments made by detectives and patrol deputies that are germane to this study.

Below are both quotes and paraphrased excerpts from the interviews of the SDSO personnel. Only those enclosed in quotation marks are direct quotes, all others are paraphrased. These comments illustrate their feelings concerning the role of computers in officer safety.

San Diego Sheriff's Office, Patrol Deputies:

- [Computers contribute to officer safety because they] allow dispatch to send information to the patrol cars en route to a particular call regarding whether the suspect has a history with weapons, etc.
- [Computers] enable deputies to ". . . gather information that gives them a 'heads up' before heading to a call."
- [Computers] allow the deputy to read information off a screen, instead of having it broadcast out loud for everyone (including a potential suspect) to hear.
- [Computers] enable you to ". . . run 'priors' before routine traffic stops."
- [Computers] enable me to map locations through the GPS (Global Positioning System), and put out BOLO's (Be on the Look Out) to other parts of the region.

- He thinks the ability to research suspects before serving a warrant helps contribute to officer safety.
- The MDC (mobile data computer) ". . . keeps the airwaves clear."

San Diego Sheriff's Office Detectives

- [re: ARJIS] "Our [regional information sharing] systems allow us to know what we are going into, and more about who we will run into."
- The system allows the department to disseminate officer safety bulletins around the region: ". . . we can also pull up criminal histories and search warrant information."
- "Our officers can share information, determine threat levels of suspects, and determine what outstanding charges might be on record that could increase the paranoia of the suspect we are apprehending." It also allows him to do a complete background check before serving any wants or warrants, which further increases officer safety.
- The information provided allows deputies to "get their ducks in a row" before pursuing a lead.

The following are responses provided by the BSO patrol deputies. These responses suggest that the feature of the computer systems considered most important to officer safety by BSO personnel is the ability to obtain information in advance of making vehicle and person stops. The deputies did not mention any other helpful functions, but pointed out that the presence of different technologies in their car takes attention away from the road, ultimately decreasing officer safety.

Broward County Sheriff's Office, Patrol Deputies

- He believes the computer systems are a distraction because the screen is hard to read, and "it draws your attention away from your surroundings." This reduces officer safety because ". . . if you are working on something in the car, someone could easily walk right up on you while you are concentrating on the computer."
- Hesitant in answering, but feels the systems contribute to officer safety ". . . because you can look up information on a plate/person before you make stops."
- He believes the systems improve officer safety because he ". . . can look up information on people before approaching them so you know what you are getting yourself into."
- Hesitant in responding, but concludes that the actual systems are helpful although ". . . you can't physically access many of them on the road because they are housed only in the station."[5]
- He believes that the computer systems contribute to officer safety, but they need improvement. Specifically, it would help to have the ability to view where his partners physically are by means of a real-time 'tracking screen' on the in-car computer. "Being able to run tags/people before making a traffic stop allows the deputies to know what they are heading into."

[5] The mobile computing systems do not have access to all of the data systems that are available through a computer housed at a district station. This is true for both SDSO and BSO.

- He feels that the systems contribute to officer safety when they are fully functional. He mentions that on this specific night, it took him 40 minutes to log onto the system. "When they are working properly, they provide helpful information before you make contact with a driver. You are 'flying blind' without it."
- He does not believe there is a direct correlation between the computer systems and officer safety.
- Believes the computer systems absolutely contribute to officer safety. He volunteered the following anecdotal evidence to illustrate his point: The deputy used the computer to get registration and wanted information on a car he was about to stop. He could not use the radio because the channel was busy with voice traffic. As he was exiting the vehicle to speak to the driver he heard a signal indicating that he had gotten a response to his inquiry. He noticed that everything on the computer screen was red, immediately alerting him to the fact that the vehicle was wanted. Before he approached the car, he was armed with the information that the vehicle was stolen and thus was able to prepare to accost the driver.
- He feels the systems often create a safety hazard by diverting his attention from the road, and therefore do not contribute to officer safety.
- He believes the computer systems contribute to officer safety because ". . . it gives you the edge over whoever is in the vehicle you are stopping."

- He does not think the computer systems contribute to officer safety because they draw attention away from the surrounding area and onto the computer screen.

The BSO detectives' responses, which follow, suggest that several features of the computer systems are important to officer safety. Several detectives mentioned the importance of being able to obtain information in advance of making vehicle and person stops. Also mentioned as important to officer safety, were access to criminal history information, access to information to enable background checks and the ability to send and receive BOLO's to other officers in the agency.

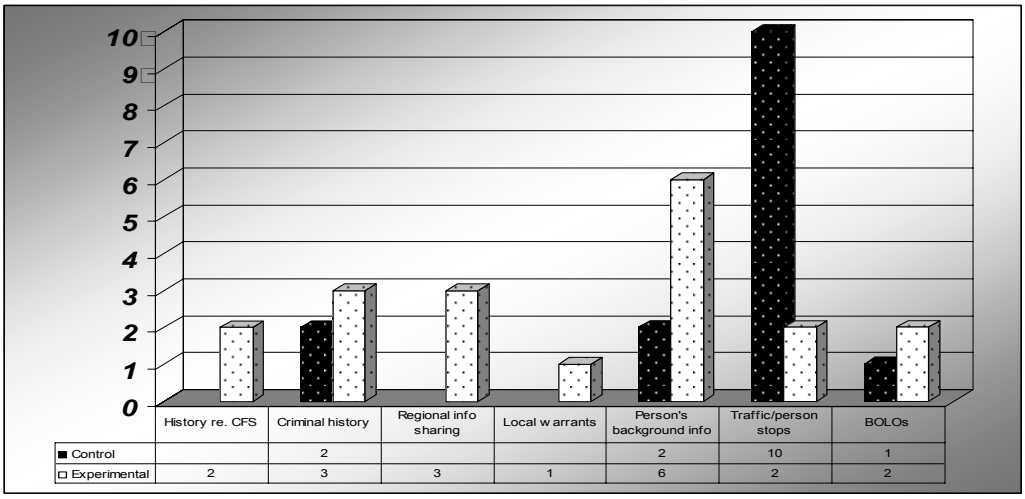
Broward County Sheriff's Office Detectives

- Hesitant in his response, and mentioned that his hesitation comes from the fact that he has worked for other departments where he has seen better systems. He would like to see some of those elements implemented in BSO.
- Hesitant in his response but conceded that the computers are better than in the past and that access to criminal history information contributes to officer safety.
- Thinks the systems contribute to officer safety because of their ability to do background checks with people involved in her cases.
- Believes the computer systems contribute to officer safety in that a deputy can research criminal histories and gather directions and maps while in-route to a location. He notes, "The more you know about your subjects, the more likely you are to come out alive."

- Thinks the BSO computer systems contribute to officer safety, but was hesitant in answering. He mentions that the only aspects that really contribute to officer safety are the ability to access information on cars before a traffic stop, and receiving BOLOs.
- He does not believe the BSO systems contribute to officer safety, but believes that systems exist which could and if made available to BSO, would increase officer safety.
- He thinks the computer systems contribute to officer safety because they provides better knowledge of the suspect's history as he approaches a house or car.
- He believes the known-offender system contributes to officer safety because it helps the street officer by providing a "heads-up" about what is happening around them.

The responses to the interviews suggest a relationship between the information the officers are able to get via computers and the degree to which they believe computers contribute to officer safety. To represent the essence and meanings of the responses to this question, I categorized them using a coding scheme that captures how information provided by computers supports officer safety. This technique, coding and categorization of meanings, has been used over the years for qualitative analysis (Kvale, 1996). The histogram (Figure 2) provides an illustration of the differences in perception between comparison (BSO) and info-sharing group (SDSO) officers regarding how computers contribute to officer safety.

Figure 2 Computer Support of Officer Safety[6]



The Pearson Chi-Square value = 17.07, $p<.05$, and df=3 suggests that a relationship can be inferred in the population of interest. The values for the test statistic, Cramer's V=.670 informs us that the association is moderately strong. Given this relationship, it is appropriate to conclude that the differences in responses between the two groups are significant and may be a mildly influencing factor to be considered in support of other quantitative (survey results) and qualitative (observations) findings .

Question 3. In your normal workday, what percentage of your total computer usage involves entering information and what percentage involves extracting information (writing crime/incident reports, gathering information to support investigations, checking wants/wanted, etc.)?

Officers estimate that the overall time spent on their computers is almost evenly split between query and entry functions. The responses to this question suggest only a

[6] The y-axis represents the number of responses; some of the interviewees gave more than one response. CFS pertains to information provided via the computer aided dispatch system about the call to which the officer is being dispatched.

slight variation between groups in total computer usage allocated to extracting data verses entering data. The Pearson Chi-Square value = 4.04, p>.10, and df=2 suggests no significant difference between groups in the percentage of total computer usage that law enforcement officers spend extracting data.

Question 4. What are the top three specific tasks for which you use a computer?

The major tasks mentioned by both groups were, 'Report writing,' 'Accessing data' and 'Communicating.' The responses to this question suggest only a slight variation between groups. This is consistent with the results reported in question 3 which suggests little difference between agencies in the amount of time that law enforcement officers spend extracting or querying data. The majority of the officers, 58%, indicated that 'Report Writing' is the number one task for which they use a computer. It is consistent with prior research, which suggests that many law enforcement officers see information technology primarily as a tool to produce reports (Tien and Mclure 1986, Rochelau 1993,). The number two task reported by officers was 'Accessing Data' from the systems. Of those interviewed, 74% named 'Accessing Data' as the top number 2 task for which they use computers. The third task mentioned by the officers was 'Communicating' with 18% rating it as their number 3 task. The officers responses indicated that they used the computer to communicate with others in different ways, such as messaging to other officers - commonly referred to as "car-to-car," interacting with the dispatchers, sending 'BOLO's (Be on the lookout for), and sending and receiving e-mail.

The Pearson Chi-Square values for the three tasks was not greater than .181 with all p values p>.05, indicating ns or no significant difference between group responses.

This suggests no significant difference between groups in the officers' assessment of the top three tasks for which they use their computers. In other words, given that the rankings of tasks are similar for both groups, one can extrapolate that they are using the computer for similar tasks.

Question 5. During the past five working days, how many times per day did you use the computer to look up or access information (look up names, person involvements, check incidents, pawned property, F.I's etc.)?

This question asked the interviewees to estimate the number of times per day they use the computer to access information. I used the last five days only to make it easier for officers to remember. The officers in the info-sharing group reported using their computers for this purpose less frequently than the comparison-group does. The Pearson Chi-Square value = 4.09, $p>.05$, and $df=2$ suggests no significant difference between groups in the percentage of total computer usage that law enforcement officers spend extracting data. This is consistent with responses to questions one, three, and four, which asked for related information.

Question 6.[7]) When you use the computer to access or look up information, what percentage of the information do you get from sources outside of the Sheriff's office databases?

The responses to this question are not consistent with what I expected to see.

[7] This question is based on working an 8-hour shift. Deputies working in the comparison group work 8 hours shifts whereas those in the experimental group work 12-hour shifts. The experimental group numbers were adjusted to an 8-hour shift to ensure comparability between groups

Officers from both groups report receiving a similar amount of information from sources external to the Sheriff's Office. The info-sharing group has access to more external information, especially the regionally shared data, which is absent from the comparison group. The deputies in the comparison group have access to data from their patrol cars, but a good deal of those data come from sources external to the Sheriff's Office, as is the case with deputies in the info-sharing group. The Pearson Chi-Square value = 1.26, $p>.10$, and $df=2$ suggests no significant difference between groups in the percentage of information that law enforcement officers get from sources external to the Sheriff's Office. Since the Detectives in the info-sharing group have easier access to regional information (ARJIS), I compared groups of detectives, independently. In doing so, I found those data similar to that presented above – the difference was not significant.

Question 7. What percentage of that information (refer to Question 6) is from other law enforcement agencies?

The responses to this question are in line with expectations regarding an agency with the ability to regionally-share information: 50% of the info-sharing group report that "a lot of" or "most of" their externally derived information comes from other law enforcement agencies. Of the officers in the comparison group, only 12% responded that "a lot of" or "most of" their externally derived information comes from other law enforcement agencies (see Table 15). The responses suggest that BSO officers are not getting much information from other law enforcement agencies - 33% responded only a "small amount" and 56% responded "none or hardly any." Of the info-sharing group

officers, 43% responded only a "small amount" and 7% responded "none or hardly any." I expected to see this difference in responses between groups of officers.

The Pearson Chi-Square value = 12.56, $p<.01^{*}$, and df=3 suggests that the difference between the groups regarding the perception of the amount of information they get from other law enforcement agencies is significant. The values for the test statistic, Cramer's V=.676, suggests that the association is moderately strong. Given this relationship, it is appropriate to conclude that the differences in responses between the two groups are significant and may be a mildly influencing factor to be considered in support of other quantitative (survey results) and qualitative (observations) findings. It also suggests that SDSO officers are getting a lot more computerized information from other law enforcement agencies.

Question 8. Is the information that you are able to get (through the computer systems) from other law enforcement agencies helpful? If so, please describe, if not, why?

The responses to this question illustrate a major difference in perception between the two groups. Officers in the info-sharing group responded unanimously (100%) that they believe the information they get from other law enforcement agencies is helpful. The responses from officers in the comparison group suggest that they feel the same, to the extent they have access to shared information via the computer system, with 50% believing that the information they are able to get from other agencies is helpful. This is an important finding when viewed in the context of the differences between agencies. It suggests that having access to information from other agencies is helpful even if it is not

* Significant at $p < .05$

plentiful, as is the case in San Diego. It supports the notion that information sharing is important to street level officers.

A theme in the responses of the SDSO officers was the value of the ARJIS system in providing information from other law enforcement agencies. Below are a few direct quotes about ARJIS from those interviews:

- " . . . extremely helpful . . ."
- ". . . responsible for helping me make most arrests."
- "The ARJIS system is more valuable than my vest or gun!"
- "Criminals are not bound by jurisdiction, that's how ARJIS helps."
- "Programs like ARJIS have helped to save lives"

Figure 3 is a synopsis of the coded response to question eight. It clearly illustrates the extent to which the law enforcement officers in the info-sharing group value regional information sharing (ARJIS). Most of the responses linked ARJIS to the positive benefits of law enforcement information sharing.

The Pearson Chi-Square value = 12.21, $p<.001^{*}$, and df=1 suggests that the difference between the groups in their perception of the value of information sharing is significant. The values for the test statistic, Cramer's V=.567 suggests that the association is moderately strong. Given this relationship, it is appropriate to conclude that the differences in responses between the two groups are significant and may be a mildly influencing factor to be considered in support of other quantitative (survey results) and qualitative (observations) findings.

