

**COPLINK: Exploring Usability of a Multimedia Database
Application for Law Enforcement**

Roslin V. Hauck

Research Associate

University of Arizona

Department of Management Information Systems

rrv@bpa.arizona.edu

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Introduction

The development of information technologies during the past few years has improved many organizations' ability to understand and disseminate data. The development of powerful databases permits the organization of information in a manner that improves information accessibility, speed of retrieval, and searching flexibility. In addition, the expansion of the Internet provides a vehicle for the sharing of information across geographical distance, encouraging collaboration among people and organizations.

Knowledge management tools that also have been developed not only pull together information but also present it in a manner that allows for easy processing of enormous amounts of data. These tools provide a means for understanding data at a more advanced level that may incorporate many different types of available data and allow for their integration and categorization. Combining databases, the Internet and knowledge management tools can produce an information retrieval system that can greatly enhance the processing of organizational data.

Law enforcement agencies across the United States have begun to focus on using such innovative information technologies to help manage criminal information by serving as intelligence tools to combat criminal activity, by aiding in case investigation, or even by predicting criminal activity.

Local Law Enforcement Technology Problems

However, many issues and obstacles must be addressed to ensure the successful deployment of these and similar information technologies in local law enforcement agencies.

Database Integration

One important aspect of problem solving is the ability to cluster related information to permit querying across many different data types and sources. This requires the ability to integrate and access the vast number of law enforcement data sources [14]. In many local law enforcement agencies, criminal information databases exist as isolated stand-alone

systems. While many law enforcement agencies depend heavily on crime-related information systems, most of their systems are not networked together; thus deterring collaboration [11]. Inability to share information with other systems prevents an agency's receiving timely information which could be used with that from other data sources to increase the efficiency of crime prevention and investigations [15].

Access to Information

Similarly, law enforcers often have a problem accessing valuable information sources. Because time can be such a crucial factor in the completion of an investigation, access to information in a timely fashion is critical. Obstacles to acquiring information promptly can include restricting access to some systems to certain types of officers and long wait times for query returns. Although a detective may need information within 3-40 hours, he or she may have to wait a few weeks to a month before receiving it. Likewise, secure remote access to textual and multimedia databases is not currently available at many agencies [15].

Interface

One important aspect of information technology for law enforcement is its ability to be used at the different levels within an organization. For example, support must be provided for quick, street-level problems as well as in-depth, lengthy investigations [14]. A vast functional needs and range of user abilities make the design of the interface to the technology an area of great importance. Although some departments are turning to the use of graphical user interfaces, many of the front-end interfaces of the current database systems used by local law enforcement are text-based. Navigation through these systems is often difficult and system commands are counterintuitive for the users. Although a system may have much useful functionality, it appears that only a very few users are able actually to operate those functions. Furthermore, because many interfaces are restricted to textual information, multimedia information such as mug shots and video clips cannot be accessed through them.

Knowledge Management

Many record management systems for law enforcement agencies contain a large amount of data for each case or incident. The problem is that, although the data are available, they are not available in a form that makes them useful for higher level processing. For example, the ideal knowledge management system should be able to provide information about problems that have not been previously identified and thus be able to give innovative and creative support for new investigations. The conversion of data to information is important to law enforcement agencies. Information is a product designed with a purpose in mind, while data serve as the elements from which this product is constructed [14]. Converting data to useful and easily understandable information is a powerful aspect of information processing that has thus far been missing from most law enforcement information systems.

TPD IT Problem and Direction

The Tucson Police Department (TPD) recently evaluated its information technology and concluded that all of the problems mentioned currently exist in the organization. TPD consequently undertook a research project to investigate the application of current state-of-the-art and near-term database, Intranet, and multimedia technologies to cost effective integration and management of its justice information database and access to it[16]. Although the scope of this project includes a multilevel development plan incorporating different information technologies, the focus of current research is on improving criminal incident information retrieval. The first step in this process has been the evaluation of TPD's current Records Management System (RMS).

TPD's Records Management System (RMS)

The main database at TPD is the Records Management System (RMS), which stores a wide variety of information about criminal cases and incidents related to calls for service recorded by the department's Computer-Aided Dispatch (CAD) system. RMS is a text-based system that is accessed using VAX computer terminals located in many offices in the main police headquarter as well as substations in different sections of the city.

