Policing in Partnership with our Community

"Adequate police protection, like beauty, lies in the eye of the beholder. The optimal or appropriate ratio of officers to population, traffic volumes, reported crimes or accidents, etc., is not a matter of mathematics or statistics. It is a matter of human judgement and community resources."

-John Schuiteman,
The Police Chief,
July 1985

Madison Police Department
Patrol Staffing and Deployment Study

On April 6, 2007, the city of Madison issued a request for proposals for a police patrol staffing study. Etico Solutions, Inc. submitted a proposal for a data-driven study that would be based upon police workload data and leave information. The proposed deliverables included a complete report of the methodologies used, the findings based on the analysis of data, and a set of interactive spreadsheets that would allow agency personnel to complete additional analysis in future years. Etico was successful in the bid process and began the study on September 18, 2007.

The researchers who conducted this study, and the subsequent authors of this report, are Timothy J. Freesmeyer, of Etico Solutions Inc., and Dr. William W. Stenzel of Prairie Land Solutions. In keeping with the original proposal for this project, a data-driven analysis of the Patrol function of the MPD was conducted. The methodology for this study was based on the Police Allocation Manual (PAM). Patrol workload for the agency was determined by analyzing four years of past Computer Aided Dispatch (CAD) data. Officer availability was determined based on two years of officer leave data and the current scheduling practices of the agency.

More than fifteen different spreadsheets were created during this study to chart workload for the patrol division and current staffing trends. One primary spreadsheet, entitled "Madison RA" serves as a key spreadsheet for determining appropriate staffing levels based on various desired performance levels. The spreadsheets are provided to the agency on a separate CD ROM accompanying this report.

It should be noted that this process relies on workload data generated from within the Madison Police Department. A number of data pieces needed for this study were not available due to data collection practices within the agency. These practices have been identified and changes have already been made to improve the data collection methods.

This study was the beginning of a change process for the Madison Police Department and should not be expected to be 100% accurate within the first year. As the police department improves their data collection methods and trains the members of the agency how to best report the work that is being performed, the final results from this methodology should get progressively better.

This report is now being submitted as the culmination of several months of analysis and numerous discussions with agency representatives. With the inclusion of the aforementioned spreadsheets and the detailed description of the processes used during this study, the methodologies and processes put in place through this study should serve the Madison Police Department and the City of Madison for many years to come.

Respectfully Submitted,

Timothy J. Freesmeyer
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Prairie Land Solutions

Executive Summary

The following report is the culmination of a nine-month study of the Madison Police Department's Patrol Division, conducted by Etico Solutions, Inc. The focus of this study was to examine the Department's current methods for the collection of patrol workload data and patrol officer availability data; to review and evaluate the current scheduling and deployment of patrol officers; and to formulate a recommendation on the appropriate staff size required for the Patrol Division to meet the objectives of the agency. The final deliverables of this study are a comprehensive report detailing the process and findings and a comprehensive set of Excel spreadsheets that will enable the department to duplicate the methods used in this study in subsequent years.

The methodologies used in this study were based on the Police Personnel Allocation Manual, (PAM) published in 1993, by the National Highway Traffic Safety Administration. The PAM model encompasses, among other things, multi-year CAD data pertaining to the frequency of calls for service handled by the agency, the average time per call spent by patrol officers, and the amount of time officers are away from their patrol duties due to such activities as time off, training, or special assignment.

This study was the first step in a continual process of improvements related to staffing and deployment practices. Several data sources that were needed for the model were either unavailable or uncollected. This is usually the norm, not an exception, when a data-driven process is introduced to an organization for the first time. Data collection methods that were non-existent or marginal in their utility were evaluated by the research team and documented in the final report. As such data collection methods are addressed and improved by the agency, the results of this staffing model are expected to gain greater depth and accuracy. Thus, it is important for the reader to place a greater emphasis on the methodology and collection practices of this process in the first several years than on the final numbers that are produced.

The recommendations contained in this report are not given as a finite number based only on the data at the time the study was conducted. This study presents a fluid model that indicates appropriate staffing levels based on historical workload data, time-off policies, and patrol performance decisions made by MPD Administrators and City Administrators. Using this model, the MPD can select a "level of service" for the Department based on the amount of proactive time per hour available to the patrol officers. Based on the staffing levels chosen, the model provides a number of tangible metrics that can be used to evaluate the return on investment when additional officers are added to the patrol division staff.

The scope of the study was limited to the Patrol Division only and did not encompass specialty units such as the Community Policing Teams, the Emergency Response Team, Traffic Enforcement Units, Traffic Investigators, or the Neighborhood Police Officers. Similarly, this study did not address staffing needs for other divisions such as Detectives, Communications, or Records. The reader is encouraged to remember that while the Patrol Division is the most visible division of the Police Department, it is still only one component within a very large department.

As stated earlier, the primary basis of this study was on multiple years of CAD data and officer leave data. Additional information was reviewed and taken into consideration as it was brought to the attention of the research team. However, it is impossible for data alone to adequately convey all characteristics of a particular agency or jurisdiction. While great care was taken to analyze each type of call and each sector within the city, data alone cannot replace the experience and observations of a command staff that has served the City of Madison for so many years.

The staffing, scheduling, and policy recommendations provided in this report are based on best practices in the discipline of resource allocation and resource deployment. Such recommendations must now be filtered through the experience and expertise of the command staff within the Madison Police Department. A recommended schedule that optimizes deployment from a quantitative perspective may not provide the level of officer or citizen safety that is expected from the citizens when viewed from a qualitative perspective. In such situations, deviation from the stated recommendations may be appropriate. Therefore, the results of this study are recommendations for consideration, a tool to be used in determining staffing levels and deployment of patrol personnel.

I. Jurisdiction and Agency

City of Madison, Wisconsin

The city of Madison serves as the capital of the state of Wisconsin and the county seat of Dane County. Located in south-central Wisconsin, the city's 2006 estimated population of 223,389 make it the second largest city in the state and the 82nd largest in the United States. Estimated growth statistics for the city of Madison show a 7.4% population increase between 2000 and 2006.[1] The city forms the core of the United States Census Bureau's Madison "Metropolitan Statistical Area" (MSA), which includes all of Dane County and the neighboring Iowa and Columbia counties. The Madison MSA had a 2006 estimated population of 543,022 and is one of the fastest-growing MSAs in Wisconsin. Madison has an estimated daytime population increase of 26.1% (54,401 people) due to commuting. In 2006 the city encompassed 68.7 square miles creating a population density of 3,252 people per square mile.

Madison is home to the University of Wisconsin-Madison, a land-grant research institution founded in 1848. The university has a student enrollment of over 42,000 students and employs over 18,000 faculty and staff. The university draws approximately 32% of their students from other U.S. states and approximately 10% internationally. With four colleges, seven trade schools, nine public high schools, four private high schools, and over twenty middle/elementary schools all within the city of Madison, educational services is the most common industry in Madison for both males and females.[1]

Madison's racial/ethnic composition in 2005 was predominately White Non-Hispanic (82.0%). The population also consisted of 5.8% Black and 4.1% Hispanic, with small populations of Asian, Chinese, American Indian, Asian Indian, Korean, and mixed-races.[1] The median resident age for Madison in 2005 was 30.6 years of age compared to the median resident age of 36.0 years for the state.

Based on the most recent census data, 52% of housing in Madison is renter-occupied. Average renter-occupied housing for the state of Wisconsin is 32%. This is most likely due to the presence of the University. Higher rates of renter-occupied housing indicate a more transient population and a more fluid demographic composite of the city.

The City of Madison consistently ranks as a top community in which to live, work, play and raise a family. In addition to ranking among the top ten "Most Livable Cities in the United States" in 2007, Madison also scores in the top ten "Greenest Cities." The city scores just as high in business and industry with a recent 5-Star ranking as a Business Opportunity Metro.

The City of Madison is known for it's miles of bicycle paths, extensive outdoor activities, and a wealth of Fine Art opportunities. As a premier meeting and convention destination, the City draws large crowds throughout the year.

Madison Police Department

Historically, the Madison Police Department has achieved national recognition for embracing a community policing philosophy that focuses on combining efforts of neighborhood officers, patrol officers, and community partners in a problem-solving approach to policing. Extensive city growth has given rise to the need to determine a level of staffing that can effectively provide the type of neighborhood policing services that residents have grown to expect from the police, while ensuring sufficient resources to maintain an effective response to basic calls for service.

The agency's intentional involvement with the citizen's they serve is evident in many ways. Citizen survey results available on the agency website reflect very strong support of the police department by the citizens and a great deal of trust in the officers and the command staff. Their deployment of Neighborhood Policing Officers and Community Policing Teams shows a commitment to their ideals of problem-oriented policing.

In 2007, the Madison Police Department was the largest law enforcement agency in the Dane County area employing over 490 staff members. The Patrol Services was the largest division within the agency with 196 officers and sergeants assigned as of January 1, 2007. In addition to the 155 beat officers assigned to handle calls for service and preventative patrol, the Patrol Services Division was supplemented with 5 K9 teams, 31 Community Policing Officers, 16 Neighborhood Officers, and 7 Traffic Services Officers. The numbers comprising the various support divisions constantly fluctuated as officers were moved within the organization and as officers began and ended their police careers.

Police Services in Madison are divided into five Districts, each with their own District Commander and assigned beat officers. Each district is subdivided into a number of sectors. Beat Officers within each district are assigned to one or more sectors and hold primary responsibility for answering calls in their assigned sectors. Officers in each District are split among three details (shifts). 1st detail is from 7a-3p, 2nd detail is from 3p-11p, and 3rd detail is from 11p-7a. The officers on the Patrol Division work a rotating schedule of 6 on-duty days followed by 3 off-duty days.

Dispatching services for the Madison Police Department are provided by a centralized dispatching center. The center is not managed by the Police Department nor are the dispatchers and call takers considered employees of the Police Department.

Like most law enforcement agencies across the country, the MPD has converted many job duties to civilians. Tasks such as parking enforcement and technology services can be done by a civilian at a lower cost than a sworn officer.

II. Summary of Patrol Staffing Methodologies

The law enforcement profession presents a unique challenge to those responsible for staffing and scheduling their patrol staff. Not only must they schedule a 24-hour operation that operates every day of the year, they must also attempt to staff proportionally to a workload that varies by time of day and day of the week.

Patrol workload can be best described as "non-uniform but predictable". Calls-for-service are not received uniformly; one at a time in consistent intervals. Furthermore, the time required to handle a call-for-service can vary greatly depending on the nature of the call. In spite of this variability, police agencies can reliably predict their most active times and their lowest call levels.

Call-for-service loads are important but they are not the only considerations when determining staff sizes and scheduling officers. Minimum staffing levels must sometimes be considered. Even at times when call volume is expected to be low, agencies may need to staff additional officers to ensure their ability to answer multiple two-officer calls safely and promptly.

Patrol divisions operate in a volatile environment that often requires dealing with complex problems. The patrol division functions in an environment that is void of walls, roofs, or fences. Their working conditions and workload is effected by weather, national events, political activities, natural disasters, demographic shifts, and numerous other environmental, economic, and social factors that affect their community. When the volume of work begins to exceed the available number of officers, a police agency cannot close its doors or stop answering the phone. It must prioritize the calls, respond without back-up, or hold the calls until a unit becomes available.

Officer-to-Population Ratios

Determinations of optimal patrol staffing have been attempted in a number of ways over the last several decades. One of the more popular methods of estimating adequate staffing is using officer-to-population ratios published each year by the FBI in their report entitled "Crime in the United States."[2] This report provides a table displaying the number of sworn officers per 1000 population. The ratios provided in the table are based on two criteria, a population range, and a general location within the United States.

The ratios are not particularly useful for individual police agencies since they do not take local criteria into account. The chart does not consider local demographics, socioeconomic status, crime rates, geographic size, or a host of other important considerations.

It should be noted that the authors of the "Crime in the United States" report specifically state that the statistics provided are not to be used as staffing guidelines. The report states: "Because of law enforcement's differing service requirements and functions as well as the varied demographic traits and characteristics of jurisdictions, use caution when drawing comparisons between agency staffing levels based upon police employment data from the Uniform Crime Reporting (UCR) Program. The data merely reflect existing staffing levels and are not preferred officer strengths recommended by the FBI. In addition, it must be remembered that the totals given for sworn officers for any particular agency reflect not only the patrol officers on the street but also officers assigned to various other duties such as those in administrative and investigative positions as well as those assigned to special teams."[1]

As an agency creates specialty units, such as bicycle officers, those officers may be drawn from patrol. This leaves fewer officers to answer calls-for-service and conduct routine patrol. This reduction in the patrol staffing is not recognized by the officer-to-population ratios since the newly created bicycle officers would still be counted as a sworn officer for purposes of the FBI statistics. Thus, the creation of specialty units to respond to specific requests of the community actually works against the agency when using officer-to-population ratios to estimate optimal staffing in patrol.

Population as a Workload

Population is an *external* workload that does not change based on the goals and self-motivation of the officers on the patrol division.