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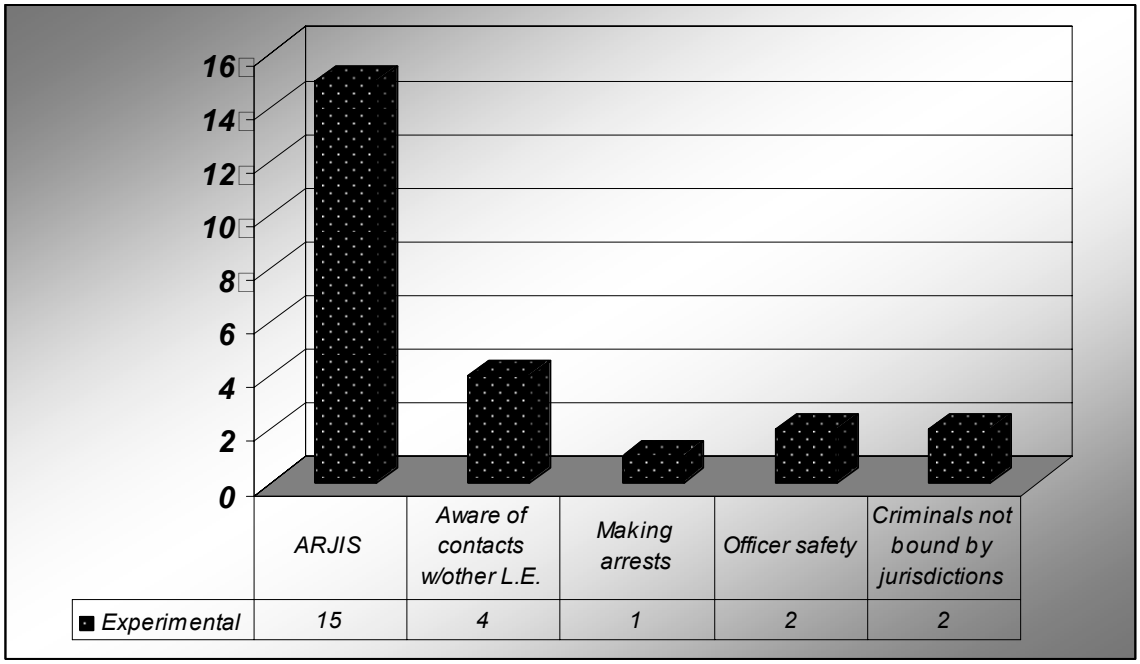
* Significant at $p < .05$

Figure 3 Responses to Why Information Sharing is Valuable



Question 9. Would you like to see the information that you are able to get (through the computer systems) from other law enforcement agencies changed? If so, how should it change? Should information be added, reduced, or changed?

This question further explores law enforcement information sharing by seeking to determine whether the interviewees felt that they needed more information from other law enforcement agencies. Differences were observed - 95% of the BSO officers desired access to more information compared to only 45% of the SDSO officers. These differences were significant with a Pearson Chi-Square value = 11.77, $p<.005$, df=1, and the Cramer's V=.557 suggests that the association is moderately strong.

An important construct addressed by this question is that of user satisfaction. Ioimo (2000, p. 56) notes: "User satisfaction is considered one of the most important

measures of information systems success (DeLone and McLean, 1992; Ives and Olson, 1984)." If this is true, the responses suggest that the info-sharing group perceives a higher degree of information system success in the area of information sharing than the comparison group.

Question 10. Only a relatively few law enforcement agencies in the nation are able to use computer systems to share internally stored data and information. What is your opinion of the usefulness (and value) of information sharing to street-level law enforcement officers?

The responses to Question 10 suggest that both groups equally shared the perception that information sharing was important to the street level officers. The difference between groups in their responses to this question is not significant; the Pearson Chi-Square value = .897, p>.100, and df=1, ns.

Question 11. Do you have any complaints about the existing computer systems or data? If so, what is your major complaint? Table 9 presents the salient system complaints from officers, compared by agency.

Table 9 Salient System Complaints

Complaint	SDSO	BSO
Too Many Passwords	21%	15%
Limited Information Available	11%	40%
Not Enough Training	21%	0
Systems are Not user- Friendly	11%	10%
Dead Spots	11%	0
Systems are too slow	7%	15%
Satisfied	7%	5%
Other	11%	15%
TOTAL	100%	100%

Complaints about systems can illustrate inherent weaknesses as perceived by its users. Several of the complaints were similar between the groups, i.e., "too many passwords," "too slow" and "not user-friendly." The difference in the most persistent complaint of each group is important and germane to this study. The top complaint of the SDSO officers, accounting for 21% of all complaints, is "not enough training" tied with "too many passwords." BSO officers' top complaint, accounting for 40% of all complaints, was "limited information available." Both groups complained about "too many passwords," with 15% coming from the BSO and 21% from SDSO.

Question 12. asks for suggestions to improve the computer systems. This was eliminated after the first few interviews – It is redundant, as the officers' suggested system improvements were the corollary of the complaints (Question 11).

Question 13. Do you have any suggestions for improvements to the information you are able to get using the computer systems?

This open-ended question asks interviewees to suggest improvements to the information available through the systems. The responses illustrated in Table 10 indicate a difference between groups. The top response for the BSO officers was the need for criminal history information while the SDSO officers' top response was "no suggestion." Both my research assistant and I got a strong impression that the motivation behind the info-sharing group's "no suggestion" response came from a sincere satisfaction with the SDSO technology instead of possible indifference or lack of an answer, as they truly did spend time contemplating the question. This suggests that they have a greater degree of satisfaction with the information available through their systems than do BSO officers.

The BSO officers noted the need for more criminal history information as their top response (30%); they also suggested a need for more information, in general, as their second highest response (25%). This aggregates to 55% of the suggestions for improvement involving the need for additional information.

The Info-sharing group's second highest suggestion, at 24%, was the need for more information; only 4% of the suggestions expressed the need for criminal history information. This aggregates to 28% of the suggestions for improvement involving the need for additional information from the Info-sharing group. The third most prevalent suggestion from both groups involved making information more easily accessible (BSO at 20% and SDSO at 19%). Both groups complained that on any given day, passwords, user rights, and system availability might play a role in the overall process of trying to access information rapidly and with ease.

Table 10 Suggestions for Improvement of Automated Information

Suggestion to Improve Information	SDSO	BSO
Provide access to more information	24%	25%
Make information easier to retrieve	19%	20%
Provide greater access to criminal history information	5%	30%
Provide access to more information from the patrol car	5%	10%
No suggestions	28%	5%
Other	19%	10%
TOTAL	100%	100%

Question 14. When it comes to choosing systems for your use, do you think management is attuned with your needs (please explain)?

Earlier research in the area of law enforcement mobile computing suggests that a difference of opinion, or "disconnect" exists between upper level management's view of

the value of field computing and the view of the field officer (Rocheleau, 1993). That research prompted this question to determine if this phenomenon extended beyond mobile computing. While this question is not germane to a specific hypothesis, it could elucidate other responses and findings and prompt questions to guide future research efforts.

The data reveal that 67% of the SDSO officers feel that management is attuned to their needs, compared to 47% of the BSO officers. The Pearson Chi-Square value = 1.54, $p>.10$, and $df=1$ suggests that any observed difference between groups is insignificant. Statistically, no significant difference exists between groups in their perception of whether management is attuned with their computing needs. If information sharing makes a difference, it does not influence the officers' perception in this area.

Interview Summary

The interview questions provided an opportunity for the researcher to gather information to support several of the hypotheses. 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. The SDSO officers' estimates are higher than the estimates of their counterparts from the BSO. As expected, we found differences in productivity related to computer usage in the quantitative analysis, Chapter 5.

An unexpected finding was the significant difference in perception between groups concerning whether the computer systems contribute to officer safety. The SDSO officers were unequivocal in their belief that systems contribute to officer safety. The BSO officers were not quite as positive. This is definitely an area that deserves further research, as it is untested and could be a dimension of TTF, unique to law enforcement.

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

Five questions dealt with the information officers are able to get from their computers. The data suggest no difference concerning the amount of information officers are able to get from outside of their agency. As expected, significant differences were found between groups and mildly strong associations in responses to questions that addressed the amount of information officers are able to get (through their computer system) from other law enforcement agencies: SDSO officers report getting more information from other law enforcement agencies than did the BSO 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' Chapter.

Direct Observation

The goal of direct observation is to corroborate and explain other findings, i.e., interview results and survey response data. I arranged to allow Sara Hoback, a research assistant, to work and ride along with law enforcement officers from both the info-sharing (SDSO) and comparison groups (BSO) after the surveys were completed and the data were analyzed. Sara has experience doing research for the US Department of Justice, Information Technology Initiative but has no law enforcement experience, which gives her an informed, yet objective perspective when observing the officers[8]. She also lives in San Diego, which made the ride-along with the San Diego County Sheriff's Office (SDSO) convenient. I instructed her to observe the officers during their normal workday and to document exactly how the officers use their computers, as she was riding along. As the primary researcher, I found nuances in the surveys that deserved further exploration, via direct observation. Having Sara do the observations permitted me to give her a general idea about theses items, but not to cloud her mind with too much related analytical data. This enabled her to look for important issues, in the absence of preconceived notions that might otherwise cloud her observations. An important part of these observations is to discover the steps the 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 11, on the following page, provides a synopsis of the salient observations. This is followed by the 'selection criteria' and an overview of the observations.

[8] The primary researcher is a retired law enforcement officer with over 30 year's of experience and has managed and implemented a number of automated law enforcement information systems.

Table 11 Synopsis of Salient (Direct) Observations

Broward County Sheriff's 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 techniques, i.e., POWERTRAC, appears to be a variable in decreasing crime and increasing clearance rates; MOST OF THE OFFICERS MENTIONED POWERTRAC;	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 in BSO;	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 POWERTRAC);	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.

Selection Criteria

Twelve law enforcement officers were selected to be part of the direct observation: four Deputies and two Detectives from each department. They were selected from three different district stations in each Sheriff's Office, chosen based on convenience (easy to get to) and accessibility (receptive to hosting a ride-along). District supervisors chose the officers purposively, based on criteria supplied by the researcher, i.e., the officers had to be highly computer literate[9], critical thinkers, who would not be afraid to tell the researcher what he or she thought. They also had to be receptive to allowing a researcher to ride along during a tour of duty. 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.

San Diego Sheriff's Department (SDSO)

Ride-Along #1, Detective

Before he began his shift, the detective mentioned his daily breakdown between computer tasks involving inputting vs. extracting data. He estimated a 60/40 split, and during this conversation, his cubicle partner (an auto theft detective) mentioned that he guessed his split to be around 20/80. However, through direct observation, Detective

[9] Computer literacy was important in ensuring that the officers knew the technology well enough to be able to use all of its functions and thus demonstrate optimal usage in the field.

#1's usage during the shift was actually a 40/60 split. When noting this, the auto theft detective who happened to be nearby, mentioned that after further thought about his split, he believed it to be closer to 30/70. His breakdown is different because he is querying the law enforcement regional information sharing system (ARJIS) repeatedly to run stolen vehicles, much more so than Detective #1, who also used ARJIS, but not as much. This observation suggests that it is difficult to estimate the actual breakdown, simply because it is hard to visualize and estimate these numbers.

Detective #1, when using systems that query information, was able to complete these tasks quickly. He is obviously well versed in ARJIS and SUN; simple property or person queries took only about 15 seconds to execute and read. Inputting took considerably longer – entering a report via X-pediter took anywhere from 10 minutes to 45 minutes. He mentioned that some people refuse to use X-pediter and instead, hand-write the reports. He noted that these people often finish their reports much faster than those "sticking it out" and using X-pediter. Besides writing reports, the other main inputting task is completing daily logs. On this day, the input for the daily log only took about 10-15 minutes to complete.

He printed out a criminal history report, and explained the listing of information. He immediately mentioned that the reports are not clear and coherent. He thinks there is too much information to sift through, and that there are a few key things missing, such as detailed sexual offender information.

During the shift he entered 10 different passwords to access different systems (voicemail, network, LEADS, SUN, MDT, DMV, CAD, ARJIS, cell phone, gun safe). At the end of the shift, he mentioned that there are simply too many passwords to

remember, and this prevents people from using all the systems to their fullest. Some people refuse to use anything beyond the most basic required systems.

In order to gain information from other law enforcement agencies, this Detective had one of two options: 1) gather information through an ARJIS or SUN query or 2) make a phone call. During this shift, he did not have to make any phone calls, but mentioned that making phones calls was a common occurrence when investigating a case. He mentions this is because information in ARJIS is often not up-to-date, and sometimes the information available is not detailed enough, which then requires a phone call to the other agency. During this particular shift, he used ARJIS about 10 times to look up information.

He walked through the process of finding a piece of computer-based information from another law enforcement agency. He initially started by signing into ARJIS and running a "name" query. When nothing came back, he entered more information, this time an address. This brought up a listing of four possible matching addresses along with associated law enforcement agencies, but they were not correct for the person under investigation. He then queried the SUN system for an Automated Name Index in an attempt to locate a Driver's License. It worked, and he now had the driver's license number and was able to go to Cal-Photo to pull it up. At this point, he stopped and made a follow-up phone call.

Eight times during the shift, other deputies and detectives asked him to answer computer-related questions. This prompted him to mention the lack of training in the department. He believes that every day he spends at least an hour, or 15 times a shift, helping other people with computer-related questions. He said this is frustrating because

it takes him away from his cases, makes him lose his train of thought, and probably in the end, resulted in his clearing fewer cases. He is adamant that this is not fair to him, because it affects his work, as he cannot just turn away people who need help and have no other way of obtaining it.

Ride-Along #2, Deputy

This patrol deputy used his MDT (Mobile Data Terminal) to run tags (automobile registration plates) about 120 times during the shift, and he ran about 12 DL's (driver's licenses checks) during routine traffic stops (totaling about 15 minutes). This day was slow; he mentioned that the day before was busier so he only had time to look up 10 tags. It is clear that his input/extract breakdown varies dramatically on a day-by-day basis.

He spent about 45 minutes writing reports at the end of his shift. The remainder of the time he was patrolling his beat, while constantly having one hand on the computer, checking the status of other officers, the GPS, and scrolling through his event log. Almost the entire time he was in the car, he had one hand on the computer. The only time his hands were not on the computer was when he stepped out of the car for routine traffic stops (which accounted for a total of 30 minutes of the shift). Having one hand on the touch screen scrolling through data appeared to be his natural position while in the car.

He is able to query using the following functions: 1) SUN queries (Wanted/Missing/TRO/SRF), 2) Stolen Vehicle and/or Registration, 3) DL by names search (queries all automated DMV state databases), 4) CA registered vehicles, 5) DL number search, 6) Free Form.

He mentioned that access to criminal history information from the patrol car would be very helpful. He also mentioned the need for photos in the cars. He repeatedly reiterated instances when he could not positively identify a suspect because they do not have a license, but if they had access to photos, it would be possible to make a positive ID with or without an actual license. He told a story about having to wait 45+ minutes for delivery of a photo printout to a scene where he was trying to make a positive ID.

He stopped at a "Community Storefront Access Center" to use other systems that are not accessible from the car. The deputies and detectives can stop at these centers to use the internet and access ARJIS instead of leaving their 'beats' or 'posts' to return to the station. This technology was recently implemented; he was very pleased to have this access, since his specific beat was one of the furthest away from the station. He mentioned that although the deputies would love to have ARJIS in the patrol cars, just having more community storefront locations might be able to provide the same service at a reduced cost, since he seemed fairly certain that installing ARJIS in patrol cars would mean overhauling the entire existing MDT because of current memory and speed capabilities.