Similar to systems described previously, RMS has many problems concerning interface, access to information and knowledge management. RMS data are organized into a number of search query types. Users are able to search on name queries, location queries, vehicle queries, etc. but they cannot search for multiple types of fields at one time. In addition, users of RMS complain that, depending on the type of query, RMS can take from a few minutes to a few hours to return its results. Many users have said the RMS interface is difficult to operate. For example, when reviewing the results from a query, accidental pressing of an escape key forces the user to repeat the query process in order to return to the screen containing the results.

Use of IT in Law Enforcement

Currently, a number of applications take advantage of various information technologies for law enforcement purposes and that number is growing. Meanwhile, the development of useful artificial intelligence tools continues to progress, and the many potential uses of databases, intelligence analysis, and other technologies such as virtual reality have yet to be fully explored.

Database Technologies

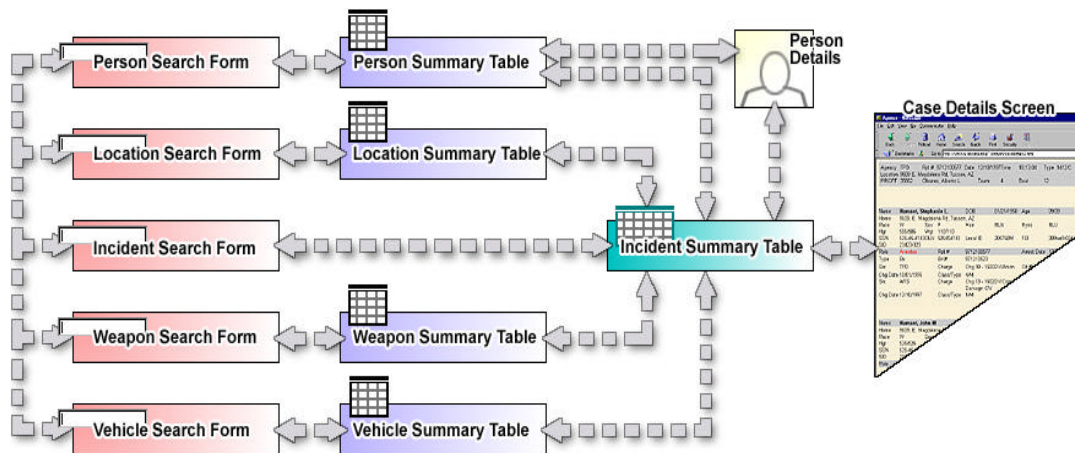
Database technology plays an important role in the management of information for a police department. A number of previous research reports detail the use of database technology to organize information in a form that can be easily searched by officers and other employees in the police department [5] [8] [9] [13] [17]. Use of relational database systems for crime-specific cases, such as gang-related incidents and serious crimes like homicide, aggravated assault, and sexual crimes has proved highly effective [3] [11] [18]. Use of databases in these criminal areas is often targeted because it both allows a manageable amount of information to be entered into the database and has the ability to combine information that may normally exist separately in neighboring police districts.

Criminal databases serve as an invaluable investigative tool by allowing the information fields they contain to be connected in search queries, thus leading to automated investigative support [3]. With the development of distributed database systems, the capability of sharing information across police districts becomes a viable method of searching for information. It is important to point out that although most of existing police information retrieval systems are text-based, a number of them support multimedia work (see, for example, [4]).

Project Summary

The goal of the Coplink Database application is to provide a consistent and intuitive web-based interface that integrates different data sources existing at TPD. Because the seamless integration of the numerous data sources is done at the user interface level, much consideration has been given to the interface design. A special effort has been made to provide screens that inform users without overwhelming them by the sheer volume of data. As part of a user-centered design effort, a number of iterations on the design of the application have occurred. Although internal stress testing of Coplink DB is currently being conducted, issues of usability of the application have yet to be addressed.

The user interface of Coplink DB has four levels of display: search forms, summary tables, person details and case details. Coupled with a history screen that displays a hierarchical user-interaction during a search session, navigation within the system is designed to be intuitive and simple.