More importantly, population does not adequately measure the amount of work created for the patrol division. Cities typically have a diverse demographic profile among their residents. The amount of work created for a police department by a particular neighborhood can be affected by that neighborhood's socioeconomic status, unemployment rate, or demographic composition.

Census populations only include the people who reside in the community as residents. Ratios and comparisons based on population do not take into account additional people that commute into a community for work, tourists that are drawn to a community, college students that maintain their home residence, or migrant workers that do not appear on any US census poll. Although these additional groups are not reflected in the city's population, they must be afforded police services and protection.

Benchmarking

A second method that is often used is a comparative analysis based on a number of "similar" agencies. This is often referred to as a form of "benchmarking". This process, in similarity to officer-to-population ratios, is also fraught with inherent assumptions and limitations.

The first assumption is that the "similar" agencies used in the compari-

son are in fact, "similar". Agencies must be found that share similar populations, agency sizes, and geographic locations. Other considerations such as demographics, socioeconomic status, geographic size, crime rate, and population density must also be considered. The list of comparable characteristics could be endless as an agency seeks to find their ultimate comparable agencies.

Another assumption is that the comparable cities are operating under the same philosophy and mission of patrol as the agency under study. Some communities applaud an agency that uses strict enforcement and zero tolerance to maintain a safe community while others would view such tactics as oppressive and overzealous. One community may be willing to fund more officers per population in order to gain greater visibility and officer presence while another community merely tolerates the police department and believes they should only be seen when they are called.

A third assumption is that the chosen "similar" agencies are staffed appropriately. If an agency chooses four similar agencies that are all understaffed, the entire exercise becomes futile. If inquiries were to be made to the similar agencies about the appropriateness of their current staffing, one may receive many different answers, all dependent on who is answering the question.

The Validity of Benchmarking

As an independent consulting company, Etico Solutions has been working with agencies throughout the United States. In addition, both authors of this study are active educators in the discipline of resource allocation and staff scheduling and have been afforded the opportunity of extended conversation with countless law enforcement managers. ***It is our observation that most law enforcement agencies are currently operating at less than optimal staffing levels based on their expected levels of service.*** In addition, agencies that can afford to staff at optimal levels are finding it difficult to identify and recruit qualified applicants. Thus, it could be argued that the profession of law enforcement, in general, is understaffed and experiencing a shortage of qualified candidates. As a result, attempts at determining optimal staffing based on benchmarking techniques, or based on the current staffing statistics of other agencies, merely reinforces a level of understaffing.

Empirical Qualitative Analysis

The assumptions and limitations associated with population-based studies or benchmarking attempts can be overcome using internal workload measures that reflect the actual demands placed on the agency's patrol division. By selecting an *internal* workload measure, calculated from past years of the agency's own call-for-service database, an agency can determine an optimal staff size for patrol that is based on the unique characteristics of the community.

For most police patrol divisions, an appropriate internal workload already exists in the form of historical CAD (Computer Aided Dispatch) data. CAD systems typically capture each activity that an officer performs along with important dates and times such as dispatching times, arrival times, and cleared times. By carefully analyzing an agency's CAD data over past years, a forecast can be made of the total hours of work that a patrol division can expect in the current year and years to come.

This workload measure, the total hours of expected work, can be used as the basis of an empirical qualitative staffing and allocation study. Once the workload is accurately determined, an agency can set performance levels for patrol based on the minutes of proactive patrol time each hour that is allotted to the average patrol officer. After determining the officer availability ratios for the agency based on current time off policies and schedules, an administrator can determine the optimal patrol staffing for their community.

This method is not a one-size-fits-all methodology for staffing. It is unique to the agency under study and driven by data. The method can be replicated in future years and does not rely on the assumptions of comparative methods. Most importantly, the process is easily modified based on data within the agency to meet special circumstances that may arise within the community.

Methodologies Used

This study utilized an empirical methodology based on internal qualitative data provided by the Madison Police Department. Four years of historical CAD data were analyzed to produce a model that can accurately forecast patrol workload. In addition, the agency provided data pertaining to officer leave times, training times, and other non-patrol days. This information was used to determine officer availability. The historical CAD data, department performance levels, and officer availability ratios were used to determine a total staff size for patrol.

This report is broken down into two sections, each dealing with a different aspect of patrol analysis. Both sections utilize the same CAD data and define workload in terms of hours of work.

The first section details the process of *police resource analysis*. This analysis examined the number of calls-for-service and the average time required to complete those calls. Officer availability was also calculated and the two results were combined to form recommendations for the optimal total staff size for patrol based on various selected performance levels.

The second section of this report used the same workload data from the CAD to determine appropriate work schedules for the officers on the patrol division. This is referred to as *patrol deployment*. By using historical CAD data, the shift schedules were modified to provide staffing by hour of the day and by day of the week that best matches the call-for-service load by hour of the day

and day of week. Scheduling the right amount of people at the right time increases efficiencies among the patrol division.

This report concludes with final recommendations for changes within the police department to either improve data collection methods or to better optimize performance of the Patrol Services division. In addition, observations made during this study, not directly related to the scope of this study, are also presented.

It should be noted that this study is the beginning of a change process for the Madison Police Department. Prior staffing studies were not based on in-depth CAD analysis and officer time-off data. Many data collection methods, necessary to accurately account for all patrol workload, were not in place at the time this study began. As a result, some data elements are estimated or are based on small samples. This is not an unusual situation based on other studies conducted by Etico Solutions with other law enforcement agencies.

Once proper data collection processes are verified or created, the agency will be able to repeat the analysis process in subsequent years. The spreadsheets that accompany this report will reduce the typical mathematical complexities by simply requiring the input of new information regarding call-for-service volumes, average call service times, and officer availability.

III. Initial Site Visit And Data Collection

Lt. Tim Peregoy was assigned as the primary liaison between Etico Solutions and the Madison Police Department. Prior to the initial site visit, Lt. Peregoy assisted in scheduling meetings and ensuring that department representatives would be available for interviews.

During the three day visit, department policies, practices, and priorities were reviewed and discussed with a number of different groups. One of the most important goals of the initial site visit was to identify data sources necessary for the project and to make contact with individuals who were most familiar with the extraction of necessary data.

Collection Of Workload Data

Since this study was focused solely on the patrol division, the majority of the information used to determine patrol workload estimates had to be extracted from the Computer Aided Dispatch (CAD) database. The Madison Police Department uses a CAD software package from New World Systems. Thomas Dull, from the Information Management and Technology department, was assigned to assist in the necessary extraction of data.

Conversations with various patrol personnel revealed the need to analyze report writing separately from the CAD analysis. Report writing, which consumes a significant amount of a patrol officer's time, was not being captured in the CAD system as a patrol activity. Three types of report writing are used by patrol; field reporting within the New World software, dictated reports, and hand-written reporting. The number of field reports was obtainable from the CAD database and the number of hand-written reports was said to be very few. The bulk of reports was reported to be done by dictation.

Information on dictated reports was obtained from Sherry Christianson, the supervisor of the Dictation Unit. A detailed account of all reports dictated, the length of each dictated report, and the date and time of the report was provided.

Collection of Officer Leave Data

Officer availability was the second major piece of information necessary for this study in order to determine a shift relief factor for the patrol division. Officer benefit time off, training days, special assignments, and any other forms of leave which takes patrol officers away from the ability to answer calls for service had to be extracted from TeleStaff, the agency's scheduling software. Lt. Tim Peregoy, the main administrator for the Telestaff software, agreed to collect any data that was needed in that regard.

Collection of Additional Resources

Additional resources were necessary for deployment analysis such as union agreements, patrol maps, current schedules of the patrol division, dispatching policies, annual reports, and records information regarding officer generated reports. This information was gathered by Lt. Peregoy and provided to Etico as it was collected.

Initial Observations

The amount of workload data found in a CAD database is highly dependent on the practices within the patrol division and within the dispatching center. Work that is not reported by the patrol officers or not entered into the CAD by the dispatchers skews the amount of estimated workload for the patrol division.

During the site visit, researchers observed the dispatching function by sitting with dispatchers and watching their use of the CAD software. Three key observations were made during this process.

- When officers responded to call-for-service requests by the public, the dispatchers created an "event" in the CAD database. This "event" created a database record containing all the relevant information and times concerning the call. However, when officers conducted self-initiated activities such as community contacts, traffic stops, or business checks, the dispatcher would color-code their unit number on the dispatching screen to show they were busy but not create an "event" based on their activity. The end result of this practice is that the CAD database only

provided a partial picture of the work being performed by patrol. This issue will be addressed later in this report.

• The patrol division has adopted a practice of limiting their services to the community during peak activity times. Under this practice, any shift supervisor can contact the dispatch center and put the entire patrol division on "Priority Calls Only" (PCO) which limits their calls to emergency responses and some calls in progress. The goal of this practice was to ensure the availability of officers for more serious calls that may occur. When the patrol division is on PCO status, callers with lower priority issues are asked to call back at a later time. A log is supposed to be kept of all callers that are turned away during PCO status but in reality, that is not being done with any consistency. Without a record of the caller's information, it is impossible to know if a caller contacts the agency at a later time or simply drops the issue. This issue will be addressed later in this report.

• While observing in the dispatch center and riding with the officers on the street, it is apparent that officers are not calling in all activities that they are performing. In other cases, officers are asking the dispatchers to clear a call out of the CAD system prior to the call being handled completely. This practice appears to be happening as officers attempt to keep the call-for-service queue empty and to reduce radio traffic. When work is performed and not properly called into the dispatcher, that work is not recorded and credited to the agency as patrol workload. This issue will be addressed later in this report.

These observations were shared with the agency administrators at the conclusion of the site visit as immediate changes that needed to be made while the study was in progress. A follow-up letter was sent to Lt. Tim Peregoy. Upon the second visit to the agency, Lt. Peregoy indicated that several changes were already in place to address these observations.

III. Resource Analysis

The process of determining appropriate staffing size is referred to as "Resource Analysis." There are two distinct parts to this analysis; (1) the determination of total workload for the division under study, and (2) the calculation of officer availability. CAD data for 2003-2007 were analyzed to determine the total workload while leave data from Madison Police Department's TeleStaff software were used to calculate officer availability. Due to the size of the CAD database, a statistical software package known as SPSS (Statistical Package for Social Sciences) was used to filter, collapse, and analyze the CAD database. Microsoft Excel was used to calculate officer availability and to display results from the SPSS software.

Patrol Workload

Total workload, in this study, was calculated by categorizing all work performed by the patrol division and then calculating an average time to complete each category of work. The most logical and reliable method of identifying workload for an agency's patrol division is using the agency's CAD data to catch the bulk of activity and then identifying other workload that is not available through CAD. Additional workload includes report writing, shift briefings, patrol vehicle maintenance, and other tasks that must be completed as part of their normal duties.

CAD Filtering and Collapsing

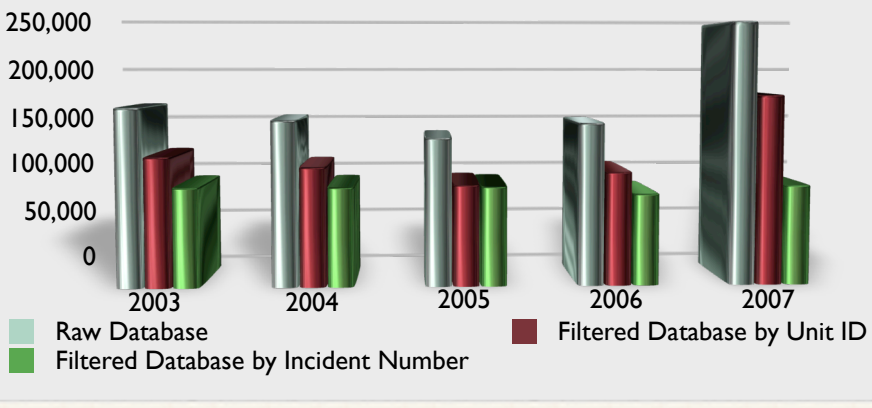
As mentioned earlier, the agency is using CAD software created by *New World Systems*. New World CAD software creates a separate record in the CAD database for every officer that responds to every incident. Call locations, dates, times, and unit identifiers are captured for every officer as they progress through each call. This provides information on the frequency of various calls-for-service and the average total time spent on each call-for-service by patrol officers.

To better explain the process used, it is important to define several key terms concerning the CAD. The CAD database looks like a large table. The rows in the table are called records while the columns in the table are called fields. Each time a unique activity performed by an officer is recorded to the database, the system assigns a unique incident number. A unique incident number will appear in only one record of the CAD if it was a single officer response. If a call has two or more officers responding, the unique incident number for that call may appear in multiple records, one for each responding unit. Therefore, when looking at the number of records in an unfiltered CAD, the activity of the agency may be overestimated due to the number of calls requiring a multiple officer response.

While the CAD database holds key information for a workload study, it must be filtered in a number of ways and collapsed before the information becomes useful for accurate analysis. The following steps detail the general process in filtering and collapsing the CAD data for analysis.