Ride-Along #3, Deputy

During the ride-along, whenever other officers asked him questions about the computer systems, he would share his response via email to the rest of his patrol group, which would elicit about 7-8 additional responses.

Similar to the previous deputy interviewed, he kept one hand on the computer the entire time he was in the car. He was constantly checking the MDT screen to see the

status of other patrol deputies, their locations, and on-going calls. There was rarely a moment when he had both hands on the wheel. He spent about 1 ½ hours outside of the car on routine stops, roll call, stops at the Community Storefront Access Center, and report writing at the end of the shift. Of his total time, he went back and forth to the computer about 100 times. Of that, 60% of the time was to use the SUN Query systems to find people, plates, and other information. About 20% of the time he was on the computer, he was checking the status and location of his patrol group, and the remaining 20% he was writing reports and doing other routine data entry tasks.

The deputy stopped about 4 times during this shift to look up information from ARJIS at the Community Storefront Access Center (after field interviews, or reports of stolen property). He mentions that this is how he chooses to access information from other agencies, and that he typically stops by the Community Storefront Access Center about 6-8 times per shift. He said this was easier than running back to the station because of the location, and the fact that he usually has the whole facility to himself, and therefore is not sidetracked by other happenings at the department. There was only one other officer at the Community Storefront Access Center each time he stopped, although there were approximately 8 terminals with ARJIS access per center. He did eight separate queries, totaling about 15 minutes.

He repeatedly mentioned that there were too many passwords and that sometimes they required different combinations of capitalization rules, and number and letter combinations. He needed eight passwords during this specific shift to gain access to his necessary systems. When asking the other patrol deputies on the computer network about

the password issue, 12 people wrote back and made joking comments about the unreasonable amount of passwords they must remember.

He continuously complained about the Xpediter report-writer system. His main complaint about the system was that it did not operate similar enough to a Word-based program, because fields of information were not transferable. However, in watching his use, it seemed that he navigated the system quickly, and with ease.

He reviewed a criminal history report, and pointed out his problems with the format. He thinks he is getting too much useless information and not enough helpful details. He wants more case disposition information.

He mentioned that not all dispatchers have an ARJIS-ready terminal in front of them, at times he has been told that he is "8th in line" when needing a specific piece of information. He said this only becomes a problem if he is far away from a Community Storefront Access Center, or the station, but that if ARJIS were installed in the patrol cars, this would never be a problem.

Ride-Along #4, Detective

He began the shift mentioning how frustrating it is to need to recall so many passwords. During the shift, he used 10 different passwords. He believes that some people do not take full advantage of the systems because they cannot keep up with all the ever-changing password requirements.

He pulled out a criminal history report on a suspect that he believed to be involved with an ongoing vehicle-theft ring. He mentioned that reports lack information that would be most pertinent to detectives. For instance, he wants to be able to view

where sex offenders are employed, and whether a sex offender lives near a school. He told a story about how a registered sex-offender was recently discovered working with female athletes at a local high school. The offender was hired through a friend of a friend, his criminal background was not discovered until after he had been working there for months. If it were possible to require employment location and/or employment details on criminal history reports, this might have been caught sooner. He is very concerned that more sexual offender information is not included in criminal history reports since this is so critical to public safety. In addition, he wants to see more federal-level convictions and "watch information," on the local criminal history sheets. He pointed out that if a Federal agency is watching a criminal, but the criminal has not made contact with the SDSO, they would have no idea that they have had other federal agency convictions or watches.

He seemed to be very at ease with using his computer systems. He says this comes from years and years of self-training. He said he believes there has been a dangerous lack of focus on computer systems training because of recent budget cuts, and thinks this is a bad idea since the deputies and detectives are so heavily reliant on computers to help them find information key to officer and public safety. He pointed out that he spends at least one eighth of his shift everyday helping less computer savvy detectives with their computer problems. According to him, this is a huge problem on the department, as they know that peer-to-peer support will take the place of formal training if there is no other choice. ". . . the proper training needs to be in place to allow me to best do my job."

He spent 80% of the shift extracting information from computer systems. He used the SUN Query a great deal, using mostly ARJIS and NCIC. He spent the remaining 20% of the time entering data via Xpediter and Choicepoint (supervisory software which helps to track some of the detectives he supervises). He mentioned that he really would like to see the various query systems all brought into one. It would be helpful to just enter a name once, and then run it through the various systems. He spent a great deal of time opening and closing different programs, and at any given time, had at least 3 systems open on his desktop. He completed about 110 separate queries during the shift within these multiple systems.

Ride-Along #5, Deputy

This midnight shift deputy is a K-9 specialist. He mentions that his computer usage during the nighttime shift varies greatly from the daytime. He feels more comfortable having one hand on the computer, constantly running tags and people during the daylight, but not at nighttime.

During the shift, he went to his computer about 60 times to look up information or to input data. The majority of that usage was checking on other patrol cars and viewing the pending calls from dispatch. He runs an occasional license plate in parking lots, but overall, his computer usage seems less than the past few interviews. His breakdown of input vs. extract is about 50/50.

While patrolling his beat, he responds to a call to take a report of a stolen bike at a victim's residence. After completing the report, he went the Community Storefront Access Center to run the stolen property through ARJIS. He then spends about 10

minutes writing the required report using X-pediter. He mentions that he comes by the Center about 8 times a shift, and it is a good way to talk with deputies from other areas to talk about what's happening out in the neighborhoods. There was a fair to large exchange of information each time he stopped in, especially BOLO's being distributed and other word-of-mouth items of interest of which they were not aware.

His major complaint during the shift is passwords. Like all the other ride-along participants, he mentions that there just needs to be one password to let you into all of the systems. He also wants to see more computer programs grouped together so that it is possible to do a single query to search multiple systems at once. He complains it is very time wasting to have to keep opening, signing-in, logging off, and closing each program every time he needs to use one.

He mentioned that the criminal history reports have too much useless information, and not enough detailed, important information. He also thinks sex-offender data need be much more comprehensive.

Ride-Along #6, Deputy

This session began with the deputy receiving word via email that a certain Sgt. within the Data Services Department was reassigned. He was very upset, as were his colleagues, at the fact that this Sgt. was the only person in Data Services with in-depth knowledge of working patrol. They believed he is responsible for many of the good things that have happened with technology implementation, especially in the patrol cars.

This Deputy kept one hand on the mobile computer screen almost the entire shift. He was very interested in where the other patrol cars were, and constantly checked the

status of calls. He ran tags every time there was a lull in traffic, or when he was not busy on a call. All together, he ran about 60 tags. During the shift, he went to the computer about 120 times to enter or extract data, with the breakdown being close to 50/50.

He did not have much interest in using ARJIS. He mentioned that he rarely uses it, and cited password and user-friendly issues as to why he does not use it more. He used dispatch to find out ARJIS information regarding a stolen car once. However, he uses the Community Storefront Access Center for report writing because he likes the "peace and quiet" of not being in the station and having many distractions. He thinks that ARJIS is very helpful for detectives, but that it really does not do much for the deputies since they do not have time on the beat to act like detectives.

Broward County Sheriff's Office (BSO)

Ride-Along #1, Deputy

This deputy spends most of his shift doing visual scans of his zone. He does not spend much time on the Mobile Data Terminal (MDT) unless he makes a routine traffic stop and uses NCIC/FCIC to run a license check. He estimates that he makes about 6-10 queries a shift, including both NCIC/FCIC and the Known Offender Database (this was developed in-house for this specific district). He does not run many tags because it takes his eyes off the road, and it is not possible (and against policy and procedures) to use the computer while the vehicle is moving. His computer sits in an awkward position in the car so that even if he wanted to use the computer while moving, it would be unsafe. The observed breakdown of his input/extraction using the computer comes out to be about 70/30.

While using NCIC/FCIC, he comments that he believes it searches too far out of range to determine close hits. This brings up a large amount of data on the screen to scan through, which he believes consumes too much time on every traffic stop.

Besides querying NCIC/FCIC and the Known Offender Database, he spends the remainder of his computer time doing routine data-entry such as case-logs, report-writing (using the Interim Report Writer, IRW), and entering information in the Captains Log. He completes accident reports by hand, because the software for computer-based accident report writing does not work correctly on his older Toshiba computer He spends about an hour a day with these data-entry tasks.

He mentioned a couple officer-safety issues besides the location of the MDT in his vehicle. He is concerned about the direction the department seems to be heading in with regard to non-verbal communication with dispatch. For example, he mentioned that they are able to notify dispatch via MDT when officers arrive at the site of a call, and when they become available again. He is concerned that without a verbal component, there is a good chance that the dispatchers might not be looking at their screen when information pops up, whereas with verbal confirmation, he feels safer.

His major complaint throughout the shift was that the departmental systems are too fragmented. He believes they need to develop a way to integrate the dispatch system with the IRW. He wastes much of his time repopulating fields in the IRW that should automatically transfer over from the notes initially sent by dispatch.

He also mentions that he would like to see more integration with other law-enforcement agencies in the region. He mentions that with POWERTRAC, a program designed for results-based management and accountability, they are responsible for

knowing crime trends and criminal activity in their zone as well as surrounding zones; this drives them to contact other agencies for information, even with the current lack of automated access to regional information.

Ride-Along #2, Deputy

This deputy patrols a zone with a very high auto-theft rate. She uses NCIC/FCIC a great deal, running about 100 license plates per shift. On this particular shift, the NCIC/FCIC database was running slow. She would type in a random plate while stopped in traffic, and by the time the information came back, the car was long gone. Sometimes it would take 90 seconds or more to get results. When she had to make a routine traffic stop, she needed to call teletype to get local warrant information, which would only take about 30 seconds to obtain results (state warrants are searched by FCIC). The observed breakdown of her input/extraction using the computer comes out to be about 50/50.

She does her "paperwork" on an ongoing basis during the shift. After each call, she finds a place to pull over and complete the report and case log, which takes about 5 minutes. She mentions that she does not like the redundant nature of the IRW program. She would like to see the notes sent by dispatch to the CAD screen automatically populate associated fields on the report writer and case log. Because she has an older computer in her car, she claims that her accident report writing software does not function properly; she is required to write her accident reports by hand. (Note: SDSO does not handle accident reports, or most traffic-related patrol. The California Highway Patrol handles this.)

Throughout the shift, it is evident that she is very aware of crime trends and the community in her assigned zone. She knows every business that has been a target of

robbery, every house or apartment that has associated drug activity, and has an established dialogue with many of the citizens in the neighborhoods. She mentioned that POWERTRAC, has resulted in an increased level of awareness and accountability for the activities in their zone. She feels that it holds her responsible for educating herself about crime trends, known offenders, and other activity on her beat. She mentioned that it also makes her aware of what is happening in areas surrounding her beat, since criminals do not respect boundaries.

This deputy did something that is not possible in SDSO; she closed her laptop. (The MDT in SDSO is a "permanent fixture" and does not have a lid to close). She would only open it when she heard the dispatch ring-tone to notify her to check her CAD, or at least every 25 minutes otherwise. She said this has an impact on lowering her distraction level by the computer.

She mentioned repeatedly that the amount of BOLO's being sent via verbal dispatch and via CAD are too overwhelming to remember. She would like to see a way to make the BOLO's only be sent via CAD, since there is only so much information one person can retain when it is told to them verbally.

Ride-Along #3, Deputy

This deputy patrols an area high in auto theft, and therefore he runs close to 250 license tags during a shift using NCIC/FCIC. He spends very little time writing reports and case logs, and mentions that his breakdown between input/extract is around 10/90. He spends very little time on the computer doing anything besides running tags.

This deputy has some great resources in his car, not seen in most of the patrol cars. He has his own printer, which he bought for his own use in the car. He mentions

this is a huge time-saver for him not to have to download files to disk to bring back in the station to print. He also has a stack of microfiche cards holding local warrant information (organized in an index similar to a phonebook) so that he does not have to radio teletype when he make a routine traffic stop. He says that any deputy can get this stack of cards from the court at the beginning of each week, but most do not take the initiative.

He mentions various ways the computers contribute to officer safety, including having NCIC/FCIC, Known Offenders Databases, and POWERTRAC crime trends information. He thinks it crazy that some deputies claim computers are a distraction. He brings up the point that before computers, deputies still had to stop somewhere to write reports during the shift, and whether it is done with paper and a pen, or on a computer, it still takes your eyes somewhat off your surroundings. Further, instead of looking at the CAD screen as they now do, they used to have to take a hand off the steering wheel to use the radio, and then write down the details of the call on a pad of paper. He thinks many older deputies overlook this fact when complaining about the computers. Finally, he mentions that BOLO's need to be sent via CAD in order to help increase officer safety, arrests, and clearance rates. When they come over the radio, he cannot remember all the information just hearing it one time. It should always be sent via CAD so that they can store it, and review it if needed.

He also mentions POWERTRAC as a great tool, which facilitates knowing what is happening in his zone. He says this makes him accountable for crime and for developing a corresponding patrol plan. Without it, deputies just patrol their areas, taking report after report; instead they are forced to think ahead and try to prevent the incident that would drive them to have to write a report. It encourages both deputies and

detectives to make contacts in surrounding regions via email, FAX and scheduled meetings. He would like to see more computer-based information available from other agencies regionally to supplement their current verbal contacts. He says that if he needs a piece of information from a surrounding region while in the patrol car, he must use his own personal cell phone to initiate a call, which could take up to 20 minutes.

He wants to see formal computer training so that he does not have to spend as much time training his colleagues. He said that many deputies do not take the initiative to train themselves, and expect the department to continually spoon-fed the computer skills to them.

Ride-Along #4, Deputy

This deputy spent most of his shift doing visual scans of his zone, because of a recent increase of burglaries in the area. He used his computer only 5 times to check license tags, and this was on routine traffic stops and a car accident scene. He used the CAD screen and IRW systems the most, because the shift got very busy with calls for audible alarms and lost property. The observed breakdown of his input/extraction using the computer comes out to be about 70/30, especially because of the amount of reports he had to write.

In patrolling his zone, he pointed out a lot of information about surrounding businesses, communities, and parks, regarding crime trends and known offender information. When asking him how he became so aware of the area, he mentioned two factors: 1) he had been an area deputy for 22 years, and 2) the implementation of POWERTRAC. He claims that POWERTRAC is tough, describing it as "a wonderful accountability tool that can be a key element in reducing crime." When asked if he

thinks this makes a difference in how he does his job, he says "absolutely." He feels that POWERTRAC helped bring down crime rates and increase clearance rates.

His only main complaint during the shift was that he would like to see the different query systems all integrated into one. He would like to enter a person's name once, and have it reach out and grab information from all the databases available to them. He spends a good deal of time opening, closing, and entering data in different systems. He is convinced the department has the capability to find a way to do this with more efficiency.