COPLINK Search Sequence Flowchart

The purpose of this research was to conduct a usability evaluation of the Coplink DB to address a number of usability goals (Table 1) that guided the design and development effort of this application. The series of items that comprised the questionnaire used to evaluate and compare the Coplink and RMS systems were based upon a number of widely used measures of usability [1], [2], [6], [7], [12]. One usability goal of this application was the *effectiveness* of the system. We calculated effectiveness by measures of impact of the system on job performance, productivity, effectiveness of information, and information accuracy. Another goal of the application is *ease of use*. We assessed achievement of this goal by measures of effort required to complete a task, ability to learn how to use the application, ability of users to navigate easily through the different screens to obtain specific information of interest, and satisfaction with the interaction. *Efficiency* was defined in terms of factors that influence the users' performance in completing the task. Speed of completing tasks, organization of the information on the screens, ability to find information and the interface design itself comprised factors related to the efficiency of the system. Benchmark levels for all three usability factors from TPD's current RMS system were established and compared with Coplink DB ratings.

In addition to the use of written questionnaires, the data collection methods of observation and structured interviewing were used to supplement findings as well as provide feedback for further development efforts.

Goals	Measures
<ul style="list-style-type: none"> • Effectiveness 	<ul style="list-style-type: none"> • Impact on Job Performance • Impact on Productivity Level • Accuracy of system • Effectiveness of information
<ul style="list-style-type: none"> • Ease of Use 	<ul style="list-style-type: none"> • Effort required to use system • Learnability • Navigation

	<ul style="list-style-type: none"> • Clarity of interaction
<ul style="list-style-type: none"> • Efficiency 	<ul style="list-style-type: none"> • Interface design • Speed • Ability to find information • Information organization

Table 1 - Usability measures

A group of 52 law enforcement personnel were recruited to participate in this study. The participants included personnel from a number of different job classifications of varying background experience (e.g., time at TPD, comfort level with computers, etc.). Table 2 represents a profile of some of the characteristics of participants in the study. The data collection sequence was as follows. Initially, all subjects were asked to complete a pre-interaction questionnaire, establishing demographic background and prior levels of computer experience (in general and with the current RMS system). Participants were then given a questionnaire that targeted the perceived usability of the current RMS system. After a brief introduction to the Coplink DB application, subjects were asked to complete at least two search tasks (stating the goal of each task) using Coplink DB. As participants accomplished these tasks, process data were collected by asking them to think aloud. After a usability questionnaire on Coplink DB had been completed, a brief interview on the Coplink DB experience concluded the study.

Job Classification	Sergeants 13% Detectives 50% Patrol officers 24% Crime analysts 13%
Police Units	Homicide 13% Adult Sexual Assault 10% Aggravated Assault 8% Auto Theft 4% Robbery 13% Burglary 8% Gangs 23% Patrol 15% General Crime 6%
Comfort level w/ computers	Very comfortable 10% Comfortable 48% Neither 30% Uncomfortable 10% Very uncomfortable 2%
Gender	Female 27% Male 73%

Table 2 - Participant Profile

Results

Both interview data and data collected from the survey data analyses support a conclusion that use of Coplink DB provided improved performance over use of the current RMS system. On all usability measures (effectiveness, ease of use, and efficiency), participants rated Coplink DB higher than RMS, with the average rating for Coplink being 4.1 (1=strongly disagree to 5=strongly agree). Statistical analyses revealed that this ratings difference was significant ($p \leq 0.0$) for all measures. Figures 1, 2, and 3 show the difference between means of each system for each measure.