1. Selecting appropriate fields - The original CAD database holds a very large number of fields that may or may not be important in a resource analysis study. Prior to extracting the CAD data from the original database, a careful selection of fields was made. The following fields were chosen for inclusion:
    a. Unique Incident Number
    b. Incident Type
    c. Incident Description
    d. Incident Creation Date
    e. Incident Creation Time

Chart 1. **CAD Incident comparisons from 2003 through 2007**



f. Incident Location
g. Incident District
h. Incident Sector
i. Responding Unit ID
j. Unit Disposition
k. Dispatch Date & Time
l. Arrival Date & Time
m. Clear Date & Time

2. Filtering by unit IDs - Once the database was extracted, it was filtered by Unit IDs to contain only officers who responded to calls-for-service. Once the unit filtering was completed, the database contained responses from only the unit types listed below. The number to the right of each unit represents the % of the overall calls in 2007 handled by that unit type.

a. Executives (0.0%)
b. Patrol Admins (0.1%)
c. Patrol Sergeants (4.2%)
d. K-9s (0.4%)
e. Traffic (0.5%)
f. Patrol Beat Units (89.5%)
g. Neighborhood Ofcs (2.5%)
h. Community Policing Teams (2.7%)

Filtering the database by Unit IDs decreases the total number of records per year in the database. The effects of the first filter can be seen in Chart 1. A complete list of all units included in the database after this filtering process is included as Appendix A. The effects of the second filter, also shown in Chart 1, are discussed below.

3. Computing Time Variables - After eliminating all units that do not answer calls for service, a number of important variables must be calculated for each responding officer for each incident. The following list of variables are calculated by reformatting the date & time stamps in the database and computing new fields.

a. Processing Times: Processing times reflect the amount of time required to receive the call-for-service from the caller and dispatch an officer to the caller's location. This time is obtained by subtracting the incident creation date & time from the dispatch date & time.

b. Travel Times: Travel times reflect the time for the officer to arrive at the caller's location after receiving the dispatched call. This time is obtained by subtracting the dispatching date & time from the arrival date & time.

c. Response Times: This time reflects the time required, from the citizen's perspective, for an officer to arrive to answer a call-for-service. This time is calculated by subtracting the incident creation date & time from the arrival date & time of the first officer. This time can also be obtained by summing the processing time and travel time of the first arriving officer.

d. Time On Call - This time is the total time that an officer spends on an incident. The time is calculated by subtracting the dispatch date & time from the cleared date & time.

4. Aggregating Key Variables - Before the database could be collapsed into single entries for each incident, the time variables listed in step 3 had to be either aggregated or filtered. Using SPSS, new fields were created for each record in the database which showed consistent values in every record per single incident. The following aggregations were performed.

a. Processing Minimum Time - Different officers assigned to the same incident could have different processing times in the CAD. To show the fastest processing time, the earliest dispatch time among all records in a single event was

selected and written to a new field called Processing_min for all other records in that incident.

b. Minimum_Travel_Time- Different officers assigned to the same incident will most likely have different travel times. It is not always accurate to say that the first officer dispatched will be the first to arrive or will have the shortest travel time. Therefore, the shortest travel time of all officers assigned to each unique incident was recorded to a new field labeled Travel_min.

c. Minimum_Response_Time- The minimum response time, as seen from the citizen's perspective, is the time between the caller's original contact with the dispatcher until the first officer arrives on the scene. This may not always be the first officer dispatched or the officer with the shortest travel time. Therefore, the shortest time between the incident date & time and the arrival date & time for each record in a unique incident was written to a new field in each record called Response_Time_min.

d. Call_Time_Summation - Finally, to determine workload, the total amount of time spent on each unique incident by all officers assigned to that unique incident had to be summed. Therefore, the time on call values for all records pertaining to the same unique incident were summed and written to a new field in each record labeled Call_Time_Sum.

5. Collapsing the Database - After aggregating the new fields listed in step 4, the database was collapsed to show only one record for each unique incident handled by patrol. Each record had the necessary fields to determine processing times, travel times, response times, and total time on call by all officers per incident. The third series in Chart 1 shows the total number of incidents in the CAD database from 2003 through 2007 after the data was filtered and collapsed. After key time variables were aggregated and the database collapsed, the analysis of the call-for-service data could begin.

Call-for-service Forecasting

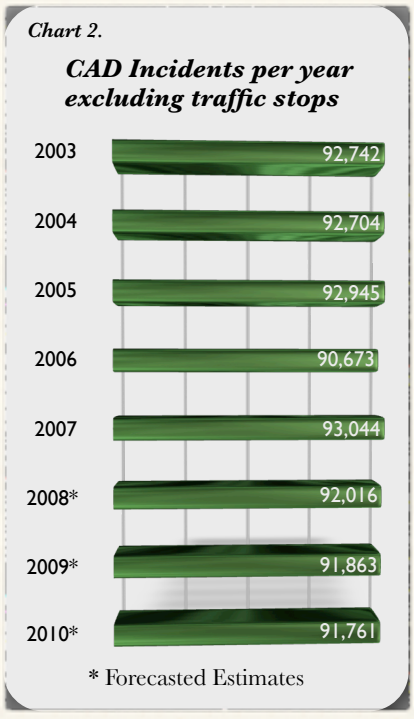
A categorical frequency report was run in SPSS to show how many incidents of each incident type were recorded in 2003 through 2007. A copy of the list is attached as Appendix B.

Based on the frequency of each incident type from the past 5 years of historical data, a forecasting routine in Microsoft Excel was used to estimate the expected workload for 2008 through 2010. It is estimated that calls-for-service for the next three years (see Chart 2) will approximate:

- 2008 - 92,016 calls-for-service
- 2009 - 91,863 calls-for-service
- 2010 - 91,761 calls-for-service

The accuracy on this estimation gets lower as the estimate gets farther from the historical data. This estimate is based solely on the existing CAD data. It is expected that the actual calls-for-service will increase over time as officers begin to call out more of their activities and as activity tracking procedures improve within the police department.

Chart 2.



Calculating Patrol Workload

The desired workload for patrol is not the number of incidents or calls-for-service that patrol officers respond to, but the total number of hours required to meet the obligations of the patrol division. To calculate this workload, the Call_Time_Sum variable created in the database during step 4d in the CAD filtering process was used. The Call_Time_Sum variable is the summed time of all officers on a particular incident, from dispatch to clear. Using SPSS, an average time on call was determined for each incident type using data from 1/1/2007 through 12/31/07. The frequency of each incident type for each year was then multiplied by the average time required to handle that incident type. The sum of all incident type times determines the total number of reactive hours that patrol is responsible to meet.

By calculating an average time on call for each incident type, the average times can be multiplied by the forecasted incident frequencies for future years yielding an estimated workload for projected years.

Current Limitations of CAD Data

It was mentioned earlier, in section II of this report, that self-initiated activities, proactive patrol, and community service activities were not being tracked in the CAD system. Only calls-for-service that come from the public and calls-for-service initiated on-view have been captured historically. Changes have been made within the police department, based on the initial site visit, to begin capturing all work performed by the officers. The methodology used for this study remains valid in the absence of proactive enforcement data. The total workload for patrol will be calculated based on only those activities and calls-

for-service to which the agency is obligated to respond or perform. These activities are referred to as *reactive activities*. Calls that are initiated by the officer such as preventative patrol, minor traffic stops, and community policing activities are referred to as *proactive activities*. Prior to this study, the CAD database was capturing most reactive work, but very little proactive work.

What is not possible, prior to the policy change to begin recording both reactive and proactive work in the CAD, is a detailed analysis on how much of an officer's time is spent on criminal activity, traffic enforcement, service calls, and administrative functions.

In addition to changing the policy within the dispatching center to record all activities, it is also important to educate the officers on the patrol division on the need to call in all work being performed in an accurate and consistent manner. Officers must begin to call out their activities as they are conducting them and not ask the dispatcher to clear a call that they will get to later. This delayed response, to keep the CAD queue cleared, distorts dispatch times and on-scene times within the CAD.

A careful review of all tasks performed by patrol officers usually reveals a number of activities performed by the officers that do not get recorded in the CAD system. In most agencies, for example, report writing times are not included in the CAD times since reports are not always written prior to clearing a call-for-service. Many officers will remain on "available" status while writing reports. This means time spent writing a report is either not captured or recorded as "busy", or "out at the station." When various activities are clustered together under one generic incident type (like "busy"), it is hard to distinguish what portion is proactive and what portion is reactive.

For this study, the amount of time spent writing field reports had to be estimated since it was not contained in the CAD. A one year sample was taken from the radio log database from 9/1/06 through 8/31/07 to estimate the number of reports taken in relation to the number of overall incidents. Based on conversations with several agency representatives, the estimated time to complete a field report was set at 30 minutes.

The majority of case reports taken by patrol officers are completed by phoning in the report to a dictation server where it would then be transcribed by a civilian. A one-year sample of dictated reports, from 7/1/2006 through 6/30/07, was obtained from the dictation supervisor. The supervisor provided a detailed log of all dictated reports during that time which included the length of each dictated report, the case number, the type of report, and the district where the report was taken. This database was compared with all calls taken during that time to create a ratio of dictated reports for a particular incident type to the total number of reports taken for that incident type. An average time for each type of dictated report was determined based on all calls of each incident type in the dictation sample. An additional six minutes was added to the average dictation length of each incident type to account for the time required to drive to the station, place the call, and then return to their area of assignment.

The patrol division also has a very small portion of reports that are handwritten. Lt. Vic Wahl conducted a very brief survey of 15 officers to attempt to estimate the time spent by officer on hand written reports during a typical shift. The results of his survey indicated that officers spent an average of 11.9 minutes per 8 hour shift hand writing reports.

Daily Administrative Duties

In addition to answering calls for service and conducting self initiated activities, there are a number of administrative duties that must be performed each day by the patrol officers. A small number of officers (15) were sampled and asked to complete a daily log depicting how much time they spent on administrative duties. The following activities and their average times per day per officer were determined:

- Squad Car Checkout (7.76 min)
- Fueling Squad (6.12 min)
- Checking e-mail (18.01 min)
- Washing Squad (.37 min)
- Property Tagging (3.44 min)
- Downloading Video (5.60 min)
- Handwriting Reports (11.90 min)
- Squad/Equip Maint (2.38 min)
- Miscellaneous (9.67 min)
- End of Shift (8.00 min)

The reader must keep in mind that not all of these activities are undertaken on every shift. Washing a squad car takes much longer than .37 minutes but it is done sporadically. Thus, the times listed above are the times spent during the sample period, they represent what the average daily time commitment would be.

Traffic Enforcement Activities

Traffic enforcement is another self-initiated activity that has not been captured historically in the CAD database. The CAD captured all traffic accidents, traffic arrests, and traffic incidents. Routine traffic stops that resulted in either a traffic citation, a written warning, or a verbal warning were not captured. After additional inquiries, the total number of traffic citations for the entire agency was determined. (See Table 1.) However, the total number of traffic stops that resulted in written warnings or verbal warnings is unobtainable at this time. Changes in recording practices should correct this limitation.

Table 1.

Traffic Citations Issued

2002	27,840	***2005***	21,604
2003	27,589	***2006***	22,447
2004	25,220	***2007***	19,788

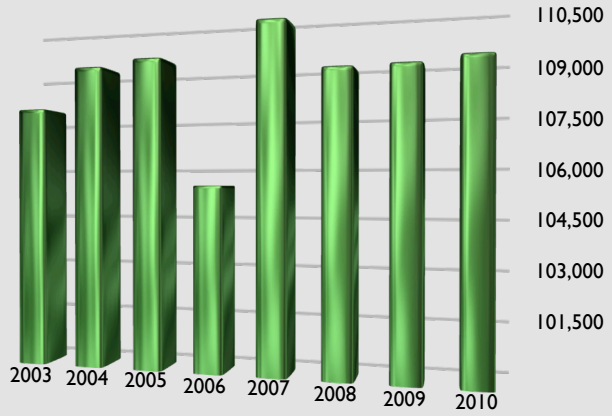
Total Reactive Workload

Bringing all of these activities together, the total reactive workload for the patrol division consists of the total time required to handle reactive activities reported in the CAD, the time required for report writing and any other activities that are not currently being captured by the CAD, the time required for the daily administrative duties of the officers, and the time required for expected levels of traffic enforcement. It is important to remember that the total reactive workload assumes that officers will be responding from call to call with no proactive time in between. Therefore, this workload will determine only the minimum number of officers required to meet minimum expectations.

This report is accompanied by an Excel spreadsheet that contains the historical and predicted number of incidents for each incident type. The spreadsheet also contains the average times calculated for each incident type and the average time required for daily administrative duties of the officers. Average times and frequencies for field reports and dictated reports are estimated in the spreadsheet based on the one year samples of each provided by the agency. And finally, frequencies and average times for traffic stops for 2007 are estimated and contained in the spreadsheet along with the number of traffic stops from previous years. Based on the spreadsheet calculations, the total hours of reactive workload for the patrol division from past years, and forecasted into previous years are contained in Chart 3.

Chart 3.