Ride-Along #5, Detective

This detective uses the Sex Crimes Access Database to query a lot of information about offenders. He also uses Choice point Software called "Autotrack" which is a private industry database that contains information about people such as past addresses, associates, AKA's, driver's license information, social security info, etc. He uses a civilian analyst to do some of his data extraction, mostly to save time. He has access to systems that other detectives do not, so he says he is not the typical "user." He uses the Sex Crimes Clearinghouse on a daily basis (this is a surrounding tri-county database funded through a state grant). He claims that many detectives do not take the time to gain authorization for many of the databases that would be very helpful to their cases. For example, he mentioned that he has access to three different databases that most detectives think they are blocked from, simply because they have not taken the time to ask for user rights. Because of this, he often has people asking him to gather information from his system. He estimates that he spends about 10% of hour every day training various

coworkers. He was very concerned about the amount of training he is expected to conduct on a daily basis. His major complaint during the shift was that there is a lack of good records management. For his specific job function, it is necessary to be able to track sex offenders, especially since there is such a high recidivism rate with these offenders. Because the current system dumps information after seven years (his estimation), they oftentimes lose the only information that could help link them to a suspect in a sexual offense case. In addition, he complains about having to use too many systems to query a single data element, and wants to see the department implement a way to have one query reach out to five or six systems. He currently has to spend a lot of time on the telephone, and sending Fax's and e-mails when he has to gather information for a case, and would much rather see this become computer-based. He thinks the BSO is ahead of the game when it comes to holding their employees accountable for their performance via POWERTRAC, and if they had a regional information sharing system, they would be "top notch."

Ride along #6, Detective

This detective works specifically with the local pawnshops around the county, and works with the corresponding area deputies to ensure they are making regular compliance checks at the pawnshops. He spends about 70% of his computer usage time extracting information from systems such as the Pawnshop Access Database, APRS (Automated Property Recovery System) and Docutrack (The court information system). The remaining 30%, he spends inputting information.

One of the first items of concern he mentions during his shift is the need for a statewide pawn system, since "no criminal in their right mind will steal and sell property

in the same county! Criminals are smarter than that!" He is happy that they have a good relationship with surrounding regions and usually have a high level of cooperation on adjoining jurisdiction cases. He assigns a deputy to every pawnshop in BSO's jurisdiction, and they are responsible for ensuring that the records are up-to-date. He thinks this liaison really helps recover stolen property, because the deputies are responsible for what is happening in their zone.

During this shift, he finds information about a certain piece of stolen property pawned in a neighboring district. He mentions that he cannot simply email or call the deputy directly to give them the information, but instead he must radio dispatch to pass along the message. He would like this changed, and at least have cell phones issued as standard equipment to the deputies to use for work-related issues only.

He is happy with his computer systems, and mentions that management does a very good job helping the department personnel. He thinks POWERTRAC has played a part in the increased recovery of stolen/pawned property. Before POWERTRAC, he thinks that many deputies were not motivated to work hard and did not try as hard to track down offenders. That has changed with POWERTRAC, which he believes has a positive impact.

Direct Observation Summary

The observations of the officers using their computers along with the comments they made, serve to support and inform interview and survey findings. Key observations, as they relate to findings, which prove or disprove hypotheses, are outlined in Table 11 (p. 89). These observations served the purpose of supporting the findings of the

interviews and survey responses. A number of observations informed hypothesis testing and provided insight and clarification of other data.

CHAPTER 5
QUANTITATIVE ANALYSIS AND HYPOTHESIS TESTING

Chapter 5 begins with the *Descriptive Statistics* section, which provides 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 two groups. Next, the *Factor Analysis* section discusses in detail, the methods used to reduce the large number of variables into core constructs associated with the hypotheses. Finally, the *Hypothesis Testing* section discusses the constructs, the results of the analysis to determine their strength and statistical significance, and the extent to which they support the hypotheses.

LEVELS OF ANALYSIS

This dissertation uses a number of statistical tests including Factor Analysis, Cronbach's Alpha, Chi-Square, Cramer's V, Mann-Whitney U, ANOVA, and Eta^2. Figure 4 on the following page, provides a diagram illustrating these statistical procedures and the levels of analysis.

Statistical Procedures

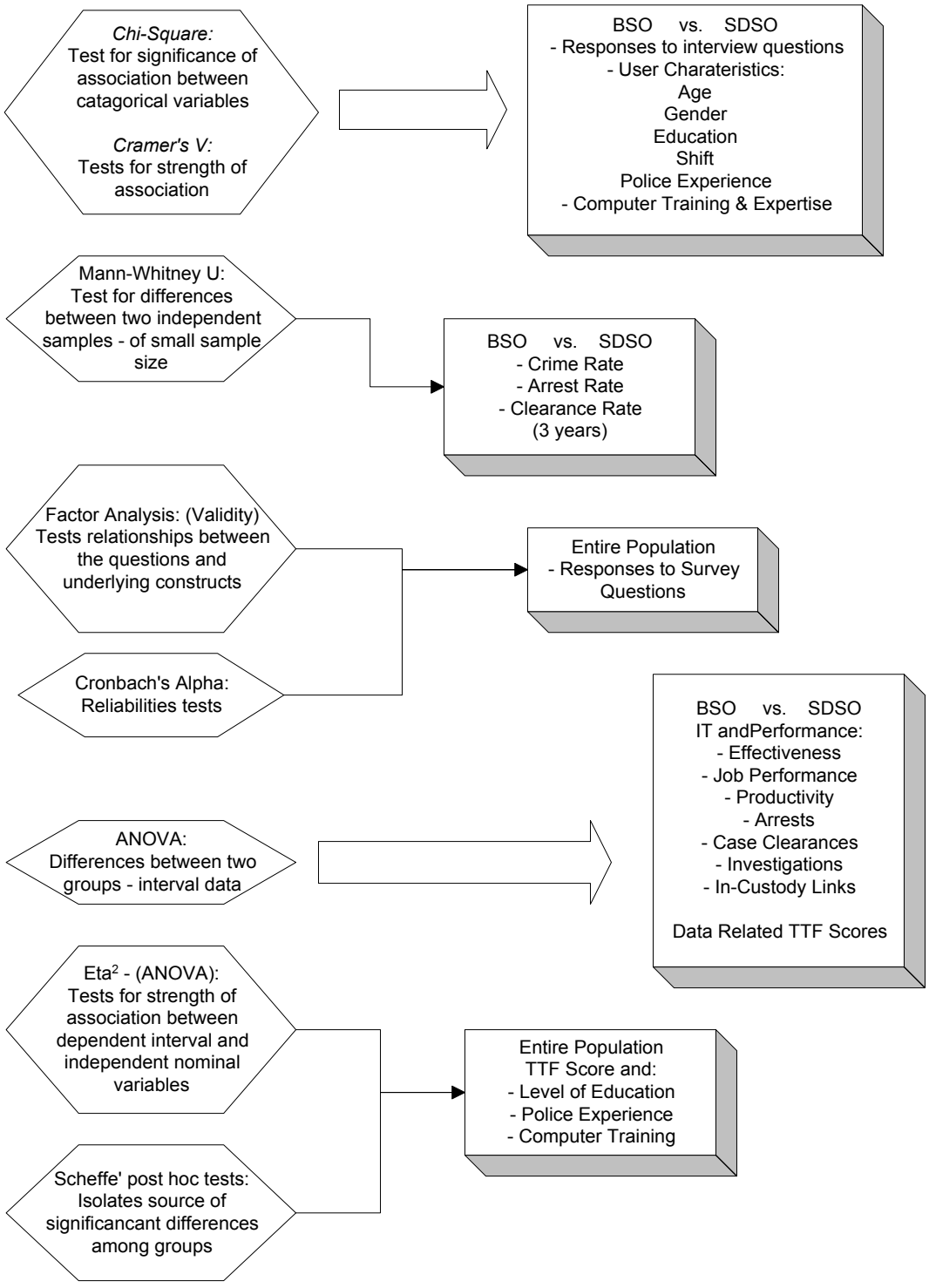


Figure 4 Statistical Procedures Diagram

DESCRIPTIVE STATISTICS

This section begins with a comparison of relevant demographic information of the participating officers. The user-characteristics or demographics data represent categorical variables gathered from the surveys and are presented in Table 12. This table includes Chi-square statistics to determine if significant differences exist between the comparison and info-sharing groups. The Chi-square is appropriate for assessing the measure of association between two categorical variables (Smithson, 2000). This step is important in ruling out rival hypotheses as a threat to validity (Bickman & Rog, 1997).

Surveys were sent to 660 randomly selected law enforcement officers, evenly divided between the 'Control' agency and the SDSO. From SDSO, surveys were completed by 300 officers (n=300) and from the 'Control' agency 288 officers (n=288). Altogether, 588 law enforcement officers participated in this study resulting in a survey response rate of 89%. Using the Chi-square statistic, the observed and the expected frequencies were compared to determine if the observed differences between groups are statistically significant (See Table 12).

Chi-Square does not compute a measure (strength) of association and it is inflated by effect size (more than 2 rows and columns) in a cross tabulation analysis, suggesting that weak relationships are statistically significant when they are not (Meier and Budney, 1993). 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) and when the table has more than two rows and two columns (Smithson, 2000).

Table 12 Chi-square Statistic of User Characteristics * Agency (Crosstab)

Variable	n	SDSO	n	BSO	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%				

Demographic Data

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, BSO 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. 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. Given this low measure of association, it is appropriate to conclude that differences in survey responses between the two groups are not likely to be an influencing factor in the findings. The Cramer's V=.474, for *Years with this agency* 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 hypothesis.

Computer Training and Computer Expertise

This section contains information concerning the computer training received by the officers as well as computer expertise. Seven questions on the survey deal with computer training. These questions address the following dimensions of training: 1)

Number of hours, 2) Adequacy (amount), 3) Timing, 4) Quality, 5) Frequency of training, 6) Source of training, and 7) Hours of self-training. Two questions (not included as part of the hypothesis) deal with computer expertise: 1) Knowledge of computers and, 2) Assists others with computer problems (i.e., the fact that an officer is frequently called upon to assist other officers with computer problems is used as evidence that the officer has a higher level of computer expertise). The Chi-Square responses to these questions by group are reported in Table 13.

Using the Chi-square statistic, I compared the observed with the expected frequencies for each variable associated with training to determine if any differences observed between groups were statistically significant. I also used the Cramer's V statistic to assess the strength of any existing relationships (See Table 13).

Table 13 Chi-Square Statistic of Computer Training and Expertise

Variable	n	SDSO	n	BSO	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%				

Variable	n	SDSO	n	BSO	df	Chi-Sq.	*P*	Cramer's V
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%				
Computer Knowledge	297		284		1	.807	.369	.037
Knowledgeable		62.6%		66.2%				
Not Knowledgeable		37.4%		33.8%				
Total		100%		100.0%				
Assists Co-workers with Computer Problems	297		286		1	.139	.709	.015
Yes		39.4%		40.9%				
No		60.6%		59.1%				
Total		100%		100.0%				

The three questions associated with 'source of training' and the questions 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.

For the question concerning 'hours of formal training,' the Pearson's Chi-Square=8.7, p<.05, df=3 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.

The four remaining questions associated with training i.e., '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.

Computer Expertise

Two survey questions are associated with computer experience: 'knowledge of computers' and 'assists others with computer problems.' For both variables, the Chi-Square values<.807, p>.05, df=1 ns, indicates independence. This suggests the lack of a significant relationship between groups associated with those variables.

Crime, Arrest and Clearance Data

In addition, certain Uniform Crime Report (UCR) data was gathered from the records of each agency. It included arrests, clearance rates, and crime rates from both agencies for the period 2000 through 2002 inclusively (Table 14). These data reflect the crime and arrests per 1000 population. It also shows clearances rates for crime classified using the national standard (UCR) as violent crime (*Crimes Against Person)* and property crime (*Crimes Against Property)*.

Table 14 Mann-Whitney U Test Statistics: Crime, Clearance and Arrest Rates* (3 Years)

	SDSO			BSO			Mann-	
	n	Mean	sd	n	Mean	sd	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

* All rates are per 1000 population except Clearance rate which is the percentage of cases solved

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

As to crime rates, Broward's violent crime rate, at 4.29 per 1,000 (population), is higher than San Diego's 3.39 per 1,000 (population). The reverse is true for Property Crime rates; San Diego's Property crime rate, at 21.10 per 1,000 (population), is higher than Broward'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 14 contains statistics associated with the Mann-Whitney U test for two independent samples. The Mann-Whitney U (ranking) = .000, $p<.05$ for property clearances rates and arrest rates indicate significant differences between Broward and San Diego (Note: a Mann-Whitney U = 0

represents the greatest difference possible between two samples (Roscoe, 1969)). In other words, Broward officers clear (solve) significantly more Property Crimes and make significantly more arrests than their peers in San Diego make. 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 $p>.10$).

Descriptives Summary

This section provided the reader with an overview of the user-characteristics or demographics of the survey respondents from the comparison and info-sharing groups as well as the crime rates, arrest rates and clearance rates for both agencies.

To determine if observed differences (between groups) are statistically significant, observed and expected frequencies were compared using cross tabulation and the Chi-square statistic. The Chi-Square scores suggest a relationship among numerous user-characteristic variables, along with low 'p.' (significance) values, indicating that differences exist between groups. The Chi-Square statistic does not compute a measure of association; it is inflated by large samples in a cross tab (Meier and Budney, 1993). To deal with this, I used the Cramer's V statistic, which is frequently used to measure the strength of association when one or more of the variables is nominal (Miller et. al, 2002). The weak measures of association represented by values for the test statistic Cramer's V, indicates that group differences are small. The evidence presented by the statistical procedures suggests that differences in survey responses between the two groups are not likely to be an influencing factor in the findings. Thus, differences between agencies

related to user characteristics or demographics can be ruled out as a rival hypothesis and a threat to internal validity.

To test for differences in arrest, clearance and crime rates between agencies, I used the Mann-Whitney U test. This procedure tests for differences between two independent samples. The test results suggest that there is no significant difference between jurisdictions in crime rate in general or violent crime clearance rates. Broward officers do clear significantly more Property Crimes and make significantly more arrests than do their peers in San Diego. These significant differences are further examined in other sections of this study.

FACTOR ANALYSIS

This section discusses the methods used to reduce the large number of variables into core constructs as well as the validation of those constructs. Using the factor analysis procedure, I examine the variables associated with each factor to identify clear and substantial relationships between the questions and underlying constructs. This section also discusses how the variables associated with each factor, group together conceptually and parallel existing theory.

Exploratory factor analysis attempts to determine the number of factors that are necessary to explain the relations among a set of indicators (Pedhazur and Schmelkin, 1991). In this dissertation, the indicators are responses to survey questions, which operationalize specific constructs.