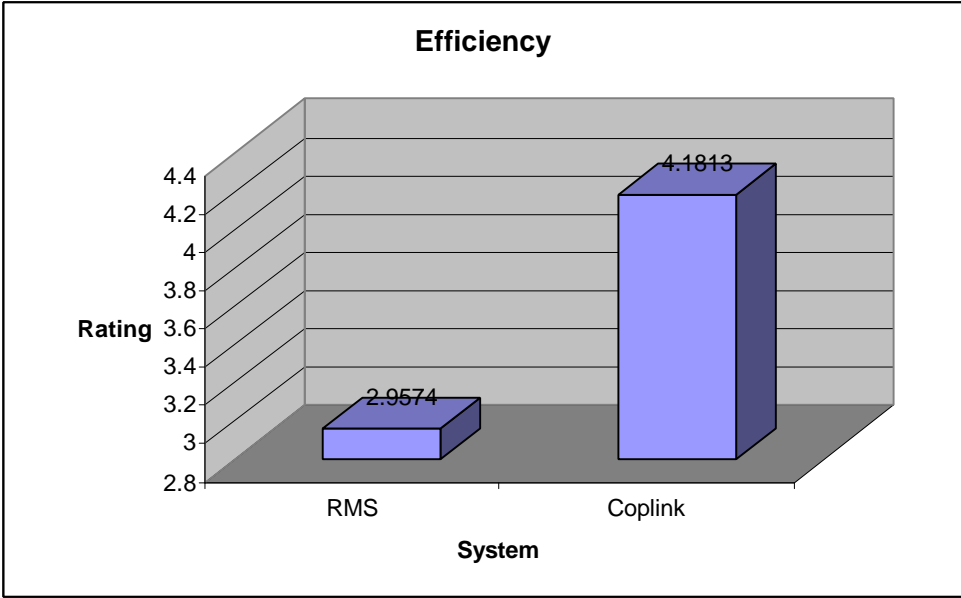


Figure 1 : Difference in means for efficiency measure ($p \leq 0.00$)

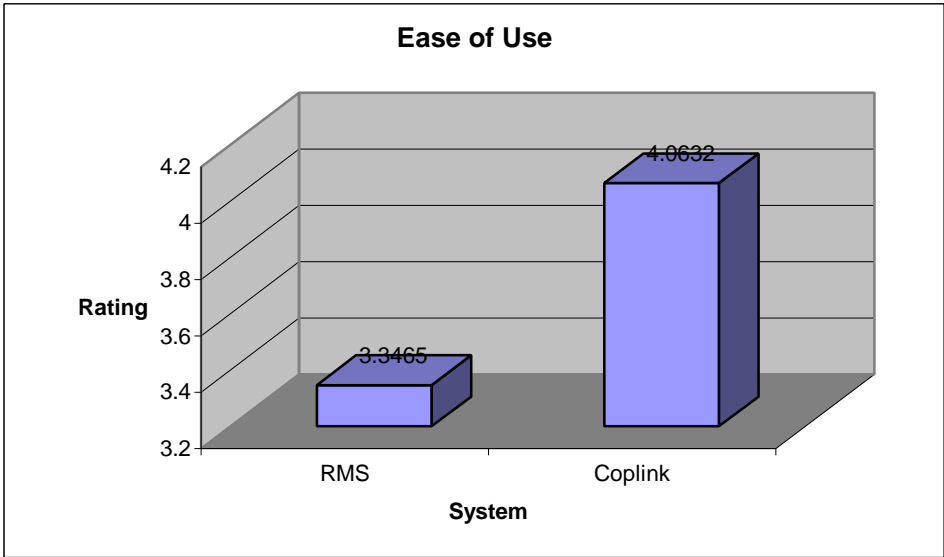


Figure 2: Difference in Means for Ease of Use Measure ($p \leq 0.00$)