Total Hours of Reactive Workload Per Year



Data Table

2003	107,876	*2007*	110,290
2004	109,115	*2008*	108,865
2005	109,315	*2009*	108,902
2006	105,519	*2010*	109,076

Table 2.

Minimum On-Duty Officers per 24 hour period

2003	43.6	*2007*	44.6
2004	44.1	*2008*	44
2005	44.2	*2009*	44
2006	42.6	*2010*	44

The numbers reflected in Chart 3 are yearly totals. The minimum number of on-duty officers required per day can be determined by first dividing the annual totals by 365 (days in a year) to get an average daily reactive workload. The daily workload is then divided by the shift length (8 hours for the patrol division less time required for daily administrative duties) to determine the minimum number of on-duty officers that must be fielded every 24 hour period. The minimum on-duty officers required per day, each working one shift, is shown in Table 2.

There is an important observation that must be noted about Chart 3. The vertical scale is not zero-based. The minimum y-value begins at 100,000 hours and extends to 110,500 hours. Thus the chart only shows the top 9% of the yearly values. This was done to emphasize the relationship of one year's workload to the next. If the chart were zero-based, the yearly values would look almost consistent from year to year. The hours of workload for 2006 actually deviates from the average by less than 3%. This deviation could be due to fewer calls for service in 2006 or it could also be due to inferior data collection methods for capturing the times of secondary officers. In December of 2006, a radio call log was implemented that greatly increased the amount of data that could be captured concerning assisting officer times for multiple officer calls.

Shift Relief Factor

The numbers reflected in Table 2 depict the number of officers that have to be fielded on a daily basis. Because officer's do not work every day of the year, a multiplying factor must be calculated to convert the number of officers needed per day to the number of officers needed on the entire patrol staff. This multiplier is referred to in this study as a Shift Relief Factor (SRF). By definition, the shift relief factor is "*the number of officers required to staff one shift position every day of the year.*"

The SRF for an agency is affected by the amount of time off patrol given to each officer. Time off includes regularly-scheduled days determined by the work schedule of the agency, administrative and benefit time off based on the personnel policies and labor agreement

of the agency, and compensatory time off given for overtime worked. Time off may also include special assignments and training that takes an officer away from his/her regular assignment for an extended period. If officers never took any time off (i.e., never had regular days off, got sick, took a vacation, or were temporarily reassigned), the SRF for an agency would be 1.00 (i.e., the agency would only have to hire one officer for each shift position to be covered). However, since officers do take time off, the actual SRF for an agency is always greater than 1.00; the more time off an officer receives, the higher the SRF value.

It is important to note that the shift relief factor is based on averages over a one-year duration and is used to calculate the overall staff size for the division under study. Using the average amount of officer leave, the average amount of training, and the average number of days off per year does not guarantee that the appropriate number of officers will appear for duty each day. The actual number of officers that will be on-duty each day will vary due to both scheduled and unscheduled time off (e.g., vacation leave and sick leave).

The following section will describe the data elements and calculations used to determine the shift relief factor for the Patrol Division.

Data Sample

To determine the SRF for the patrol division of the MPD, data was collected for a two-year period: January 16, 2005 through January 15, 2007. Data was only collected for officers who were assigned to patrol for the entire two-year period. The number of officers on each detail (shift) is shown below in Table 3. Cross-shifters represent officers who worked for two or more shifts during the two-year data collection period

Table 3.

Leave Data Sample

Detail (Shift)	*# of Officers*
1st (Days)	*31*
2nd (Afternoon)	*42*
3rd (Nights)	*40*
Cross-Shifters	*16*
Total	*129*

Regular Days Off

The patrol officers work a duty cycle schedule of six 8-hour work days followed by 3 days off (6-on-3-off). This nine-day rotating schedule provides the officers with 121.67 regularly scheduled days off per year. The officers work an average of 37.33 hours per week or an average of 4.67 days per week.

Administrative & Benefit Time Off

Administrative and benefit time off is the average amount of paid time off an officer receives each year. Since the amount of administrative and benefit time off is determined by the personnel and operating policies of an agency, it is not a calculated value, but rather is based on time off data from the agency. The amount of administrative and benefit time used to calculate the SRF only includes time off taken which may be less than the total administrative and benefit time earned. The reason for this distinction is that some agencies permit officers to sell some or all of their accrued administrative and benefit time back to the agency. Administrative and benefit time that is "bought" by the agency is accounted for in the agency's budget. Administrative and benefit time that is taken as time off is accounted for with the SRF.

Data for administrative and benefit time off was obtained for each of the 129 officers from the TeleStaff system. The average number of administrative and benefit days off per year per officer, shown in Table 4, is 27.02 days.

Table 4.

Admin & Benefit Time Off

Leave Type	*Days*
Administrative Leave	*0.274*
Bereavement Leave	*0.43*
Family Leave	*1.699*
FTO	*0.791*
Holiday Leave	*1.644*
Injured	*0.1*
Jury Duty	*0.004*
MPPOA Earned	*0.065*
Military Leave	*0.686*
Sick Leave	*5*
Vacation Leave	*15.654*
Workers Comp Time Off	*0.674*
Total	*27.02*

Non-Patrol Time

Non-patrol time is on-duty time which the officer spends off his/her normal assignment (e.g., patrol). Non-patrol time includes time spent on special assignments (e.g., serving on a regional drug task force) or time spent off assignment because of extended training (i.e., training that requires one or more days). Like administrative and benefit time off, the average amount of non-patrol time is based exclusively on personnel data from the agency.

While it is obvious that the SRF should include regularly-scheduled days off and administrative and benefit time off, there may be disagreement about whether non-patrol time should be included. A patrol commander, for example, would likely argue that when an officer is pulled off his regular assignment (e.g., patrol) for a special assignment that lasts for several days or weeks, he/she is lost to patrol just as if they were absent due to a vacation or illness. The budget director for the agency, however, may argue that whether an officer is on patrol or on a special assignment, he/she is still on-duty and that temporary assignments are part of the job. There is no absolute right or wrong answer to this issue. Including non-patrol time will produce a higher SRF and, as a result, a larger staff requirement.

In all Etico Solutions studies, non-patrol time is included in the SRF. For this study, it is absolutely appropriate to include non-patrol time in the SRF since the CAD was not capturing special details and special assignments as part of the workload.

Data for non-patrol time for each of the 129 officers was also obtained from the TeleStaff system. The average number of non-patrol days per year per officer, shown in Table 5, is 22.135 days.

Table 5.

Non-Patrol Time

Leave Type	*Days*
Light Duty	*3.979*
Event	*1.514*
Special Assignment	*0.648*
Training	*15.794*
Miscellaneous	*0.199*
Total	*22.135*

Net Comp Time Off

The last component that must be included in the shift relief factor is the net comp time off patrol. Net comp time off measures the net gain or loss in work for an agency due to the amount of overtime worked and compensatory time off taken. There are two important observations concerning the net comp time effect:

- All comp time off taken is included in the calculation because regardless of where the overtime is worked, the time off is taken from patrol.
- Only overtime worked on patrol is included in the calculation since patrol gains no work form overtime worked on a non-patrol assignment.

If an agency adopts a policy of paying for all overtime instead of giving comp time off, the net comp time off value may be negative. A negative net comp time off value indicates that the agency has gained more hours of work in overtime than it has given away in comp time off. As a result, the total hours worked per year per officer will be larger which will produce a lower SRF and a lower total staff requirement. The advantage of a lower staff requirement, however, is offset by the increase in the budget to pay for the overtime.

Data for the net comp time calculation was obtained from the TeleStaff system. The average patrol officer used 13.55 days of compensatory time per year and worked an average of 10.94 days of overtime. Using this information, the net comp time effect on the patrol division is 2.50 days.

Summing the data from the Regular Scheduled Days Off, the Administrative and Benefit Time Off, the Non-Patrol Time, and the Net Comp Time Off, the total number of hours off patrol per year per officer can be obtained. The average time off patrol per year per officer for the Madison Patrol Division is 1,386.61 hours. (See Table 6.) Assuming a non-leap year and an 8 hour shift, officers are actually working an average of 1,533.39 hours per year.

Table 6.

Average Time Off Patrol per Year per Officer

Time Off Category	*Days*	*Hours*
Regularly Scheduled Days	*121.67*	*973.33*
Admin & Benefit Time	*27.02*	*216.16*
Non-Patrol Time	*22.14*	*177.12*
Net Comp Time	*2.5*	*20*
Total	*173.33*	*1386.61*

Calculating the Shift Relief Factor

Once again, the shift relief factor is defined as "*the number of officers required to staff one shift position every day of the year.*" The formula used for this factor is:

Since the MPD uses an 8-hr shift length for patrol, the previous formula can be re-written as:

Or...

$$\left(\begin{matrix}\textit{Shift}\\ \text{Relief}\\ \textit{Factor}\end{matrix}\right) = \frac{\left(\begin{matrix}\text{Total Number of Hours Required}\\ \text{To Cover One Shift Position Every}\\ \text{Day for One Year}\end{matrix}\right)}{(365 \times \text{Shift Length}) - \left(\begin{matrix}\text{Average Hours Off}\\ \text{Patrol per Year}\\ \text{per Officer}\end{matrix}\right)}$$

Or...

$$\text{SRF} = \frac{(365 \times \text{Shift Length})}{(365 \times \text{Shift Length}) - \left(\begin{matrix}\text{Average Hours Off}\\ \text{Patrol per Year}\\ \text{per Officer}\end{matrix}\right)}$$

$$\text{SRF} = \frac{(365 \times 8 \text{ hours})}{(365 \times 8 \text{ hours}) - (1387.69)}$$

$$\text{SRF} = 1.904$$

How can one unit, fielded 24 hours a day, require 6 officers?

Unlike most other municipal divisions, the Police Patrol Division requires consistent and continuous staffing 24 hours a day, seven days a week. In many cases, when a patrol officer takes a day off, for any reason, their position cannot be left vacant. Their absence must be filled with another patrol officer.

The shift relief factor, calculated above, dictates that in order for the Police Department to put one unit on the street, working one 8-hour shift per day, every day of the year, they must have 1.904 officers on their total patrol staff.

If the agency chooses to put one unit on the street, around the clock, this number would be multiplied by three (the number of 8-hr shifts in a 24-hr period). This second factor, called a daily relief factor, indicates that each unit the Police Department puts on the street around the clock, requires 5.712 officers on their total patrol staff.

IV. Improving Patrol Performance With Proactive Time

To the casual observer, it might appear that to achieve maximum patrol efficiency, officers should be engaged in reactive activities every minute of every hour. Such a conclusion is not accurate however. Including an appropriate amount of proactive time provides benefits for the agency, the officer, and the citizens of the jurisdiction. In fact, a lack of sufficient proactive time can negatively impact the ability of an agency to provide optimal police services to the community.

Among the arguments for including proactive time is the need to avoid having officers running from call to call. Agencies that operate in such an environment report several drawbacks. The most obvious is the inevitable officer burn-out that can occur. Less obvious is the loss of information that may help to solve a crime. It is conventional wisdom for police investigations that the solvability of a case begins to deteriorate from the moment the incident occurs. If the initial responding officer is rushed to move on to the next call, there is a greater chance that important follow-up opportunities and information will not be collected, diminishing the solvability of the case.

Another drawback is the loss of time for on-the-job training. In agencies where shift assignments are based on seniority, it is possible to have shifts where the majority of officers have very limited experience. When corrective action is needed by the supervisor, proactive time must be available. If officers are clearing calls and going directly to the next call throughout the shift, the supervisor will not have the training opportunities needed to help officers avoid future mistakes.

Perhaps most importantly, proactive time has a direct impact on several widely-accepted measures of patrol performance including (1) cross-beat dispatching, (2) patrol interval, and (3) the probability of saturation. All three measures are discussed below.

Cross Beat Dispatching

A main tenet of community-oriented policing is the need to have officers become familiar with a small geographic area of the jurisdiction. In many agencies this is accomplished by assigning officers to patrol beats. By working in the same area for extended periods of time, officers can develop ownership of the area and, equally important, build relationships with the local residents. Often overlooked, however, is the frequency and duration of time that officers are directed from their assigned beat to answer a call-for-service (CFS) in another area. Dispatching an officer from his/her assigned beat to respond to a call in another beat is referred to as a "cross-beat dispatch."