Using the Principal Component Analysis extraction method I analyzed responses to the 23 survey questions to determine if a more manageable number of underlying

constructs account for the main sources of variation. The Eigenvalues loaded to 7 factors accounting for 74% of the variance. Addressing the issue of the proper amount of variance to account for, Stevens (1996, p. 367) notes: ". . . one would want to account for at least 70% of the variance . . ." In order to interpret and identify the factors, they must be rotated (Kline, 1993). Ocam's razor suggests that we should choose the simplest explanation of those that fit the facts (Kline, 1993). Kline (1993, p.66) notes, "Simple structure rotations yield interpretable, replicable factors . . ." To properly identify and interpret the factors, I employed the Oblimin Rotation with Kaiser Normalization. As expected, the survey questions 'loaded' to factors that represent constructs important in this dissertation (see Table 15, p.122). I examined the questions associated with the seven factor groupings and found that they were easy to interpret and made sense, conceptually. Table 16 (p. 125) displays the 7 factors, their factor loading scores, and the related survey questions. The factors names are based upon their conceptual underpinnings.

On the surface, seven factors might appear to be a large number. To allay concerns with the number of factors, I used the criteria suggested by Miller, et. al. for determining that this is ". . . a good analysis" (Miller, et. al, 2002, p.184). The first criterion is that all variables should load highly on only one factor, and low on other factors. This is true for all variables in this model except one; the last question of factor 7 (with a loading of .506) loaded similarly (.510) on Factor 1 "Ease of Use." I will address this problem in the following two sections.

Table 15 Factors and Survey Questions

Construct/Factor	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
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

Construct/Factor	Survey questions	Factor Loading
	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

The second criterion is to examine the factor loadings to see if the interpretation is consistent with theory (Miller, et. al., 2002). For example, the two questions loading to Factor 1 are the same questions validated by Goodhue as the construct 'Ease of Use.' The same can be said for the questions loading to factors 4, 5, 6, and 7, each of which is a construct of Goodhue's TTF. This is visually presented in Figure 5 (on the following page), which is a graphic that maps each factor to corresponding theory. Here, the links between and the overlap of theories are clearly illustrated.

The third and final criterion for assessing the acceptability of factors is to determine whether the factors make sense (Miller, et. al., 2002). I have already established the link between the factors and theory, which on the surface, suggests that they make sense. Beyond that, the questions loaded to factors which aligned with the expected constructs, thus they pass the third and final test for acceptability.

In addition, as mentioned earlier, the last question of factor 7 loaded at .506. It also loaded at .510 on Factor 1 "Ease of Use." Conceptually, it aligns better with Factor 7, which is specific to "data." It not only fits better, conceptually, with factor 7 than with

factor 1, the Cronbach's Alpha score for factor 7 (including this question) is .86, which suggests a high degree of reliability.

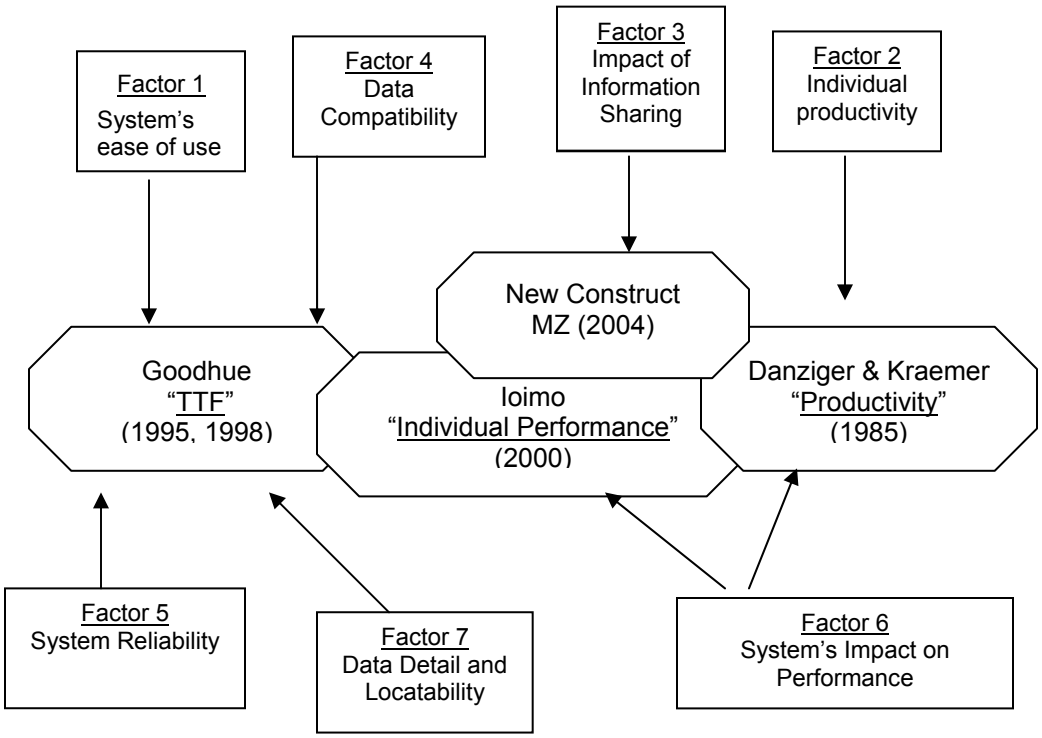


Figure 5 Factors Aligned with Theories

Factors, Constructs and Theory

In this section, I present a brief overview of the survey instrumentation explaining the relationship between the factors, constructs and theory. I begin with Goodhue's *Task-Technology Fit* (TTF) theory. Goodhue (1988, 1995, and 1998) and 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. As discussed

previously, the Goodhue instrument served as the foundation for the survey used in this study; some manipulation was necessary to ensure wording appropriate to a law enforcement environment. TTF is comprised of three major areas and six groups of questions as outlined below. Questions within each of the major areas group by construct. In the factor analysis conducted by this researcher, the questions loaded to factors that mirror the below outlined TTF constructs. In most cases, I used the TTF construct name as the factor name.

Dimensions of TTF: How Well the Technology Matches the Tasks of Users

Table 16 Dimensions of TTF Aligned with Factors

Goodhue's TTF Construct	Factor
Ease of Use: Ease of doing what I want to do using systems hardware and software for submitting, accessing and analyzing data	1. *Ease of use*
Data Compatibility: Information from various sources can be consolidated or compared without inconsistencies	*2. Data Compatibility*
System Reliability: Dependability and consistency of access and uptime of systems	3. *System Reliability*
Performance Impact: System's impact on the job performance of the users	4. *Performance Impact*
Data Detail: The extent to which the data is sufficiently detailed to support users work functions	5. *Data Detail and**
Data Locatability: Ease of determining what data is where	5. *Data Locatability**

* Factor loadings were sufficiently high to combine these two constructs

An important construct associated with this instrument is *Individual Performance*. Goodhue (1998) suggests an expansion of the instrument to include other "task domains." The "task domain" that had been the focus of the TTF instrument is limited to managerial use of organizational information (delivered via automated systems) for decision-making

(Goodhue, 1998). Expanding the instrument to assess how the technology fits other "task domains" means changing the focus from assessing how technology supports the task of managerial decision making to how it supports other tasks. Ioimo (2000) modified the Goodhue instrument, changing the focus to how the technology (mobile computing) supported law enforcement officers in their daily performance. He also noted the following about testing the link between evaluations of TTF and performance: " . . . there has been some initial testing of the link between user evaluations of TTF and performance (Goodhue and Thompson, 1995), in general there has been surprisingly little research on the existence of this critical link" (Goodhue, 1998, p.128; Ioimo, 2000). expanded Goodhue's survey by adding a number of questions to measure the individual performance of law enforcement officers using mobile computers.

In this study, I expanded further upon Goodhue's (1985) and Ioimo's (2000) survey instrument, adding 6 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 (Detectives).

Individual Performance Indicators

1. 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
2. Number of your last ten actively investigated cases which would have been unworkable without the use of the computer
3. Number of your last ten arrests which were assisted by computing
4. Number of your last ten arrests which you probably would have not been able to make without the use of computerized information
5. Number of the last ten cases you cleared by arrest or by the investigation of subjects held in-custody which were assisted by computing

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

The final construct of this instrument is *Information Sharing*, which is a critical element of this study. During the literature review, I could find little evidence of research on information sharing in the law enforcement environment. The literature suggests that law enforcement officers use information (Danziger and Kraemer, 1985) and need more of it in the performance of their daily activities (Brown, 2001). 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." I developed three questions, outlined below, to determine the extent to which officers perceive information sharing as a benefit in their daily jobs.

Utility of Information Sharing

1. The information I am able to get from other law enforcement agencies is a big help to me in my job
2. The information I am able to get from other law enforcement agencies makes me more productive
3. The information I am able to get from other law enforcement agencies makes me more effective

Reliability Testing

In further analyzing these data, I examined the data of the seven factors individually, to test their reliability and interrelatedness. Using Cronbach's Alpha, I tested the reliability and internal consistency for the series of questions representing each

of the 7 factors. The analysis of each of the seven factors, as presented in Table 17, show high reliability for all factors (Cronbach's Alpha > .70).

Table 17 Cronbach's Alpha Reliability Test Results

FACTOR (Constructs)	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

Factor Analysis Summary

In the final analysis it is important to note that the variables associated with each factor loaded highly on one factor and very low on all other factors, suggesting a clear and substantial relationship between the questions and underlying constructs. Another important characteristic is that the variables making up each factor group together conceptually and are consistent with theory. Finally, statistical analysis, Cronbach's Alpha scores, suggests that the model and factors are reliable.

The findings in this section are important for several reasons. First, it validates Goodhue's (1998) TTF theory and suggests its applicability to occupations other than management or managers. Second, this validation extends to a new task domain, i.e., the functions of street level police officers. Third, it introduces a new area of research i.e., law enforcement information sharing, which the preliminary data suggest is important to street-level law enforcement officers.

HYPOTHESIS TESTING

In the following pages, I present the hypotheses and their supporting constructs. These constructs, operationalized as survey questions, are analyzed to determine their strength and statistical significance. The hypotheses are tested using 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.' This section begins with Table 18 which provides an overview of the hypothesis and the test results.

Table 18 Hypothesis Testing Results

Null Hypothesis	Results
1. No difference exists between the info-sharing group and the comparison group's assessment of the impact of information technology on *individual effectiveness*	ANOVA: 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*.
2. No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual performance.*	ANOVA: 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.*
3. No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity.*	ANOVA: 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.*
4. No 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.*	ANOVA: No significant difference was found between groups scores in the number of arrests made which were assisted by information technology.
5. No 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.*	ANOVA: The info-sharing group scores were significantly higher than the comparison group, suggesting that information technology plays a role in clearing more cases.

Null Hypothesis	Results
6. No difference exists between the info-sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.	ANOVA: A significant difference was found between groups' 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.
7. Level of education does not influence user-satisfaction with available technology.	ANOVA: No significant association was found between levels of education and TTF scores.
8. Experience does not influence user-satisfaction with available technology.	ANOVA, Eta^2, and Scheffe' Post Hoc: Officers with more experience reported significantly lower TTF scores - strength of association was weak.
9. Neither the amount nor the type of computer training influences user satisfaction with available technology.	ANOVA, Eta^2, and Scheffe' Post Hoc: A positive and significant association was found between satisfaction with: 'amount,' 'timing,' 'quality,' 'frequency' of training, 'number of training hours,' and TTF scores. The strength of the association was weak for all training categories.

Table 19 presents a synopsis of the ANOVA statistical tests for Hypotheses 1 through 6. These hypotheses test to determine if differences in responses to survey questions exist between the two groups of officers, SDSO and BSO. The tests for Hypotheses 7 through 9 are presented in Table 20, which follows. They are not included in Table 19, as they differ: they do not test for differences between the two groups of officers.

A synopsis of the ANOVA statistical tests for Hypotheses 7 through 9 are presented in Table 20, on page 132. These hypotheses differ from the first six Hypotheses in that they do not test for differences in survey responses between groups of officers (SDSO and BSO). They test the entire population, both groups together, to determine if differences in responses are associated with level of education, amount of police experience or amount, type and level of satisfaction with computer training.

Table 19 ANOVA Summary: Hypotheses 1-**6 –** Group Differences by * Agency

Hypotheses 1-6	SDSO n	SDSO Mean	SDSO sd	BSO n	BSO Mean	BSO sd	F	*p*
Ho_1: 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
Ho_2: 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
Ho_3: 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*
Ho_4: Computer Assisted Arrests	297	4.88	3.00	287	5.08	3.04	.680	.410
Ho_5: Computer Assisted Case Clearances	297	3.36	2.58	287	2.92	2.46	4.30	.039*
Ho_6: 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

** Significance p<.05*

The ANOVA statistic for Hypotheses 7 – 9 tests to determine if TTF mean scores (responses to the survey questions representing a user's satisfaction with technology) differ between or among levels of 'Education,' Experience,' or 'Computer Training.' These tests, for example, answer the following kinds of questions (not meant to be all-inclusive). Is there a difference between the TTF scores of officers with college degrees and those with a high school education? Do officers with more than 10 years of law enforcement experience tend to be more (or less) satisfied with the technology (higher or lower TTF scores) than those with less than 5 years experience? Are TTF scores of officers who received 10 or more hours of computer training significantly different from

the scores of officers who received less than 5 hours of computer training? Note: higher TTF scores represent a greater degree of satisfaction with the technology.

Table 20 ANOVA Summary: Hypotheses 7-9 – Education, Experience, Training by * TTF (mean)

Hypotheses 7-9	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
Ho_7: Level of Education	584	4.63	.794	5	1.44	.209	n/a
Ho_8: Police Experience							
Time in current position	573	4.63	.795	3	3.46	.016	.018
Years with this agency	583	4.62	.793	5	2.78	.017	.024
Years as Police officer	580	4.62	.796	5	4.51	.000	.038
Ho_9: Computer Training							
Training Hours Received	581	4.63	.796	3	5.58	.001	.028
Amount of Training	581	4.63	.794	1	74.40	.000	.114
Timing of Training	578	4.63	.796	3	17.39	.000	.083
Training Quality	583	4.63	.794	3	11.70	.000	.057
Frequency of Training	581	4.63	.795	1	42.59	.000	.069
Source of Training	577	4.63	.795	2	2.75	.065	.009
Hours of Self Training	581	4.63	.795	3	.345	.793	.002

Analysis of Hypothesis 1

Ho_1: No 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.*

An ANOVA (Analysis of Variance) is used to assess differences on the Impact of Information Technology, by group. The ANOVA is traditionally used to test whether differences exist in mean scores of independent samples (Smithson, 2000).

Table 21 ANOVA: Hypothesis 1 – IT Impact on Effectiveness * Agency

	SDSO			BSO			F	*p*
	n	Mean	sd	n	Mean	sd		
q21. Effect IT on my productivity and effectiveness	297	5.66	1.18	287	5.41	1.49	5.30	.022
q51. Effect of info. sharing on effectiveness	291	4.94	1.29	285	4.87	1.39	.372	.542

To operationalize this construct, I used the responses to two questions, which specifically addresses 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 first question (21) has been validated in prior studies and proven reliable. Goodhue and Thompson (1995) developed this question as part of the TTF instrument to assess the impact of technology on individual performance. They assessed validity and reliability using a sample of over 600 users employing 25 different technologies (Goodhue and Thompson, 1995). Ioimo (2000) applied this instrument to the law enforcement setting in assessing the impact of mobile computers. Because of its specificity, the question has face validity; it seeks to discover officers' perceptions of whether the computing environment has a positive impact on "effectiveness." Question 21 deals only with the impact of the computing environment (IT) on effectiveness: it does not address whether information sharing impacts effectiveness, which is important to this dissertation. Question 51, developed and validated specifically for this dissertation, seeks to address this void: it informs the research of the degree to which information-sharing technologies influence effectiveness.