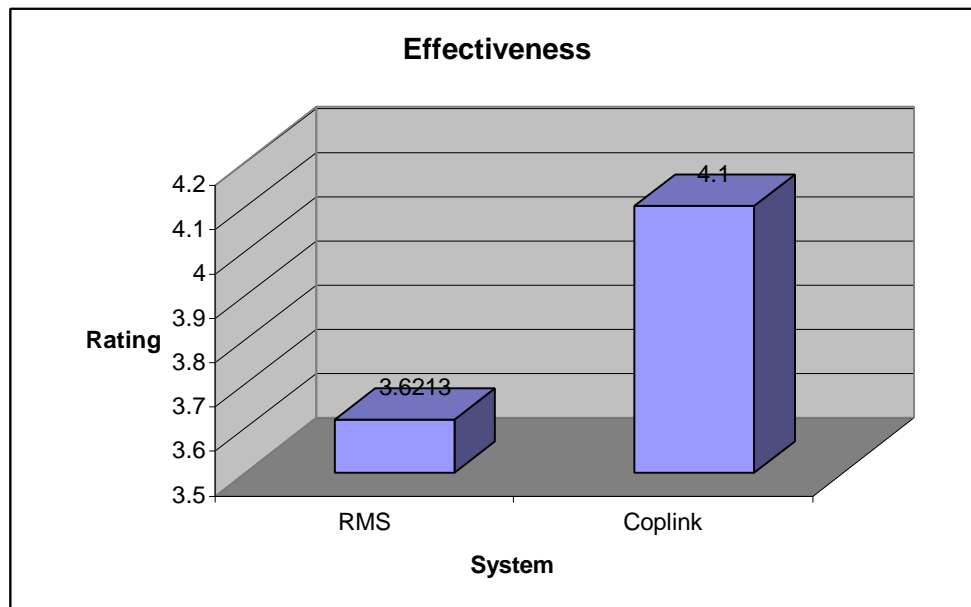


Figure 3: Difference in Means for Effectiveness Measure ($p \leq 0.00$)

In addition to the statistical data, these findings are supported by qualitative data collected from participant interviews. Comments collected from interviews indicate that Coplink DB was rated higher than RMS in terms of interface design and performance as well as functionality. The general themes that emerged from the interviews also can be categorized into factors of speed, ease of use, interface, and information.

I. Speed

"quicker," "100% quicker," "quicker to get details," "Speed is the main strength," "quicker returns," "get information quicker," lead to more work efficiencies," "rapid response," "speed of service," "saves time," "faster"

II. Ease of Use

"easier to use," "easier to read/search," "easily accessible," "easy to navigate," "easier to see," "user friendly," "very easy to use," "a lot easier to use,"

"simple to use," "user friendly,I could use it without training."

III. Interface

"get bulk of information on one screen," "good graphics," "simplified form," "navigation is good," "all information on one page," "less steps to get information," "navigation is easier," "format is easy to understand," "history screen is good," "visually pleasing," "flexible to organize [sort]," "little navigation," "details and incidents are kept separate," "[I] like the person detail screen," "like uniformity of screens," "like colors," "easy to find your way around," "availability of information on one screen," "getting all information is easier," "liked person detail screen," "easy to look at."

IV. Information

"More information than RMS," "more effective and efficient", "a lot more information than RMS," "enter less information, the more you get," "interlink between information," "ties information together."

Figure 4: Categorized interview results. Subjects asked to compare COPLINK DB to RMS and/or comment on their opinion of COPLINK DB.

Participants indicated that the quality and quantity of information from Coplink DB surpassed those of RMS. In a review of current RMS practices, a number of detectives and officers were to have been unable to use RMS but were able to use Coplink DB to conduct searches. It is evident from this research study that Coplink DB allowed a population of TPD personnel to access information that would have been quite difficult for them to have acquired using the RMS system.

From both the questionnaire and the interview data collected from this evaluation, it is evident that many participants rated the information found in Coplink as more useful than the information in RMS. This finding is very interesting, because most of the information contained in Coplink has been taken from RMS. Coplink's ability to allow the user to structure his/her query results by sorting by a number of fields is an important strength of the system. Sorting ability allows users to organize the results in a

meaningful manner given the context of the user's search task. Cases in RMS are organized by date. Coplink DB, on the other hand, allows users not only to organize by date but also to sort by crime type or even team and beat.

Patrol officers who participated in the study indicated that the availability of Coplink DB at substations (within their individual areas) or in patrol cars would of great benefit to on-the-street information access needs that are currently unmet. In particular, they stressed the importance of being able to use mug shots for participants to determine identity quickly. One patrol officer related an incident in which he apprehended a suspect he believed to be wanted for prior criminal activity. Using RMS, the only way the officer could verify the identity of the suspect was to take the person physically to downtown headquarters and have the identification office check his fingerprints. The patrol officer indicated that had he had Coplink DB, either in the patrol car or at one of the local substations, he could have checked mug shots on file as well as current case information on the 'wanted' person to quickly and easily verify the person's identity.

Conclusion

It is evident from this study that the use of knowledge management applications, such as Coplink DB can have a significant impact on law enforcement, with users with different job classifications and backgrounds benefiting from its use. Coplink DB was designed and developed based upon a user-centered methodology. This research demonstrates the success of efforts to implement this methodology as well as its contribution to the performance level of Coplink DB, illustrating the potential value of knowledge management to law enforcement. The participants in this research study strongly voiced their eagerness for the deployment of Coplink at TPD. Given the favorable results of our Coplink DB study, we are currently working toward refining the system's functionality and developing a plan for deployment and field-testing.

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