Based on probability theory, the amount of time an officer spends on cross-beat dispatches per hour, designated as "M_X," can be estimated if the number of minutes of reactive time per hour per officer (M_R) and the number of beats (N) are known. Assuming one patrol unit per beat and approximately the same level of M_R in each beat, the formula for cross-beat dispatching is:

$$M_x = \frac{M_R^{\,2}}{60}\left(1 - \frac{1}{N}\left(\frac{M_R}{60}\right)^{(N-1)}\right)$$

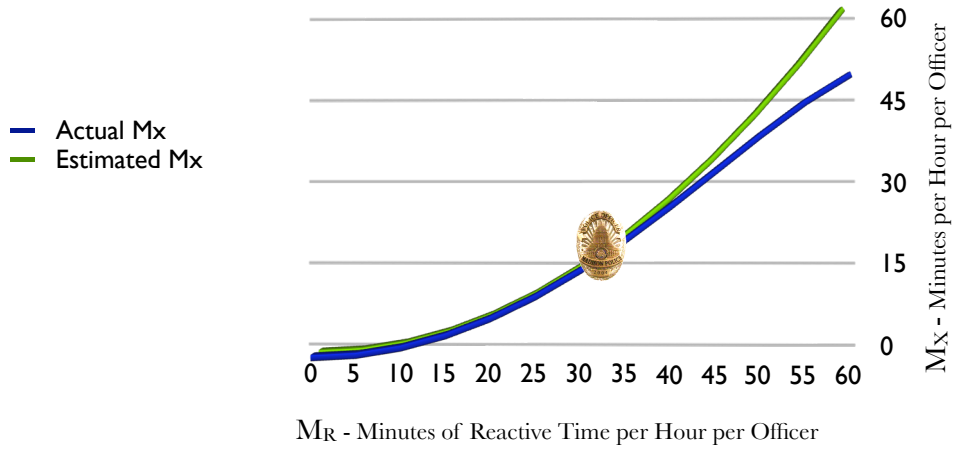
As the number of beats increases, M_x can be estimated as:

$$M_x = \frac{(M_R)^2}{60}$$

Notice that in both formulas, M_R is squared (i.e., multiplied by itself). As a result, as the minutes of reactive time per hour per officer increase, the minutes of cross-beat dispatching (M_X) per hour per officer increase at even a faster rate.

The change in M_X as M_R is changed is illustrated in Chart 4 which shows graphs for both the exact and approximate formulas for M_X assuming a five-beat deployment. The curves are based on historical CAD data collected for this study that found that the patrol division for the MPD currently has a M_R value of approximately 32.5 minutes per hour per officer. The M_X value for the MPD, approximately 17.6 minutes per hour per officer, is located on the chart at the point designated by the MPD badge.

Chart 4. Cross-beat Dispatch Levels as a Function of Reactive Time per Hour



Patrol Interval

A second patrol performance measure that is directly related to proactive time is the patrol interval (PI). A patrol interval is defined as the average time interval between two consecutive passes by the same location by police units while on random patrol. The patrol interval is a measure of how much "visibility" the patrol force provides in the community, the lower the patrol interval, the greater the level of visibility. Since random patrol is a proactive activity, the patrol interval is dependent on how much proactive time is available.

The patrol interval is calculated based on: (1) the number of street miles in a jurisdiction, (2) the average patrol speed, (3) the number of proactive minutes per hour per officer (MP), and (4) the number of units on patrol. The formula is given by:

$$PI = \frac{Street\ \ miles\ \ in\ \ the\ \ jurisdiction}{Average\ \ patrol\ \ speed * \left(\frac{M_P}{60}\right) * Units\ \ fielded}$$

The formula indicates that the patrol interval will decrease if either the minutes of proactive time per hour per officer or the number of units is increased.

Table 7 shows the average patrol interval for each patrol district by shift, using the agency's current M_p value of 27.5 minutes per hour per officer and an average urban patrol speed of 10 mph. Since an exact patrol speed for the City of Madison had not been calculated, a nation-wide average was used. Since the same patrol speed and M_P value were used for all of the calculations, the differences between districts and shifts reflect the differences in street miles to be patrolled and the average number of units fielded. The East and West districts have higher patrol intervals due primarily to the number of street miles to be patrolled. Conversely, patrol interval values for the Central District are lower because it is a much smaller geographic area. The variation in patrol interval values within each district are a direct result of the available staffing on shift; for example, the patrol interval for the West District is significantly lower on the 2nd Detail (1500 – 2300) because average staffing for the District is higher on the 2nd Detail than on the other two details.

Table 7.

Patrol Interval (Hours) for the MPD, by District, by Shift

	West District 1	South District 2	Central District 4	North District 5	East District 6	City-Wide
0700 - 1500	11.3	6.1	3.0	8.1	11	8.0
1500 - 2300	6.8	4.9	2.1	5.0	9.9	5.6
2300 - 0700	12.3	4.5	1.6	6.5	9.9	6.2
District	9.4	5.1	2.1	6.3	10.3	6.5

Probability of Saturation

The probability of saturation (POS) is defined as the probability that when the next call-for-service arrives at the dispatching center, there will be no free units available to take the call. The POS is directly related to: (1) the average number of calls-for-service per hour, (2) the average time required to complete each call-for-service, and (3) the number of units on patrol. These three variables are the same variables that determine the average number of reactive minutes per hour per officer (M_R). As a result, as M_R increases, the POS also increases; that is, as M_R increases, the likelihood that a CFS will have to be "stacked" at the dispatching center increases. POS values for an agency are constantly changing as call volumes fluctuate, the time required to handle calls changes, and/or the number of units in the field is altered.

One way to reduce the POS value is to field additional units. The obvious cost of this option is the cost of paying for additional personnel and equipment. A second option is to reduce the CFS workload handled by patrol, for example, by using call screening or by adopting a policy of not sending a unit for low priority calls. A third option is to reduce the amount of time officers spend on each call. The last two options have the potential for negative reactions from the community.

Table 8 shows the probability of saturation for each MPD patrol district by shift. Two important limitations of the values in this table are: (1) the same average service time of 59.5 minutes per patrol event (based on the total amount of reactive time and total number of patrol events obtained from MPD CAD data for this study) was used for all districts and shifts, and (2) staffing levels were based on the middle six hours of each shift which does not account for staffing limitations that may occur during shift changeovers. The differences in the POS values reflect differences in call volumes and staffing in each district and shift. With these limitations in mind, these results should only be used to provide a preliminary assessment of this patrol performance measure.

Table 8.

Probability of Saturation (%) for the MPD, by District, by Shift

	West District 1	South District 2	Central District 4	North District 5	East District 6	City-Wide
0700 - 1500	9.5	12.5	6.5	22.5	8.9	10.5
1500 - 2300	1.2	17.7	2.9	8.3	15.2	5.7
2300 - 0700	1.8	0.6	0.1	1.6	0.8	0.7
District	3.0	6.1	1.5	8.2	5.6	4.0

Although the POS for the city overall (4.0%) is quite low, there are districts and shifts which may merit additional scrutiny (e.g., North District, 1st detail; South District, 1st and 2nd details; East District, 2nd detail; and West District, 1st Detail).

How Much Proactive Time Is Needed?

Three patrol performance measures are discussed above: cross-beat dispatching, patrol intervals, and the probability of saturation. All three measures are directly related to the amount of reactive and proactive time available per hour for each patrol officer.

To reduce cross-beat dispatching, lower patrol intervals, and reduce the probability of saturation, an agency has three options: (1) reduce the patrol workload, (2) reduce the amount of time spent on patrol activities, or (3) increase the number of officers on patrol. Many departments have instituted programs to reduce the patrol CFS workload but at the same time instituted community-oriented policing initiatives which emphasize the need for officers to spend more time with citizens. In reality, for most agencies, the key policy decision is how many officers are needed to handle the reactive and proactive workload of the department. The number of officers required to handle the reactive workload of the department is referred to as the "minimum" number of officers since in most instances these officers are responding to service-on-demand types of calls that cannot be deferred. The additional officers that added to the minimum number of officers to handle the proactive activities of the department are referred to as "performance" officers since these officers provide the time needed to meet the patrol performance objectives of the department (i.e., objectives based on cross-beat dispatching, patrol interval, and POS).

Determining how many performance officers are needed is a subjective decision. That decision was once eloquently posed by John Schuiteman in the July 1985 edition of *Police Chief* magazine. Schuiteman stated: "Adequate police protection, like beauty, lies in the eye of the beholder. The optimal or appropriate ratio of officers to population, traffic volumes, reported crimes or accidents, etc., is not a matter of mathematics or statistics. It is a matter of human judgement and community resources."

Based on the level of police presence and service expected by the citizen's of Madison and the resources available to the MPD, the department will have to decide how many minutes out of each hour, each patrol officer should have available for proactive activities such as community-oriented policing and free patrol. The number of minutes for proactive activities is the M_P value discussed above. Since the values for M_R and M_P must always add up to 60 minutes, the decision for M_P is equivalent to deciding how the patrol hour should be divided into time for reactive activities (M_R) and time for proactive activities (M_P).

Once a value is selected for M_P, the total amount of proactive time that must be added to the total reactive time based on historical data can be determined using the following procedure:

1. Use the M_P value to determine the "performance factor" (F_{perf}) with the following calculation:

$$\textbf{Performance Factor } (F_{perf}) = \frac{60}{60 - M_P}$$

2. Use the performance factor to calculate the "total patrol time" using the following calculation:

$$\textbf{Total Patrol Time} = F_{perf} \times \textbf{Total Reactive Time}$$

Notice that if M_P is 0, the value for $F_{perf} = 1$ and the total amount of patrol time will equal the total reactive time (i.e., all patrol time will be spent on reactive activities). If a value of 30 minutes is selected for M_P (i.e., specifying that the average patrol hour consist of 30 minutes of reactive time and 30 minutes of proactive time per hour), the value for $F_{perf} = 2$ and the total patrol time required will be doubled in order to accommodate the additional patrol time required for the 30/30 split in the hour.

Applying the same calculations used earlier, the annual Total Patrol Time is divided by 365 to get an average daily workload. That workload is then divided by the shift length (minus any daily administrative time calculations) to determine the total number of officers, both minimum and performance, that must be fielded every 24 hours.

When the minimum number of units, based on reactive time only, was calculated above for 2008 using a M_R value of 60 (and equivalently a M_P value of 0), a total need of 44 officers per day was determined. If M_P is set equal to 30, the total patrol time is doubled, and an additional 44 units are needed to provide the proactive time specified by the M_P value.

Patrol Performance as a Function of M_R and M_P

Since the M_R and M_P values are selected by agency administrators, this report does not contain a recommendation for an exact number of officers for the MPD Patrol Division. Rather it illustrates the impact of various M_R and M_P values by showing the changes in various patrol performance measures. As the number of reactive minutes per hour per officer (M_R) decreases and the number of proactive minutes per hour per officer (M_P) increases, the probability that no units will be available when the next CFS arrives (POS) and the time spent by units on cross-beat dispatches (M_X) will decrease, and patrol visibility, as measured by the patrol interval, will increase. All of this is accomplished, of course, by an increase in the number of on-duty officers required per day, and the total number of patrol officers assigned to the patrol division.

Tables 9-11 show the impact of changes in M_R and M_P values on several patrol performance measures and on total staff requirements. Columns 1 and 2 in each table show the values for MR (from 60 to 20 minutes per hour per officer) and MP (from 0 to 40 minutes per hour per officer). Column 3 of Table 9 shows the minutes of cross-beat dispatching per hour per officer assuming a five-beat deployment. Columns 4 and 5 of Table 9 show the number of on-duty officers needed per day and the total number of patrol officers that must be assigned to patrol. The two highlighted rows in each table represent M_R values which bracket the current M_R value of 32.5 minutes based on historical data for the MPD. The cross-beat dispatching time shown in the highlighted rows bracket the 17.6 minutes of cross-beat dispatching that is shown for the MPD in Chart 4.

For Table 10, Columns 2 through 17 show the patrol interval values for each detail within each district. Each patrol interval value is based on the average daily staffing level for that detail in that particular district and the street miles within that district. The PI values in the highlighted rows bracket the current estimated patrol intervals based on historical CAD data for the MPD.

For Table 11, Columns 2 through 17 show the POS values for each detail within each district. Each POS value is based on the average number of calls coming into that district per hour, the overall average time to handle calls for service, and the average daily staffing levels for that detail in that particular district.

Tables 9-11 are included in this report to assist the Police Administration in determining the appropriate balance of reactive time per hour (M_R) and proactive time per hour (M_P) for the Patrol Division. While no rigid guidelines exist for the "proper" value for either M_R or M_P, past studies have reflected a desire by agencies to maintain a M_R value of 25 to 35 minutes per hour. Due to the Madison Police Department's strong commitment to community policing, it is recommended that the agency make every effort to keep their M_R value on the lower end of the range.