Impact of information technology on effectiveness

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 – 'the computer environment has a large, positive impact on my effectiveness and productivity in my job' - reveals that San Diego officers had greater scores (M=5.66, sd=1.18) than Broward officers (M=5.41, sd=1.49). Officers from both agencies report that the technology has a positive impact on effectiveness but San Diego officers had stronger feelings about this. The mean value for San Diego officers M=5.66, indicate that they 'agree' that the technology has a positive impact on effectiveness, while the mean value for Broward officers M=5.41, suggest that they 'somewhat agree.'

"Shadowing" or riding with the officers during a routine shift provided important direct observations that further supported my findings (this portion of the study will be notated throughout this section as 'direct observation'): the SDSO officers appeared to rely more on computer systems to support their job functions, which could influence their perception of its impact on effectiveness. While San Diego officers perceive a higher degree of effectiveness attributable to computing, at a statically significant level, these results do not inform the research of the degree to which information sharing technologies contribute to this effectiveness.

Impact of information sharing technology on effectiveness

Examination of the means for question 51 – 'the information I am able to get from other law enforcement agencies makes me more effective' - 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 San Diego and Broward 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 21) 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.

Results – Hypothesis 1(Mixed Support for Hypothesis)

The differences in (group) responses to question 21 described earlier, suggest San Diego officers perceive a higher degree of effectiveness attributable to *computing in general.* Question 51 determines whether differences found relate to the availability of information sharing technology. Responses to this question suggest that differences between groups in their assessment of the impact of information technology on individual effectiveness are not related to information sharing.

Based upon the data presented and the statistical strength of those data, I find mixed support for this hypothesis. A significant difference exists between the info-sharing and the comparison groups' assessment of the impact of their overall information technology on individual effectiveness, but not on their assessment of the impact of information sharing technology on individual effectiveness.

Analysis of Hypothesis 2:

Ho_2: No significant difference exists between the info sharing and comparison group's assessment of the role automation plays in enhancing *individual performance.*

In testing hypothesis 2, I used the ANOVA statistical procedure to examine the (means) responses of the info sharing and comparison groups to two sets of questions. The first is Factor 6 – 'System's Impact on Performance' operationalized as the composite (mean) of the scores for questions 21 and 22. It is meant to assess the impact of information technology in general.

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.

The second set of questions was developed to assess the impact of information-sharing technologies specifically, on job performance.

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 first two 'Performance Impact' questions (q. 21,22) were used as originally developed (except for minor changes in verbiage), tested, and validated by Goodhue and Thompson (1995, p.223). Goodhue and Thompson found the questions highly reliable. Ioimo (2000) also used these questions in his research and applied them to the law enforcement environment. During his testing of the questions he found the data to be ". . . highly reliable . . ." (Ioimo, 2000, p.198).

I conducted a factor analysis (See 'Factor Analysis' p.122) and found high factor loadings for each question (.88 and .91, respectively). I also found the data to be highly reliable with a Cronbach's Alpha score of .87 for the factor. Since both of these questions relate directly to performance, and together they have proven to be a reliable factor or measure of performance in this and other empirical studies (Goodhue and Thompson 1995; Ioimo, 2000), I used the composite (mean) of these scores and called the factor "Performance Impact" to test Hypothesis 2

The second set of questions (48, 49, 51), 'Impact of Information Sharing on Job Performance' represent a new construct; I could find little research data in this area. In validating its use, I conducted a factor analysis (See 'Factor Analysis' p.122) and found high factor loadings for each question (-.92, -.94, and -.92, respectively). I also found the data to be highly reliable with a Cronbach's Alpha score of .92 for the factor, which I named 'Impact of Information Sharing on Job Performance.' I operationalized the construct 'Impact of Information Sharing on Job Performance' as a composite (mean) of these 3 questions, using the following as justification. All three questions relate to a different aspect of how information sharing might affect an officer's job performance; they correlate strongly as one factor with high factor loadings; and they have been tested and proven highly reliable.

Table 22 ANOVA: Hypothesis 2 – IT Impact on Job Performance * Agency

	SDSO			BSO			F	*p*
	n	Mean	sd	n	Mean	sd		
Factor 6: Sys Impact on Performance	296	5.90	1.04	287	5.61	1.33	8.28	.004
Factor 3: Info Sharing Impact on Performance	291	4.89	1.18	285	4.76	1.27	1.71	.192

Information systems' impact on performance

Examination of the means show that for 'Sys Impact on Performance' (Factor 6), San Diego officers (M=5.90, sd=1.04) had a higher composite score than Broward officers (M=5.61, sd=1.33) – Table 22 (p. 137). This suggests that while Broward officers 'agree' that the computer environment has a large, positive impact on their job performance, San Diego officers 'more strongly agree.' The ANOVA statistic 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.

Information sharing impact on performance

Examination of the mean scores for "Factor 3, Info Sharing Impact on Performance" shows that San Diego (M=4.89, sd=1.18) had slightly greater scores than Broward (m=4.76, sd=1.27). These scores suggest that while both San Diego and Broward officers 'somewhat agreed' that the information they are able to get from other law enforcement agencies assists them in the performance of their jobs, the extent of that agreement was greater for San Diego officers. The ANOVA on this construct (Table 22) suggests the responses did not differ at a statistically significant level, by agency: F (1, 574) =1.71, ns. The composite scores suggest no significant difference between agencies in the officers' perception of the degree to which information sharing affects an officer's job performance.

Results – Hypothesis 2 (Mixed Support for Hypothesis)

A significant difference exists between the info-sharing and the comparison groups' 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. Based upon the data presented and the statistical strength of those data, I find mixed support for this hypothesis. 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. In response to the questions addressing the impact of only information sharing technologies specifically, the responses were not quite as positive for either group and were not significantly different.

Analysis of Hypothesis 3

> Ho_3: No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity*.

To test hypothesis 3, I used the ANOVA statistical procedure to examine the (means) responses of the info sharing and comparison groups to two sets of questions. The first is Factor 2 – 'System's Impact on Individual Productivity' operationalized as the composite (mean) of the scores for questions 24 through 29. It is meant to assess the impact of <u>information technology in general</u> on individual productivity measures. Unlike the responses to the other survey questions tested thus far, these questions represent ratio data with "0" being the lowest and "10" being the highest possible score.

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

The second measure was the responses to question 49. This was used to determine if information sharing technology specifically, impacts productivity.

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

Table 23 ANOVA: Hypothesis 3 - IT Impact on Individual Productivity * Agency

	SDSO			BSO				
	n	Mean	sd	n	Mean	sd	F	*p*
Factor 2, Sys Impact on Individual Productivity Measures	297	4.97	2.69	287	4.47	2.61	5.22	.023
q49. Impact of Info sharing productivity	291	4.86	1.22	285	4.64	1.38	4.13	.043

System's impact on individual productivity measures

As indicated earlier, I operationalized the construct 'individual productivity measures' by using the composite score (mean) to questions 24 through 29 (Factor 2). 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). In validating the construct 'Individual Productivity Measures,' I conducted a factor analysis (See 'Factor Analysis' – Factor 2, p.121 for details) and found high factor loadings for each question (.512, .619, .804, .736, .828, and .809, respectively). I also found the construct to be highly reliable with a Cronbach's Alpha score of .83 for factor 2, which I named 'Individual Productivity Measures.'

Examination of the mean scores for 'Individual Productivity Measures' finds San Diego (M=4.97, sd=2.69) with higher scores than Broward (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**.** The ANOVA on this construct (Table 23) suggests the responses differ at a statistically significant level, by agency: $F(1, 582) = 5.22$, $p < .05$.

Information sharing impact on productivity

Because the responses to 'individual productivity measures' (Factor 2) do not account for the possible affect of information-sharing technologies on an officer's productivity, I included question 49 as part of the test for hypothesis 3. As explained earlier, I developed and tested questions 48, 49, and 51 to operationalize 'Impact of Information Sharing on Job Performance.' Question 49 specifically addresses the extent to which information sharing makes an officer more productive: it has face validity. I field tested it with 40 officers and reviewed it with managerial and information technology professionals from both SDSO and BSO. Examination of the mean scores for the responses to question 49 'Impact of info-sharing on productivity' indicates that San

Diego officers (M=4.86, sd=1.22) had slightly higher scores than Broward (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 Broward officers 'somewhat agree' but to a lesser extent. The ANOVA on this construct (Table 23, p.140) suggests the responses differ at a statistically significant level, by agency: $F(1, 574) = 4.13$, $p<.05$.

Results – Hypothesis 3 (Support for Hypothesis – reject the null)

The data suggest 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 Broward. Based upon the data presented and the statistical strength of the data, I am able to reject the null hypothesis and conclude that a difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual productivity.

Analysis of Hypothesis 4

> Ho_4: 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.*

I operationalized the construct 'Arrests' 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

Table 24 ANOVA: Hypothesis 4 - Technology Assisted Arrests * Agency

	SDSO			BSO			F	*p*
	n	Mean	sd	n	Mean	sd		
Comp. q26-27 Computer Assisted Arrests	297	4.88	3.00	287	5.08	3.04	.680	.410

Examination of the mean scores for the responses to 'arrests' indicates that Broward (M=5.08, sd=3.05) had higher scores than San Diego (m=4.88, sd=3.0). Extrapolating the results from these scores suggest that Broward 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 24 displays the ANOVA statistics for the construct 'arrests.'

These results are not what I expected to find. I logically assumed 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. These data do not support my expectation. This leads to a critical question of significance. Are the differences in scores significant? While Broward did have slightly higher mean scores, the ANOVA (Table 24) suggests no significant difference between groups F (1, 582) =.680, ns. The data presented suggests that officers perceive computing as a factor in

slightly more than half of the arrests made in Broward and slightly less than half of the arrests made in San Diego.

Results - Hypothesis 4 (No Support for Hypothesis - Unable to Reject the Null)

The mean scores differed slightly between groups: the difference was not significant. I am therefore unable to reject the null hypothesis: '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.'*

Analysis of Hypothesis 5

Ho_5: 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 *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

Table 25 ANOVA: Hypothesis 5 - Technology Assisted Case Clearances * Agency

	SDSO			BSO				
	n	Mean	sd	n	Mean	sd	F	*p*
Comp. q28-29 Computer Assisted Case Clearances	297	3.36	2.58	287	2.92	2.46	4.30	.039

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. Examination of the mean scores for 'Case Clearances' indicates that San Diego (M=3.36, sd=2.58) had higher scores than Broward (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 Broward officers perceive computing as assisting in 29% of their case clearances. The ANOVA F (1, 582) =4.30, $p<.05$ (Table 25), indicates that this difference between groups is significant.

Results - Hypothesis 5 (Support for Hypothesis - Reject the Null)

The data presented reveal that computer systems are perceived as being is more of a factor in case clearances by San Diego officers than by officers in Broward. The statistical strength of those data indicates that a difference exists between the groups, suggesting that computing is more instrumental in case clearances in San Diego than in Broward. I am able to reject the null hypothesis (Ho_5) that "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 *clearing cases*."

Analysis of Hypothesis 6

> Ho_6: No 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.

To test hypothesis 6, I used 7 questions, which represent three dimensions of Task-technology Fit (Goodhue, 1998) as part of the TTF instrument. 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. The questions, divided into three groups, are listed below.

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

To operationalize this construct, I calculated one composite score (mean) for each of the three dimensions relating specifically to data: Questions 6 & 7 - "Level of Detail", questions 8 & 9 - [data] Locatability, and questions 14-16 - [data] "Compatibility."

Table 26 ANOVA: Hypothesis 6 – (TTF) Data Meets Officers' Needs * Agency

	SDSO			BSO				
	n	Mean	sd	n	Mean	sd	F	*p*
Level of Detail	299	4.82	1.33	286	4.54	1.46	5.99	.015
Locatability	299	3.88	1.40	286	4.37	1.36	18.27	.000
Data Compatibility	298	3.8132	1.08	286	3.8112	1.10	.000	.982

I used an analysis of variance statistical procedure (ANOVA) to discern whether variation of the group means around the overall mean exists at a statistically significant level. Table 26 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.

The mean scores (Table 26) 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 Broward (M=4.54, sd=1.46) also 'somewhat agree' but to a lesser extent. 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 26), 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 officers in Broward (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 officers in Broward are more satisfied with the ease in which they can locate their data. The statistical strength of those data suggests that a difference exists between the groups.

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 Broward (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.

Results - Hypothesis 6 (Mixed Support for Hypothesis - Reject the Null)

Responses to two of the three dimensions relating specifically to data: questions 6 & 7 - "Level of Detail", questions 8 & 9 - [data] Locatability, suggests 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, I am able to reject the null hypothesis (Ho_6) that 'no 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.'

Analysis of Hypothesis 7

Ho_7: Level of education does not influence user-satisfaction with available technology.

This hypothesis differs from the previous hypotheses in that it does not compare mean scores between groups (SDSO and BSO). It seeks to determine whether TTF score (satisfaction with technology) is influenced by level of education. It examines the mean TTF scores of the entire population, by levels of education, and compares the TTF of each level to determine if an association exists between level of education and TTF score. It will reveal, for example, if users with higher or levels of education tend to be more satisfied with the technology (i.e., report a higher TTF score). Note, a higher TTF score suggests a greater degree of satisfaction with the technology.

Table 27 ANOVA: Hypothesis 7 - TTF Measure * Education

Variable	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
Education				5	1.44	.209	n/a
High School Grad	57	4.82	.735				
Some college	263	4.59	.786				
2 year degree	97	4.70	.772				
4 year degree	134	4.58	.847				
Some graduate credits	19	4.41	.814				
Master degree or higher	14	4.77	.678				
Total	584	4.63	.794				

* Eta^2 not calculated for p>.05

The variables used to test this hypothesis came from the responses to the survey questions. The "Education" survey questions, borrowed from Ioimo (2000), consist of check boxes with level of education assigned to each as shown below.

Education: Check the highest level completed

☐ High School Grad ☐ Some college

☐ 2-year degree ☐ 4 year degree

☐ Some graduate credits ☐ Masters degree or higher

I coded the responses to these questions according to the following coding scheme and entered them into SPSS for analysis.