Table 9. ***Relationship Between Proactive Time and Patrol Performance Measures***

M_R	M_P	M_x	Officers/Day	Total Patrol Staff
60	0	48.0	44	84
59	1	47.2	45	86
58	2	46.3	46	87
57	3	45.3	46	89
56	4	44.3	47	90
55	5	43.3	48	92
54	6	42.2	49	94
53	7	41.1	50	95
52	8	40.0	51	97
51	9	38.8	52	99
50	10	37.6	53	101
49	11	36.5	54	103
48	12	35.3	55	105
47	13	34.0	56	107
46	14	32.8	57	110
45	15	31.6	59	112
44	16	30.4	60	115
43	17	29.2	61	117
42	18	28.0	63	120
41	19	26.8	64	123
40	20	25.6	66	126
39	21	24.4	68	129
38	22	23.3	69	133
37	23	22.2	71	136
36	24	21.0	73	1`40
35	25	19.9	75	144
34	26	18.9	78	148
33	27	17.8	80	153
32	28	16.8	82	158
31	29	15.8	85	163
30	30	14.8	88	168
29	31	13.9	91	174
28	32	12.9	94	180
27	33	12.1	98	187
26	34	11.2	102	194
25	35	10.4	106	202
24	36	9.6	110	210
23	37	8.8	115	219
22	38	8.0	120	229
21	39	7.3	126	240
20	40	6.7	132	252

Table 10. ***Relationship Between Proactive Time and District Patrol Intervals***

M_R	M_P	West 1st Detail	West 2nd Detail	West 3rd Detail	South 1st Detail	South 2nd Detail	South 3rd Detail	Central 1st	Central 2nd	Central 3rd	North 1st Detail	North 2nd Detail	North 3rd Detail	East 1st Detail	East 2nd Detail	East 3rd Detail
60	0	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite	Infinite
59	1	558.0	334.9	609.0	304.4	243.3	221.4	148.2	105.9	78.0	401.3	246.7	320.7	545.7	490.9	490.9
58	2	275.8	165.5	301.0	150.5	120.2	109.4	73.2	52.4	38.6	198.3	121.9	158.5	269.7	242.6	242.6
57	3	179.7	107.9	196.2	98.1	78.4	71.3	47.7	34.1	25.1	129.2	79.5	103.3	175.8	158.1	158.1
56	4	133.3	80.0	145.5	72.7	58.1	52.9	35.4	25.3	18.6	95.9	58.9	76.6	130.4	117.3	117.3
55	5	104.3	62.6	113.9	56.9	45.5	41.4	27.7	19.8	14.6	75.0	46.1	59.9	102.0	91.8	91.8
54	6	85.1	51.1	92.9	46.4	37.1	33.8	22.6	16.2	11.9	61.2	37.6	48.9	83.2	74.8	74.8
53	7	72.2	43.3	78.8	39.4	31.5	28.6	19.2	13.7	10.1	51.9	31.9	41.5	70.6	63.5	63.5
52	8	61.8	37.1	67.5	33.7	27.0	24.5	16.4	11.7	8.6	44.5	27.3	35.5	60.5	54.4	54.4
51	9	53.9	32.3	58.8	29.4	23.5	21.4	14.3	10.2	7.5	38.7	23.8	31.0	52.7	47.4	47.4
50	10	47.5	28.5	51.9	25.9	20.7	18.8	12.6	9.0	6.6	34.2	21.0	27.3	46.5	41.8	41.8
49	11	42.4	25.4	46.2	23.1	18.5	16.8	11.2	8.0	5.9	30.5	18.7	24.3	41.4	37.3	37.3
48	12	38.1	22.9	41.6	20.8	16.6	15.1	10.1	7.2	5.3	27.4	16.8	21.9	37.2	33.5	33.5
47	13	34.5	20.7	37.7	18.8	15.0	13.7	9.2	6.5	4.8	24.8	15.3	19.8	33.7	30.3	30.3
46	14	31.2	18.7	34.0	17.0	13.6	12.4	8.3	5.9	4.4	22.4	13.8	17.9	30.5	27.4	27.4
45	15	28.6	17.1	31.2	15.6	12.5	11.3	7.6	5.4	4.0	20.5	12.6	16.4	27.9	25.1	25.1
44	16	26.1	15.7	28.5	14.2	11.4	10.3	6.9	5.0	3.6	18.8	11.5	15.0	25.5	22.9	22.9
43	17	24.1	14.5	26.3	13.2	10.5	9.6	6.4	4.6	3.4	17.4	10.7	13.9	23.6	21.2	21.2
42	18	22.2	13.3	24.2	12.1	9.7	8.8	5.9	4.2	3.1	16.0	9.8	12.8	21.7	19.5	19.5
41	19	20.5	12.3	22.4	11.2	9.0	8.1	5.5	3.9	2.9	14.8	9.1	11.8	20.1	18.1	18.1
40	20	19.0	11.4	20.8	10.4	8.3	7.6	5.1	3.6	2.7	13.7	8.4	10.9	18.6	16.8	16.8
39	21	17.7	10.6	19.3	9.7	7.7	7.0	4.7	3.4	2.5	12.7	7.8	10.2	17.3	15.6	15.6
38	22	16.4	9.8	17.9	8.9	7.2	6.5	4.4	3.1	2.3	11.8	7.3	9.4	16.0	14.4	14.4
37	23	15.3	9.2	16.7	8.4	6.7	6.1	4.1	2.9	2.1	11.0	6.8	8.8	15.0	13.5	13.5
36	24	14.3	8.6	15.6	7.8	6.2	5.7	3.8	2.7	2.0	10.3	6.3	8.2	14.0	12.6	12.6
35	25	13.3	8.0	14.5	7.3	5.8	5.3	3.5	2.5	1.9	9.6	5.9	7.7	13.0	11.7	11.7
34	26	12.5	7.5	13.6	6.8	5.4	4.9	3.3	2.4	1.7	9.0	5.5	7.2	12.2	11.0	11.0
33	27	11.6	7.0	12.7	6.3	5.1	4.6	3.1	2.2	1.6	8.4	5.1	6.7	11.4	10.2	10.2
32	28	10.8	6.5	11.8	5.9	4.7	4.3	2.9	2.1	1.5	7.8	4.8	6.2	10.6	9.5	9.5
31	29	10.2	6.1	11.1	5.5	4.4	4.0	2.7	1.9	1.4	7.3	4.5	5.8	9.9	8.9	8.9
30	30	9.5	5.7	10.4	5.2	4.2	3.8	2.5	1.8	1.3	6.8	4.2	5.5	9.3	8.4	8.4
29	31	8.9	5.3	9.7	4.9	3.9	3.5	2.4	1.7	1.2	6.4	3.9	5.1	8.7	7.8	7.8
28	32	8.3	5.0	9.1	4.5	3.6	3.3	2.2	1.6	1.2	6.0	3.7	4.8	8.1	7.3	7.3
27	33	7.8	4.7	8.5	4.2	3.4	3.1	2.1	1.5	1.1	5.6	3.4	4.5	7.6	6.8	6.8
26	34	7.3	4.4	7.9	4.0	3.2	2.9	1.9	1.4	1.0	5.2	3.2	4.2	7.1	6.4	6.4
25	35	6.8	4.1	7.4	3.7	3.0	2.7	1.8	1.3	0.9	4.9	3.0	3.9	6.6	6.0	6.0
24	36	6.3	3.8	6.9	3.5	2.8	2.5	1.7	1.2	0.9	4.6	2.8	3.6	6.2	5.6	5.6
23	37	5.9	3.6	6.5	3.2	2.6	2.3	1.6	1.1	0.8	4.3	2.6	3.4	5.8	5.2	5.2
22	38	5.5	3.3	6.0	3.0	2.4	2.2	1.5	1.0	0.8	4.0	2.4	3.2	5.4	4.9	4.9
21	39	5.1	3.1	5.6	2.8	2.2	2.0	1.4	1.0	0.7	3.7	2.3	2.9	5.0	4.5	4.5
20	40	4.8	2.9	5.2	2.6	2.1	1.9	1.3	0.9	0.7	3.4	2.1	2.7	4.7	4.2	4.2

Table 11. ***Relationship Between Proactive Time and Probabilities of Saturation***

M_R	M_P	West 1st Detail	West 2nd Detail	West 3rd Detail	South 1st Detail	South 2nd Detail	South 3rd Detail	Central 1st	Central 2nd	Central 3rd	North 1st Detail	North 2nd Detail	North 3rd Detail	East 1st Detail	East 2nd Detail	East 3rd Detail
60	0	85.7	53.1	33.5	77.3	100.0	18.3	61.5	53.3	18.5	100.0	85.4	30.4	68.7	94.7	21.1
59	1	81.8	48.3	31.9	74.7	98.2	17.3	57.6	50.1	16.6	98.3	81.0	27.6	65.5	91.0	18.7
58	2	79.9	46.2	30.9	73.1	96.9	16.8	56.0	48.7	15.8	96.6	79.1	26.3	63.9	89.4	17.8
57	3	76.1	41.8	29.1	70.5	93.7	15.6	52.6	46.2	14.0	93.9	74.7	23.9	60.6	85.9	15.9
56	4	74.2	40.4	28.4	68.9	92.3	15.2	51.7	44.8	13.0	92.2	72.3	23.4	59.0	84.5	15.5
55	5	70.4	37.7	26.5	66.3	89.0	14.1	49.5	42.3	11.3	89.4	69.1	22.3	55.2	81.4	14.7
54	6	66.5	34.8	24.9	63.2	85.6	13.1	47.3	39.5	9.9	86.0	65.9	21.1	52.0	78.3	13.9
53	7	64.6	33.4	24.0	62.1	84.2	12.5	46.4	38.4	9.5	84.9	64.2	20.6	50.4	77.0	13.5
52	8	60.8	30.7	22.4	59.0	80.9	11.5	44.2	35.6	8.6	81.6	61.4	19.5	47.2	73.9	12.7
51	9	57.0	27.9	20.5	56.3	77.6	10.4	42.0	33.1	7.9	78.8	58.2	18.3	44.5	70.8	11.9
50	10	54.6	25.2	18.9	53.2	74.8	9.4	40.2	30.3	7.1	75.4	55.1	17.3	42.8	68.1	11.2
49	11	52.2	22.3	17.1	50.6	71.5	8.3	38.0	27.8	6.2	72.6	51.9	16.2	41.2	65.0	10.4
48	12	49.8	20.6	15.4	47.9	68.2	7.3	35.8	25.0	5.4	69.8	48.8	15.0	39.5	61.9	9.6
47	13	47.4	19.0	13.4	44.8	64.9	6.0	33.6	23.4	4.6	66.5	46.0	13.8	37.9	58.7	8.7
46	14	43.8	16.8	12.4	40.6	60.1	5.5	30.5	21.3	3.7	62.0	41.1	12.2	35.4	54.3	7.6
45	15	41.4	15.2	11.8	38.8	56.8	5.2	28.3	20.1	3.4	59.9	38.0	11.0	33.5	51.2	6.8
44	16	37.4	12.9	10.8	36.6	52.1	4.7	25.2	18.1	2.9	56.8	34.5	9.4	31.1	46.7	5.6
43	17	35.0	11.3	10.1	35.3	48.8	4.4	23.1	16.7	2.5	55.1	32.8	8.2	29.4	43.6	4.8
42	18	31.4	9.7	9.1	33.4	45.6	3.9	21.1	14.7	2.0	52.3	30.3	7.3	27.0	40.6	4.2
41	19	27.8	8.6	8.1	31.4	43.0	3.4	19.7	12.7	1.6	49.6	27.8	6.8	24.5	38.3	3.8
40	20	25.9	7.3	7.1	29.4	40.4	2.9	18.4	10.8	1.2	46.8	25.3	6.2	22.1	35.9	3.5
39	21	24.0	6.2	6.0	27.5	37.8	2.4	17.0	9.6	1.1	44.0	22.8	5.6	19.6	33.5	3.2
38	22	21.4	4.6	4.7	24.7	34.2	1.7	15.0	8.4	0.8	40.3	19.3	4.8	17.0	30.2	2.7
37	23	19.5	4.1	4.0	22.8	31.6	1.4	13.6	7.5	0.6	37.5	16.6	4.3	15.9	27.9	2.4
36	24	17.0	3.3	3.6	20.1	28.0	1.3	11.6	6.3	0.4	33.7	15.0	3.5	14.6	24.5	1.9
35	25	14.5	2.6	3.1	17.3	24.6	1.1	9.8	5.0	0.3	29.9	13.3	2.8	13.2	21.5	1.4
34	26	12.0	1.9	2.7	14.8	21.3	0.9	8.0	3.9	0.3	26.3	11.7	2.1	11.8	18.4	1.0
33	27	10.5	1.5	2.1	13.5	19.1	0.7	7.1	3.3	0.2	24.2	9.5	1.8	9.9	16.5	0.9
32	28	9.1	1.1	1.5	12.1	17.0	0.5	6.2	2.7	0.1	21.9	7.4	1.5	8.2	14.6	0.7
31	29	7.5	0.7	1.1	10.7	14.8	0.3	5.2	2.1	0.1	19.7	6.3	1.3	6.4	12.7	0.6
30	30	6.1	0.6	1.0	9.4	12.8	0.3	4.3	1.5	0.0	17.5	5.3	1.0	5.6	10.9	0.5
29	31	4.6	0.4	0.8	7.8	10.1	0.2	3.2	1.1	0.0	15.0	4.2	0.7	4.8	8.5	0.3
28	32	3.8	0.2	0.5	6.1	8.3	0.1	2.5	0.9	0.0	12.2	3.0	0.5	4.0	6.9	0.2
27	33	3.0	0.1	0.3	4.6	7.0	0.1	2.0	0.6	0.0	9.8	2.3	0.4	3.1	5.8	0.1
26	34	2.1	0.1	0.2	4.0	5.6	0.0	1.6	0.4	0.0	8.5	1.8	0.3	2.2	4.6	0.1
25	35	1.5	0.0	0.2	3.2	4.1	0.0	1.0	0.3	0.0	7.1	1.1	0.2	1.6	3.3	0.1
24	36	1.1	0.0	0.1	2.5	3.0	0.0	0.7	0.1	0.0	5.6	0.8	0.1	1.3	2.4	0.0
23	37	0.7	0.0	0.1	1.6	2.4	0.0	0.5	0.1	0.0	4.0	0.5	0.1	0.9	1.9	0.0
22	38	0.4	0.0	0.0	1.2	1.6	0.0	0.3	0.0	0.0	3.0	0.3	0.0	0.5	1.3	0.0
21	39	0.3	0.0	0.0	0.9	1.0	0.0	0.2	0.0	0.0	2.3	0.2	0.0	0.4	0.8	0.0
20	40	0.1	0.0	0.0	0.5	0.7	0.0	0.1	0.0	0.0	1.5	0.1	0.0	0.2	0.5	0.0