1 = High School Grad	2 = Some college
3 = 2-year degree	4 = 4 year degree
5 = Some graduate credits	6 = Masters degree or higher

The next step is to associate the respondents' education level with their evaluations of TTF. TTF is a measure of a user's overall satisfaction with the technology, i.e., how well the technology fits the task at hand (Goodhue, 1998). The TTF questions borrowed from Goodhue (1998) are operationalized as factors in this study. These factors correspond to six key dimensions of TTF (Goodhue, 1998). In Table 28, Goodhue's six TTF dimensions are linked to the factors and to the survey questions, which loaded to those factors. To operationalize this construct (TTF), I used the composite scores (mean) of the responses to all questions representing the five factors and six dimensions of TTF.

Table 28 Factors and Dimensions of TTF

QUESTIONS	DIMENSION OF TTF	FACTOR
19, 20	Ease of use	Ease of use
13, 14, 15	Data Compatibility	Data Compatibility
16, 17, 18	System Reliability	System Reliability
21, 22	Performance Impact	Impact on Performance
6, 7	Data Detail	Data Detail and Locatability
8, 9	Data Locatability	Data Detail and Locatability

To test this hypothesis I used the ANOVA to determine if TTF score (dependent variable) differed by the respondent's level of education (independent variable). Higher TTF scores are associated with greater degrees of satisfaction with the technology. Although the mean TTF scores differed by level of education no discernable pattern was

evident (see Table 27, p.150). Respondents with only high school diplomas and those with graduate degrees rated TTF the highest at 4.82 and 4.77 respectively. The remaining scores were lower except for the respondents with 2-year degrees who rated TTF at the next highest level, 4.70. The ANOVA F (5, 578) =1.44, ns (Table27) suggests no significant difference in TTF associated with level of education.

Results - Hypothesis 7 (No Support for Hypothesis - Unable to Reject the Null)

The data presented suggest that no relationship exists between the users' level of education and user satisfaction (assessment of TTF) with technology. I am therefore unable to reject the null hypothesis (Ho_7) and conclude that 'Level of education does not influence user-satisfaction with available technology.'

Analysis of Hypothesis 8

Ho_8: Experience does not influence user-satisfaction with available technology.

This hypothesis does not compare mean scores between groups (SDSO and BSO). It seeks to determine whether the level of satisfaction with technology (TTF score) is influenced by law enforcement 'experience.' It examines the mean TTF scores of the entire population, by amount of experience, and compares the TTF of each level to determine if an association exists between amount of experience and TTF score.

Table 29 ANOVA: Hypothesis 7 - TTF Measure * Experience

Experience	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
Time in current position				3	3.46	.016	.018
Less than 1 year	104	4.76	.788				
1-2 years	114	4.74	.689				
3-5 years	144	4.61	.812				
6 or more years	211	4.50	.825				
Total	573	4.63	.795				

Experience	n	TTF (mean)	sd	df	F	*P*	Eta^{2*}
Years with this agency				5	2.78	.017	.024
Less than 1 year	25	4.97	.823				
1-2 years	45	4.80	.796				
3-5 years	117	4.69	.806				
6-10 years	130	4.65	.729				
11-20 years	208	4.54	.785				
21 or higher	58	4.43	.858				
Total	583	4.62	.793				
Years as law enforcement officer				5	4.51	.000	.038
Less than 1 year	31	4.97	.701				
1-2 years	32	5.02	.715				
3-5 years	81	4.77	.721				
6-10 years	137	4.59	.818				
11-20 years	210	4.55	.779				
21 or higher	89	4.47	.843				
Total	580	4.62	.796				

To test this hypothesis I used the ANOVA statistic to determine if TTF score differed by the respondent's level of experience. The 'Law Enforcement Experience' survey questions, borrowed from Ioimo (2000), consist of check boxes with level of experience assigned to each as shown below and presented in the survey.

Law Enforcement Experience

Time in current position: ☐ Less than 1 year ☐ 1-2 yrs ☐ 3-5 yrs ☐ 6 or more years

Years with this agency: ☐ Less than 1 year ☐ 1-2 yrs ☐ 3-5 yrs ☐ 6-10 yrs ☐ 11 - 20 yrs. ☐ 21 or higher

Years as a law enforcement officer: ☐ Less than 1 year ☐ 1-2 yrs ☐ 3-5 yrs ☐ 6-10 yrs ☐ 11 - 20 yrs. ☐ 21 or higher

This study uses three dimensions of experience, measured as follows. The first 'time in current position,' should assess relative expertise in a given assignment area. The second measure 'years with agency,' captures differences in perception of officers

who might have worked for a different agency or are new to the agency. The third 'years as a law enforcement officer,' captures information concerning law enforcement experience in general.

Time in current position

The ANOVA, $F(3, 573) = 3.46$, $p < .05$ (Table 29) suggests a significant difference in TTF scores associated with 'Time in current position.' The data suggest that officers with less experience in a given position tend to assess the technology (TTF) more positively. The biggest difference in (mean) TTF scores exists between officers with less than two years experience and those with three or more year's experience.

Years with this agency

The next measure of experience tested is 'years with agency.' The ANOVA, $F(5, 577) = 2.78$, $p < .05$ (Table 29, p.152) suggests a significant difference in TTF scores associated with 'Years with this agency.' At the extreme end of the experience spectrum a difference in mean scores exists between officers with less than 1 year of experience 'in the agency' and those with 21 years or higher (4.98 and 4.43, respectively). The mean scores also suggest that officers who have been with the agency fewer years assess the technology more favorably (i.e., a higher TTF score).

Years as a law enforcement officer

The final measure of experience tested is 'Years as a law enforcement officer.' The TTF scores are similar to the scores found in 'Years with this agency.' The ANOVA, $F(5, 574) = 4.51$, $p < .01$ (Table 29, p.152) suggests a significant difference in TTF scores associated with 'Years as a law enforcement officer.' A difference in mean

scores exists between officers with less than 1 year of experience 'as a law enforcement officer' and those with 21 years or higher (4.97 and 4.47, respectively). The mean TTF scores also indicate that officers who have more law enforcement experience assess TTF with a lower score, which indicates a lesser degree of satisfaction with the technology.

Strength of association

Because we are using an ANOVA to compare a dependent variable (TTF Assessment Score) at an interval level, to independent nominal variables (level of experience), we must examine the measures of association to test the strength of any existing relationship. I used the Eta^2 to examine the association, or relationship, between scores for TTF measure and groups within the experience variables. As indicated earlier, 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 Eta^2 statistics reveal that while the relationships between any measure of experience ('time in current position,' 'years with agency,' and 'years as a law enforcement officer') and TTF score are statistically significant, they are very weak (Eta^2= .018, .024, and .038 respectively). Given this weak association, it is appropriate to conclude that differences in user-satisfaction with technology (TTF score) while significant, are not strongly influenced by law enforcement experience.

Results - Hypothesis 8 (Tentative Support for Hypothesis – Reject the Null)

The ANOVA scores (Table 29) suggest a significant difference in TTF scores associated with each measure of experience, i.e., time in current position,' 'years with agency,' and 'years as a law enforcement officer.' The Eta^2 statistics reveal that the

relationships are weak, therefore it is appropriate to conclude that differences in user-satisfaction with technology (TTF score) are not strongly influenced by law enforcement experience. While these results offer support for rejecting the Null hypothesis, the existence of a weak relationship may indicate a need for further examination, testing and exploration of the variables in question.

Analysis of Hypothesis 9

> Ho_9: Neither the amount nor the type of computer training influences user satisfaction with available technology.

Like Hypotheses 7 & 8, this hypothesis does not compare mean scores between groups (SDSO and BSO). It seeks to determine whether the level of satisfaction with technology (TTF score) is influenced by 'computer training.' Hypothesis 9 examines the mean TTF scores of the entire population (both BSO and SDSO), by amount and type of computer training and compares the TTF of each level to determine if an association exists between different aspects of computer training and TTF score.

Table 30 (p. 157) provides the mean scores of the 'TTF Measure' (level of satisfaction with the technology) for each dimension of training. In testing this hypothesis, I used the ANOVA statistical procedure to examine differences in the TTF assessment score by amount and type of computer training received.

Table 30 ANOVA: Hypothesis 9 - 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/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 33-38 found in Part E of the survey are 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. I

added question 39 to determine the amount of self-training. Questions 33 through 39 are presented below as they appeared in the survey instrument.

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

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

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

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

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

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

39. 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 30, p. 157) suggests a significant difference in 'TTF Measure' scores between groups (Training hours received), $F(3, 577) = 5.58$, $p < .01$.

To determine the source of the significant *F-value* I used the ANOVA Post Hoc procedure. 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 30, p.157) indicates a significant difference in 'TTF Measure' scores between groups (Amount of training), $F(1, 579) = 74.40$, $p < .01$. This suggests a significant difference in user satisfaction with technology between respondents who felt that the amount of training was adequate and those who felt that it was not.

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 30) suggests a significant difference in 'TTF Measure' scores between groups (Training hours received), $F(3, 574) = 17.39$, $p < .01$.

I used the ANOVA Post Hoc procedure 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 a significant difference in user satisfaction with technology between those who were satisfied with the timing of the training and those who were not.

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 30, p.157) 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 determines the source of the significant *F-value*. 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 a significant difference in user satisfaction with technology between those who were satisfied with the quality of the training and those who were not.

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 30, p.157) indicates a significant difference in 'TTF Measure' scores between groups (Frequency of Training), $F(1, 579) = 42.59$, $p < .01$. These results suggest a significant difference in user satisfaction with technology between those who are satisfied with the frequency of the computer training and those who are not.

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 30) suggests no significant difference in 'TTF Measure' scores exists between groups (Source of Training), $F(2, 574) = 2.75$, ns. These findings suggest that the source of computer training does not appear to be related to 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 between 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, I used the Eta^2. 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 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.

Results – Hypothesis 9 (Tentative Support for Hypothesis – Reject the Null)

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 provide information suggesting tentative support of the hypothesis, acknowledging 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.

Hypothesis Testing Summary

Hypothesis 1 & 2: Impact of information technology on individual effectiveness and performance

While both Broward and San Diego officers feel that information technology in general contributes to their individual effectiveness and job performance, Officers from San Diego have stronger feelings about it; that difference was significant. Both groups of officers felt that a specific technology - information sharing technology - contributes to their individual effectiveness and job performance; I found no significant difference between group responses, resulting in mixed support for hypotheses 1 and 2.

Hypothesis 3: Impact of information technology on productivity

Analysis of the data suggests both groups of officers feel that information technology in general, and information sharing specifically, make them more productive. The level of support for this notion was stronger among San Diego officers than it was among Broward officers. The significant difference between groups suggests that the information technology and information sharing technology both contribute more to productivity in San Diego than they do in Broward; therefore, I reject the null hypothesis.

Hypothesis 4: Technology and arrests

While the analysis clearly indicates that information technology assists both groups of officers in making arrests, I observed no difference between groups. This suggests no major linkage between information sharing technology and the number of arrests officers make. I fail to reject the null hypothesis.

Hypothesis 5: Technology and case clearances

The analysis suggests that information technology assists both groups of officers in clearing cases. San Diego officers are reporting a significantly higher number of case clearances attributable to computing. This suggests that information sharing technology might play a role in the number of cases cleared by officers; therefore, I reject the null hypothesis.

Hypothesis 6: Data meets officers' needs

Responses to two of the three TTF dimensions (Goodhue, 1995) relating specifically to data: 'Level of Detail,' [data] and 'Locatability,' suggest that a significant difference between the groups. Analysis of the final dimension, 'compatibility,' suggests that neither group has a problem with data compatibility. These results offer partial support for this hypothesis and suggest that the presence of information sharing technologies does influence the level of officer-satisfaction with the available data.

Hypothesis 7: Education influences user-satisfaction

The data do not support this hypothesis. I found no relationship between any level of education and the officers' assessment of TTF (satisfaction with the technology). These findings suggest that satisfaction is more a function of the system, its performance, data etc. and the amount of education is not a strong contributing factor.

Hypothesis 8: Experience influences user-satisfaction

Hypothesis 8 examines whether experience influences user-satisfaction (TTF Assessment). These findings suggest a statistically significant but weak, association between the number of years of experience and user-satisfaction. While these results offer support for rejecting the Null hypothesis, the existence of a weak relationship may

indicate a need for further examination, testing, and exploration of the variables in question.

Hypothesis 9: Computer training influences user-satisfaction

Hypothesis 9 tests whether computer training influences user-satisfaction with the available technology. The relationships between certain training variables and scores for 'TTF Measure' are statistically significant, though low Eta^2 suggests that training influence may not be particularly strong. While these results offer support for rejecting the Null hypothesis, additional research and/or changes in survey instrumentation may provide further evidence regarding this association.

CHAPTER 6
SUMMARY AND CONCLUSIONS

This chapter provides a brief synopsis of the research findings, presented as follows. Each hypothesis is presented with its supporting quantitative, qualitative, and triangulated findings. Next, is an acknowledgement of the study's limitations, which is followed by the policy implications. The chapter culminates with recommendations for future research.

As a prelude to discussing the conclusions, this chapter begins with an overview of the intent of this study, presented within the context of the fundamental research question. The fundamental research question seeks to determine whether differences in perception of the value of information technology exist between two groups of law enforcement officers – those using automated regional information sharing (San Diego officers, the info-sharing group) and those using automated systems that do not facilitate the sharing of regional data (Broward officers), the comparison group. The use of a comparison group helps to mitigate the inherent design weakness of assessing the impact of an intervention after-the-fact. This is an accepted method of creating a comparison base when random assignment is not possible (Bickman et al., 1997). This study employs primarily, a survey design but includes both an associational and comparative research approach to test the hypotheses associated with this question.

The research methodology consisted of four different data gathering approaches: surveys, interviews, field observation, and review of records. Triangulation can reduce distortions and validity threats inherent in single-method studies (Maxwell, 1997).

Table 31 Summary of Hypothesis Results

Null Hypothesis	Results
1. No difference exists between the info-sharing group and the comparison group's assessment of the impact of information technology on *individual effectiveness*	Reject the Null - Mixed Support for Hypothesis
2. No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual performance.*	Reject the Null - Mixed Support for Hypothesis
3. No difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing *individual productivity.*	Reject the Null - Support Hypothesis
4. No 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.*	Unable to reject the Null - No Support for Hypothesis
5. No 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.*	Reject the Null - Support Hypothesis
6. No difference exists between the info sharing and comparison group's assessment of the degree to which the data available to officers meets their needs.	Reject the Null - Mixed Support for Hypothesis
7. Level of education does not influence user-satisfaction with available technology.	Unable to reject the Null - No Support for Hypothesis
8. Experience does not influence user-satisfaction with available technology.	Reject the null - Tentative Support for Hypothesis
9. Neither the amount nor the type of computer training influences user satisfaction with available technology.	Reject the null - Tentative Support for Hypothesis

Findings

This section presents a synopsis of the findings. It begins with the results for each hypothesis (Table 31, p.167), i.e., whether or not the data support the hypotheses or a rejection of the null. This is followed by an overview of the quantitative results and whether those findings support the hypothesis. After this, the qualitative findings are reported. A synthesis of the two (quantitative and qualitative) is then reported, providing a multidimensional overview of the analysis and results for each hypothesis.