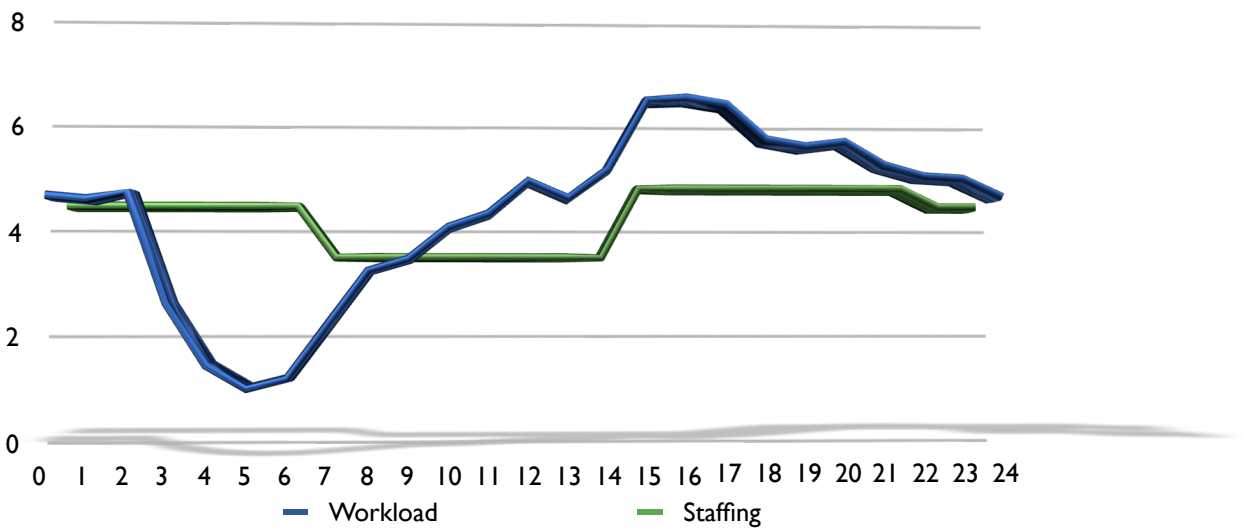
V. Resource Deployment

The patrol workload determined in the first section of this report was used to make a determination of the necessary patrol staffing size to meet a desired performance level. In the second section, the same workload data will be used again in order to compare the current staffing practices both geographically (by district) and temporally (hour of day and day of week) to the call for service load of the Patrol Division.

Police departments are fluid entities. Officers transfer in and out of patrol and total staff sizes for patrol divisions often fluctuate as conditions change within the department and within the city they serve. Some numbers that were provided at the beginning of this study may have changed by the time this report is prepared. However, the process remains consistent and can be repeated whenever necessary with updated numbers from Patrol.

It has been noted previously in this report that the CAD data used in this study is only a partial picture of the true amount of work being performed by the patrol division. Calls for service initiated by the citizens are being captured but any self-initiated activity and a vast majority of service activities are not contained in the CAD data set. Changes have been made to capture these items in the future. To account for the partial data, deployment plans in this section have been calculated based on the percentage of total workload for each hour of the day instead of the actual number of hours of work reflected in the CAD for each hour of the day. By basing graphs on percentages, the percentage of available officers by hour of day can be charted against the percentage of workload by hour of day. An example of this comparison is shown in Chart 5.

Chart 5. Workload % vs Staffing % by Hour of Day



If officer staffing were directly proportional to the call for service workload, the two lines shown in Chart 5 would overlap completely. Areas existing between the two lines shows the potential for optimization. Deployment plans will never achieve an exact match to workload. While officers are scheduled in finite blocks of time depending on the shift length, the workload changes from hour to hour.

The least intrusive technique for optimizing the current schedule is to alter the number of officers assigned per district and per shift in each district. This does not require a change in the duty-cycle-schedule currently in use by the agency and does not involve changing the starting and stopping times of the existing shifts.

Another technique is to add additional shifts, referred to as "power shifts" or "tactical shifts", to the traditional 3-shift deployment to cover times of increased calls for service. By using power shifts to cover the activity peaks, the traditional shifts can be scaled back to prevent having an excessive amount of officers on-duty when the call for service level is light. However, the use of supplemental shifts requires additional supervisors in order to keep unity of command among all shifts.

A final alternative is to change to a different shift length or a different duty-cycle-schedule that would allow more flexibility by management to match staffing to workload. Currently, the department is using an 8-hour 6-on-3-off rotating duty cycle schedule which provides uniform staffing by day of the week. A change to a fixed day off schedule would allow the agency to staff more officers on days when the level of calls for service is higher. It is also possible to create a "hybrid" schedule which incorporates both rotating and fixed schedules.

Analysis of Current Deployment

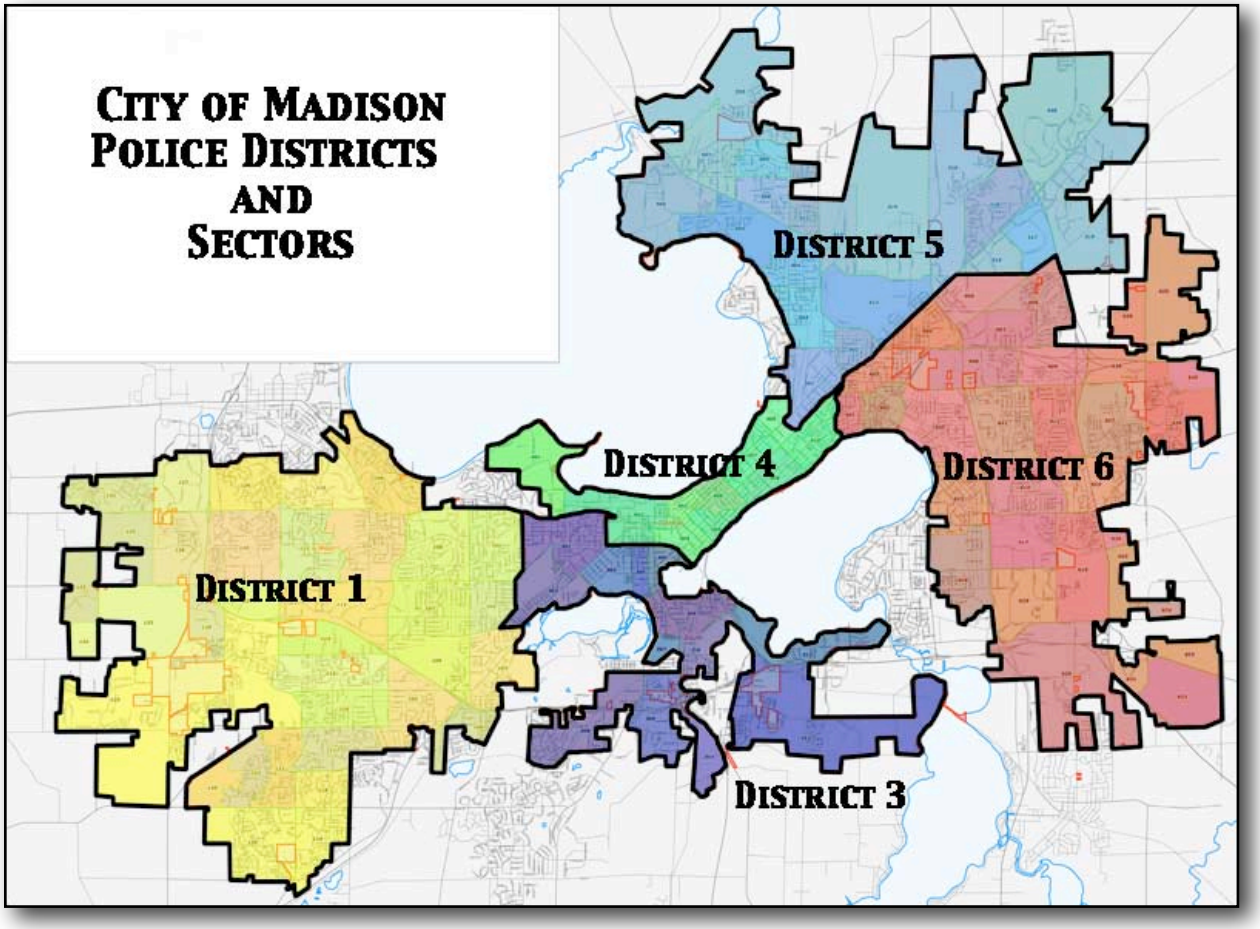
The first step in analyzing the current deployment is to examine the current district design to ensure that it is meeting the objectives of the agency. The objective of this study was to equalize the amount of reactive time per officers in the patrol division. The second step is to review each district independently and compare the staffing within the district by shift with the workload in that particular district. Finally, the current response times for the MPD will be reviewed. All analysis for this section were completed based on the hours of reactive time spent on calls for service as indicated in the CAD database between January 1, 2007 and December 31, 2007.

Current District Design

For purposes of police deployment, the City of Madison is divided into five districts. Each district operates out of its own station and is assigned a set number of officers, detectives, and command staff. Districts are subdivided into sectors and calls for service are recored based on the sector in which they occurred. Table 12 provides comparative information about the districts.

Table 12.

District	Location	Street Miles in District	Number of Sectors	Hours of Work in CAD	Assigned Officers
1	West	325.2 miles	35	24,106 hours	40
3	South	118.2 miles	13	16,382 hours	26
4	Central	72.0 miles	10	21,293 hours	42
5	North	155.8 miles	20	19,038 hours	31
6	East	238.5 miles	26	15,527 hours	28

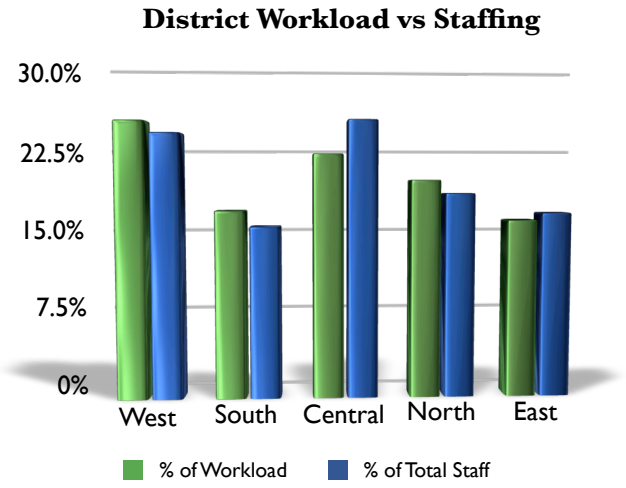


Current Workload vs Staffing

The overall staffing assignment by district showed a close correlation between the percentage of patrol workload and the percentage of assigned patrol staffing in each district. The workload varies significantly among the districts, but the agency's adoption of community policing and their decentralized structure discourages changing district boundaries. With established district stations and district borders, optimization of district workload is better accomplished by changing the number of officers assigned to each district.

After examining the workload across districts, the next step was to examine the workload within each district. On a district level, officers are deployed across three separate shifts, or details. Coverage is provided during shift changes by starting a portion of each shift one hour earlier than the rest. The first detail works from 6a to 2p and 7a to 3p. The second detail works from 2p to 10p and 3p to 11p. The third detail works from 10p to 6a and from 11p to 7a.

Chart 6.



For purposes of this study, the time collected for each shift was from 7 a.m. to 2:59 p.m., 3 p.m. to 10:59 p.m. and 11 p.m. to 6:59 a.m. for first, second, and third shifts respectively. The workload was examined by day of the week and also by hour of the day. The following charts demonstrate the workload percentages for each district. While all seven days of the week are charted for each district (muted lines), the most important lines are the average for all seven days (blue lines). Since the patrol division uses an unlocked rotating schedule, the staffing by day of the week is uncontrollable. Therefore, deployment by shift must be calculated based on the average officers per day. The bright green lines show the average percentage of staff scheduled for each hour of the day.