Ho_1, Ho_2: Effectiveness, Performance – Mixed Support for Hypotheses – Reject the Null

- 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.
- No significant difference exists between the info-sharing and comparison group's assessment of the role automation plays in enhancing individual performance.

Quantitative results: Mixed support

Analysis of Variance (ANOVA) tests of the responses to 588 surveys indicates a significant difference between groups (San Diego vs. Broward Officers), suggesting that San Diego officers perceive computing as playing a greater role in making them more effective and in improving their performance. This research question was non-specific as to systems; it did not seek to determine which systems contribute to effectiveness or

performance. It examined the officers' perception of the impact of computing systems in general.

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). Earlier studies have linked MIS success to effectiveness (Ives, et al., 1983) and individual performance impact (DeLone and McLean, 1992).

Another question important to these hypotheses 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 indicates 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. These findings 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. Therefore, I found only partial support for these hypotheses.

Qualitative results: Support

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, thus resulting in mixed support for the hypotheses.

Interviews: Interviews revealed a pattern of computer usage. Officers from San Diego felt that they use their computers more than the Broward 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 Broward 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 also support these hypotheses.

Effectiveness and performance summary: Mixed support for hypotheses

Do differences exist between groups of officers (San Diego vs. Broward) 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 testing support for these hypotheses: 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 than it does in Broward, while the quantitative findings suggest that it does not.

Ho_3: Productivity - Support Hypothesis (Reject the Null)

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

Quantitative results: Support hypothesis

Analysis of Variance (ANOVA) tests indicate a significant difference between groups (San Diego vs. Broward Officers), suggesting that San Diego officers perceive computing as playing a greater role in making them more productive. The scores 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 Broward.

Qualitative results: Support hypothesis

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. Broward 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 for this hypothesis. 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: Support for hypothesis

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) attributable to information technology. 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.

Ho_4: Arrests – No Support for Hypothesis (Unable to Reject the Null)

- 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: No support

Analysis of Variance (ANOVA) tests results are the opposite of what I expected. Broward 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. Broward officers use

this type of system more exclusively than San Diego officers do. This could explain the slightly higher score reported by Broward 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 support on-site or immediate arrests.

The POWERTRAC accountability system (which I will call the 'performance management imperative'), in place at the Broward County Sheriff's Office is a variable that appears to impact performance. This management tool causes the officers to focus their efforts in areas that 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 system usage, particularly systems that support arrests.

Arrest summary: No support for hypothesis

Which group of officers - Broward or San Diego - perceives automation as playing a greater role in providing information that directly assists them in making arrests? The answer is neither; both groups of officers believe information technology provides information that directly assists them in making arrests. 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.

What is troublesome about these results is the arrest statistics for the past three years. Broward officers made significantly more arrests[11] 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 significant role in arrest rate. The arrest statistics only speak at absolute numbers and do not address cause. The qualitative findings offer the best clue; the difference could be due to the management philosophy and the performance management imperative (POWERTRAC). This performance management imperative mandates a different type of policing on the part of the Broward 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 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.

Ho_5: Case Clearances - <u>Support Hypothesis (Reject the Null)</u>

- 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 <u>clearing cases.</u>

Quantitative results: Support for hypothesis

[11] 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.

Both groups of officers felt that information technology assisted them in clearing cases.[12] San Diego officers perceive computing as assisting in 34% of the crimes they solve (case clearances) while Broward officers perceive computing as assisting in 29% of their case clearances. The Analysis of Variance (ANOVA) tests indicate a significant difference between groups (San Diego vs. Broward Officers), suggesting that San Diego officers perceive computing as playing a greater role in case clearances.

Qualitative results: Support for hypothesis

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. The BSO deputies, without this kind of technology, are at a disadvantage in terms of having technology that supports case clearances.

Interviews: The BSO 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

[12] Case clearance should not be confused with an arrest; the former refers to solving a crime while the latter refers to physically taking someone into custody. For example, cases such as a homicide, sexual assault etc. can be solved or "cleared" by matching DNA or fingerprint evidence left at the scene of a crime to the perpetrator. If the officer obtains a warrant, the case is considered solved or cleared, even though no arrest was made. If another officer subsequently arrests the suspect on the warrant, the second officer gets credit for the arrest but not the case clearance.

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: Support for hypothesis

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 than in Broward, 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 Broward's technology, the crimes statistics do not mirror these findings. I expected the crime statistics to reflect differences in clearances rates between groups with San Diego having the higher of the two. This is not the case. 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 Broward. This difference suggests that variables other than computers contribute to case clearances. Computers might still assist San Diego officers in more of their cases clearances, but the *performance management imperative* apparently results in higher clearance rates for property crime in Broward. This is similar to the findings for arrests and suggests that any additional research to establish the link between TTF and performance, as recommended by Goodhue (1998),

incorporate variables that could affect performance, such as the *performance management imperative*, especially when TTF is applied to law enforcement or other public sector organizations.

Ho_6: Data Meets Needs – Mixed Support for Hypothesis (Reject the Null)

- 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.

Quantitative results: Mixed support for hypothesis

The ANOVA tests results support the fact that San Diego officers and Broward 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 officers in Broward 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: Support for hypothesis

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 BSO deputies 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 – moving from system to system. Broward

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: Mixed support for hypothesis

When compared to Broward officers, 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 Broward 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 largely a stand-alone system, separate from the 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?

Ho_7: Education and User Satisfaction (TTF) - <u>No Support for Hypothesis (Unable to Reject the Null)</u>

- Level of education does not influence user-satisfaction (TTF score) with available technology.

Quantitative results: No support for hypothesis

The ANOVA test statistics suggest that user-satisfaction with available technology is not dependent upon or related to level of education. Using the TTF Measure to assess the overall satisfaction with the technology, I could find no significant difference in mean scores when examined by education level. Variables other than education level influence user satisfaction with the technology.

(Qualitative tests are not appropriate for this hypothesis.)

Education and User Satisfaction summary: No support for hypothesis

Does education influence user satisfaction with the technology? Neither the quantitative nor the qualitative research findings support this hypothesis. Linking education to technology usage in law enforcement is not new. Earlier research failed to demonstrate a link between a law enforcement officer's level of education and perceived benefit from technology (Danziger and Kraemer, 1985). The findings of this dissertation expand upon Danziger and Kraemer's (1985) work by demonstrating that education has no effect on a user's satisfaction with the available technology. While technology has changed dramatically since 1985, perhaps it has not changed to the extent that higher levels of education will foster a greater or lesser level of satisfaction with technology. Could it be that law enforcement technology lends itself to usage by people with levels of education normally found in law enforcement agencies?

Ho_8: Experience and User-Satisfaction – <u>Tentative Support – Reject the Null</u>

- Experience influences user-satisfaction (TTF score) with available technology.

Quantitative results: Tentative support for hypothesis

The ANOVA test statistics offer support for this question. Experience is associated with user-satisfaction (TTF assessment) but that association is weak.

Qualitative results: Support for hypothesis

Neither the direct observation nor the interviews provided sufficient information to support this hypothesis. In making observations and conducting interviews, the researchers did not attempt to assess the amount of experience beyond that which was obvious from listening to and watching the officers. Based upon that limited information, there did not appear to be an association between experience and the officers' satisfaction with the technology.

Experience and user satisfaction summary: Tentative support for hypothesis – reject null

Does experience influence user satisfaction with the technology? This hypothesis receives some support from the quantitative research. These findings parallel and expand upon the findings of earlier research specific to law enforcement computer usage and experience. In examining police use of computers, Northrop et al. (1995) found that experience did not correlate with system usage. This dissertation examined another dimension of experience - its affect on satisfaction with technology - and found experience is weakly but significantly associated with satisfaction.

Ho_9: Training and User-Satisfaction – <u>Tentative Support - Reject the Null</u>

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

Quantitative results: Support for hypothesis

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 associated with the amount or type of computer training received.

Qualitative results: Questionable results

Direct Observations: Both the Broward and the San Diego County Sheriff's Office 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 lack of training or complexity of use. The lack of formal computer training did not appear to influence their level of satisfaction with the technology.

Training and User Satisfaction summary: Tentative support for hypothesis – reject null

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.' The

quantitative analysis supports the hypothesis, but 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* - Broward 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 agencies as large and complex as the Sheriff's Offices in Broward County and San Diego with exactly the same computing environment. To control for these differences, survey questions specific to information sharing are 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 POWERTRAC accountability program, influences the policing methods of the street level officers in Broward. 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 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 Recommendations

Information sharing, TTF, 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 added construct of Goodhue's (1995) Task Technology Fit (TTF) theory (see pages 21-23). It also associates, for the first time, TTF to quantitative measures of performance in the form of outputs i.e., investigations, arrests, and clearances (see pages 26-29), a future direction suggested by Goodhue (1995): in doing so, it established an important link between information sharing and the productivity of street level officers.

Recommendations

- The evidence presented here suggests a link between user evaluations of technology (TTF) and productivity. More data is needed to determine if different types of information sharing systems share that link. Local law enforcement officials should collaborate with the Federal Government, universities or the private sector to make post-implementation evaluation a part of information sharing technology projects.
- Reduce the reliance on self-reporting and perception and strengthen the link between productivity and information systems, using quantifiable performance measures.
- The Federal Government should consider making post-implementation evaluation a condition of information sharing technology grants.
- 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.

The 'Performance management imperative'

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

Recommendation

- 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 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.

Recommendations

- While additional empirical data is necessary to demonstrate a correlation 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

The lack of computer training is an issue for officers in both agencies, but it does not appear to be a strong influence in user-assessment of TTF. The presence of informal consultancy training could make a difference in TTF assessment. More research is necessary to determine if this is true. The presence of this informal training suggests that

the street level bureaucrats 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.

Recommendations

- More research is necessary to determine exactly how this informal consultancy training influences system usage and user-satisfaction.
- Agency-wide training policy should incorporate and improve upon the informal computer training created by field officers.

Suggestions for Future Research

This research builds upon existing knowledge and in doing so presents areas in need of further research. The suggestions for future research presented in this section evolve from the findings of this dissertation.

Strengthen the link between individual performance and TTF

Perceived performance impacts should be supplemented by measures that are more direct. Future research should attempt to isolate and quantify performance variables that can be directly associated with computer usage, outputs and outcomes.

Examine the problems with data locatability.

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).

Expand this study to investigate TTF over a range of 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.

Research the interaction among the performance management imperative, technology, and individual performance

This study suggests that certain differences in outputs between agencies (arrests and property crime clearances) are related to the existence of a performance management imperative (POWERTRAC). While this theory was not tested as part of this study, the findings present questions that merit further consideration. Is the performance management imperative responsible for the greater number of arrests and higher property crime clearance rates in Broward County? If so, why would it not result in higher violent crime clearance rates? Is information-sharing technology particularly useful in assisting officers in solving violent crimes? If so, what attributes of the technology help the most? The interaction between information technology, particularly information sharing

technology, and the performance management imperative deserves further research and attention.

Examine the relationship between officer safety and information technology, with particular emphasis on information sharing

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. This dissertation makes a case for adding a qualitative component to any TTF assessment; without the qualitative portion of this study, the potential link between information sharing and officer safety would not have been discovered.

Research 'experience' and its impact on user satisfaction (TTF)

This study suggests that satisfaction-with-technology is weakly but significantly associated law enforcement experience. The weak association suggests a need for further examination, testing, and exploration of the variables in question. Future research should examine areas such as age; is experience or age responsible for the association? Is it the resistance to change by older workers? Maybe the more experienced officers are more demanding of the technology because they know the kind of information they need and thus are less satisfied when they do not readily find it. In the end, these findings suggest more questions than answers, opening the door to further research opportunities.

Investigate computer training methods and their impact on user satisfaction (TTF)

The findings in this study suggest the need for research to determine exactly how informal consultancy training influences system usage and user-satisfaction. Other computer training questions also deserve attention. Is computer training an element of user satisfaction (TTF)? What computer training methods are the most effective in enhancing satisfaction? Does a relationship exist between training method, user-satisfaction, and performance impact? If so, which training methods most affect the bottom line?

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Appendix A

Glossary of Terms

GLOSSARY OF COMMONLY USED TERMS

Automated Regional Information System (ARJIS): A "single-point of entry" system with an ability to query all regional justice data, it is complex criminal justice enterprise network utilized by 38 local, state and federal agencies in the San Diego region. It is chartered with supporting a regional web based enterprise network that utilizes technical and operational standards to build interfaces to all criminal justice systems in the region. It is utilized for tactical analysis, investigations, statistical information and crime analysis.

Be on the Lookouts (BOLO's): A brief message/photo disseminated to officers of a law enforcement agency to inform them to be aware of a wanted person or dangerous situation in the community. (In BSO and SDSO, these messages can be sent via radio or via CAD.)

CDPD – Cellular Digital Packet Data: A technology that enables mobile computers to send and receive data via the cellular phone system.

Computer Aided Dispatch (CAD): A process that provides real-time information to dispatchers and officers, allowing both access to critical information to help make more informed decisions; allows for the automation of call-taking and transferring the information from dispatch to those in the field. (Both BSO and SDSO have CAD available for patrol deputies.)

Florida Crime Information Center (FCIC): A telecommunications network for law enforcement and criminal justice agencies throughout Florida, it provides linkage to the National Crime Information Center (NCIC) and other states via the National Law Enforcement Telecommunications Network. It is comprised of over 40,000 workstations statewide and handles approximately 35-40 million transactions per month.

National Criminal Information Center (NCIC): A computerized index of criminal justice information (i.e.- criminal record history information, fugitives, stolen properties, missing persons). It is available to Federal, state, and local law enforcement and other criminal justice agencies and is operational 24 hours a day, 365 days a year.

Mobile Data Computer (MDC): A computer that resides in the patrol car, it is loaded with special software and a wireless network that allows deputies to query persons, vehicles and articles. It is also equipped with a fully encrypted, silent dispatching system.

Provide Objectives Where Enforcement Resources Target Responses Against Crime (POWERTRAC): A formal reporting and evaluation process used to hold law enforcement officers accountable to the people they serve and a management accountability program. It is a diligent weekly review process that can examine each crime committed within jurisdictions, spot crime trends and develop ways to use existing resources to prevent future crimes. (This process is utilized in BSO, but not SDSO.)

Appendix B

Instruction to Survey Participants

Instructions to Survey Participants

OVERVIEW AND INSTRUCTIONS:

You have been randomly selected to participate in a National Institute of Justice–sponsored study being conducted to assess the use of information technology by law enforcement officers who work in the field. The purpose of the study is to evaluate how you use existing information technology and how it impacts the work you do. It is important to note that the findings of the study will be used to improve the systems that you use and could influence law enforcement systems development nationally.

Your role in the study will be to complete the brief survey enclosed. No identifying information will be collected from the answers you provide, and you can be assured that your name will not be attributed to any specifics.

Please COMPLETE ALL ITEMS on the survey, using your best judgment, by either checking the appropriate box or providing answers to the questions asked. There are no "right" or "wrong" answers. We are interested in your opinion.

Thank you in advance for your participation.

Appendix C

Surveys