District 1: West

Chart 7. ***District 1: Workload Percentages by Hour of Day***

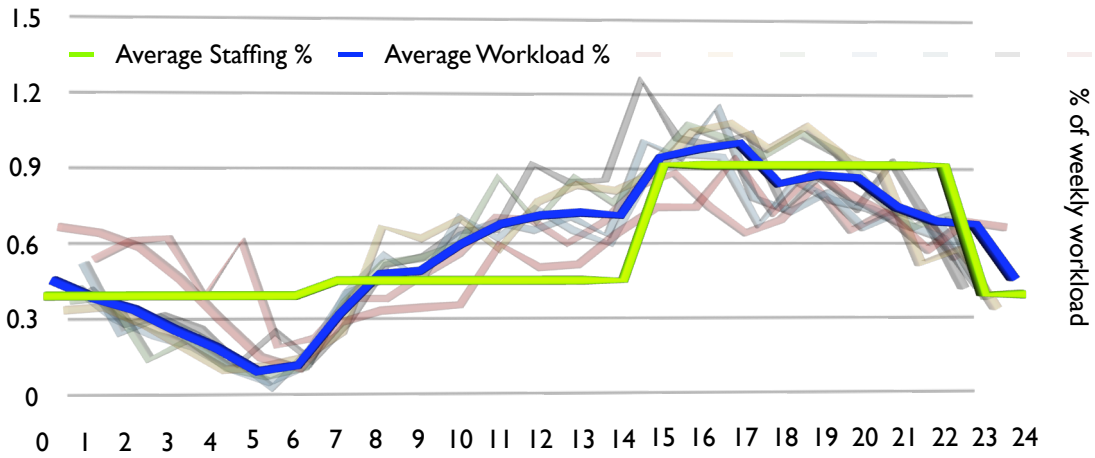


Chart 7 shows a moderately similar workload by hour of the day for each day of the week in District 1. The two curves that start high in the early morning hours are for early Saturday and early Sunday mornings. The single peak showing at 3 p.m. occurs on Friday afternoons. Comparing the average workload curve (blue) to the average staffing curve (green) shows inconsistencies from 2a to 7a and from 9a to 3p. Reallocation by shift would provide improvement in this district.

Chart 8.

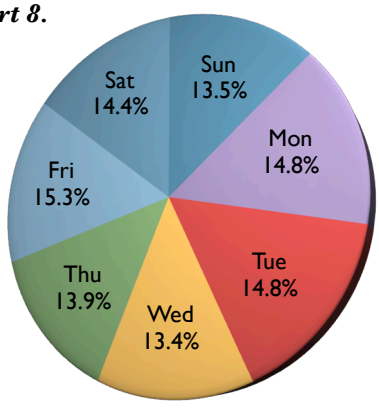


Chart 8 on the immediate right shows a similar workload by day of the week in District 1. Workload in this district dictates consistent staffing by day of the week. District 1 could be staffed appropriately using an unlocked rotating schedule as long as all squads are assigned the same number of officers. Since the workload by hour of the day varies throughout the day in a predictable manner, supplemental power shifts added to the three traditional shifts may assist in meeting the peak workload times between 12p and 10p without overstaffing during the low activity times between 2a and 7a.

District 3: South

Chart 9. ***District 3: Workload Percentages by Hour of Day***

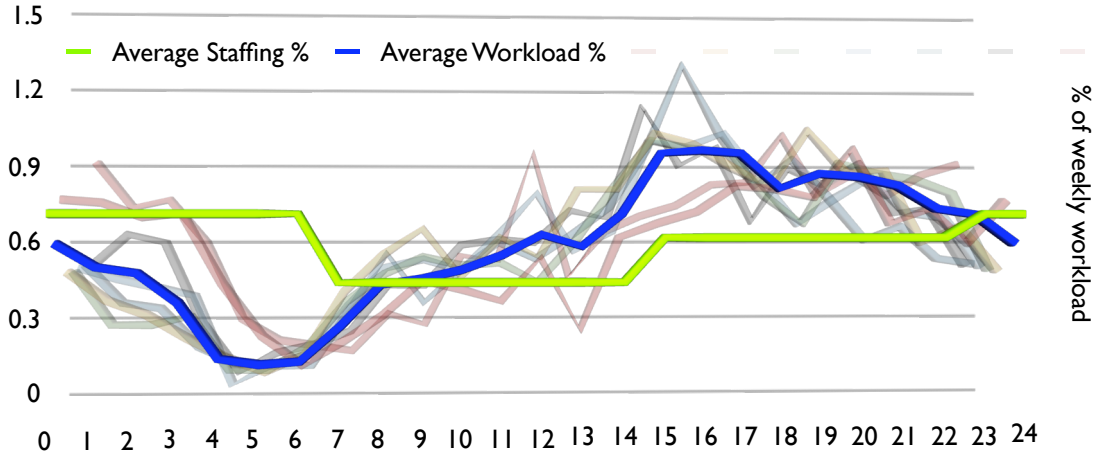


Chart 9 shows a moderately similar workload by hour of the day for each day of the week in District 3. The two curves that start high in the early morning hours are for early Saturday and early Sunday mornings. The two peaks showing at 3p and 4p occur on Friday and Thursday afternoons respectively. Comparing the average workload curve (blue) to the average staffing curve (green) shows that the current staffing practices are not consistent with workload. The staffing percentages are too high in the morning hours and then remain too low in the afternoon and evening hours until approximately midnight. Reallocation of officers by shift is necessary in this district to create a closer correlation between workload and staffing.

Chart 10.

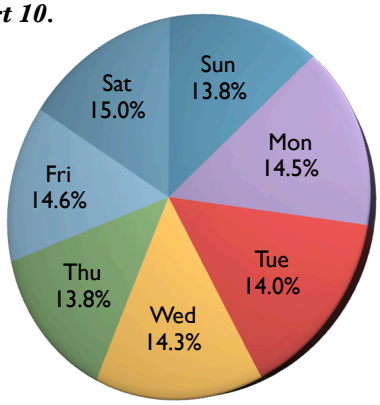


Chart 10 on the immediate right shows a similar workload by day of the week in District 3. Workload in this district dictates consistent staffing by day of the week. District 3 could be staffed appropriately using an unlocked rotating schedule as long as all squads are assigned the same number of officers. Since the workload by hour of the day varies throughout the day in a predictable manner, supplemental power shifts added to the three traditional shifts may assist in meeting the peak workload times between 1p and 11p without overstaffing during the low activity times between 3a and 7a.

District 4: Central

Chart 11. ***District 4: Workload Percentages by Hour of Day***

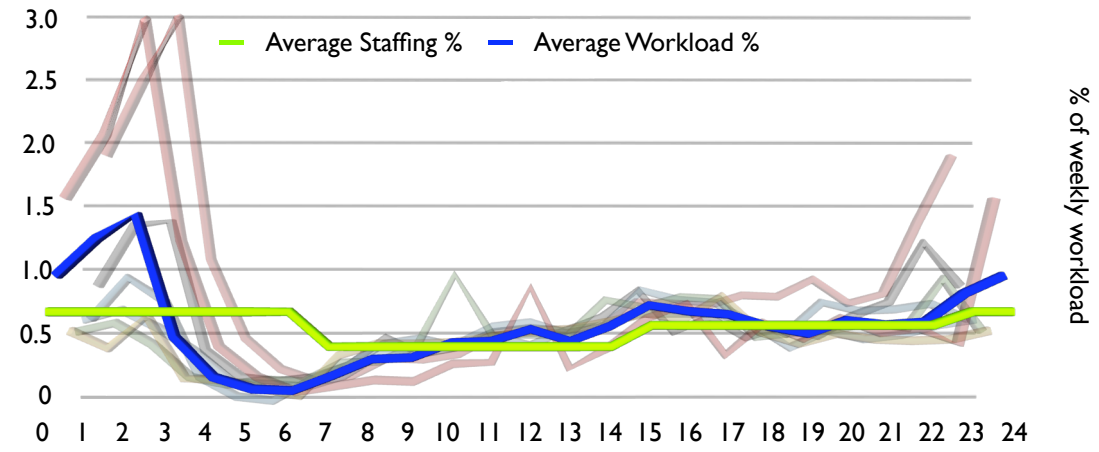
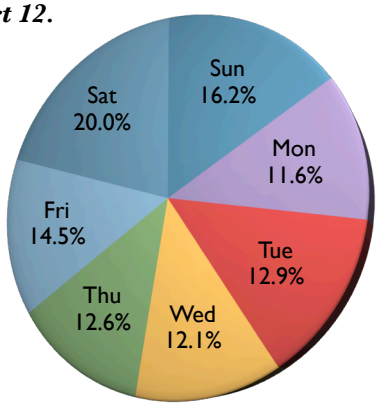


Chart 11 shows a more variable workload curve across the seven days of the week in District 4. The two curves that start high in the early morning hours are for early Saturday and early Sunday mornings. The two peaks showing at 10a and 12p occur on Tuesday and

Sunday respectively. Staffing percentages between the hours of 7a and 11p match the workload sufficiently. However, there is a strong need for a supplemental shift between the hours of 9p and 5a on Thursday, Friday, and Saturday. Reallocating more officers to the third detail would benefit the agency between 11p and 4a but would create overstaffing between 4a and 7a.

Chart 12 shows the percentage of workload by day of week for 2007 in District 4. More than half of the workload in District 4 occurred on Friday, Saturday, and Sunday nights. However, due to the current unlocked rotating schedule of patrol, there are always two squads on-duty each day and one squad off-duty. Since the squads are not all the same size, any day of the week could have eight officers staffed on one week and only five officers staffed on another. This is problematic for this district. Based on charts 11 and 12, this district would benefit from a fixed shift of officers working from 7p to 5a, Thursday through Sunday. This additional shift would address the workload spikes in the early morning hours and provide additional proactive time during the bar close period.

Chart 12.



District 5: North

Chart 13. ***District 5: Workload Percentages by Hour of Day***

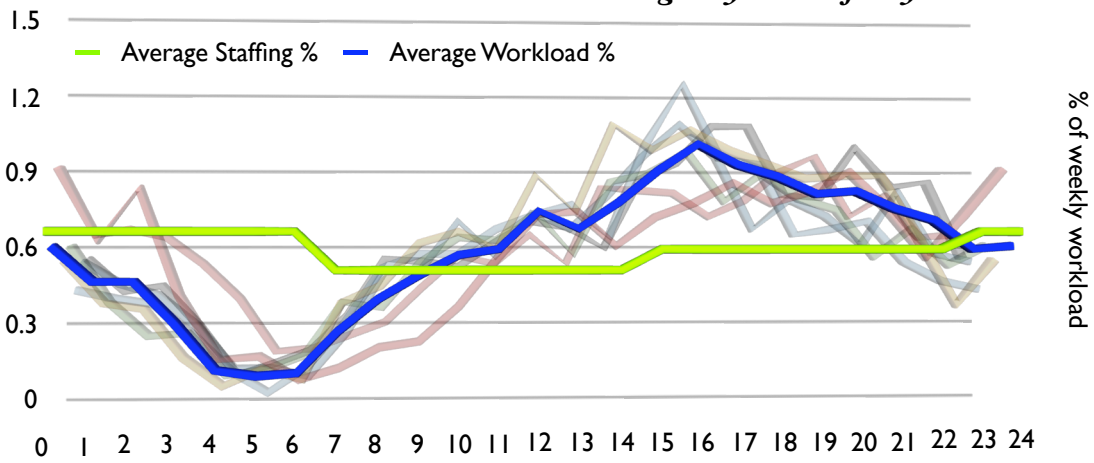
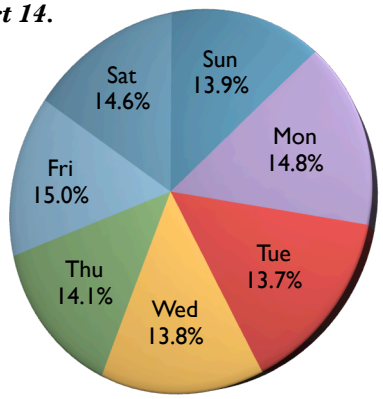


Chart 13 shows a moderately similar workload by hour of the day for each day of the week in District 5. The two curves that start high in the early morning hours are for early Saturday and early Sunday mornings. The highest peak for 2007 data occurred on Wednesday afternoons at approximately 4p. It can be seen that there is a consistently high workload in the late afternoon and early evening hours. Comparing the average workload curve (blue) to the average staffing curve (green) shows that the current staffing practices are not consistent with workload. The staffing percentages are too high in the morning hours and then remain too low in the afternoon and evening hours until approximately 11p. Reallocation of officers by shift is necessary in this district to create a closer correlation between workload and staffing.

Chart 14 on the immediate right shows a similar workload by day of the week in District 5. Workload in this district dictates consistent staffing by day of the week. District 5 could be staffed appropriately using an unlocked rotating schedule as long as all squads are assigned the same number of officers. Since the workload by hour of the day varies throughout the day in a predictable manner, supplemental power shifts added to the three traditional shifts may assist in meeting the peak workload times between 7a and 3a without overstaffing during the low activity times between 3a and 7a.

Chart 14.



District 6: East

Chart 15. ***District 6: Workload Percentages by Hour of Day***

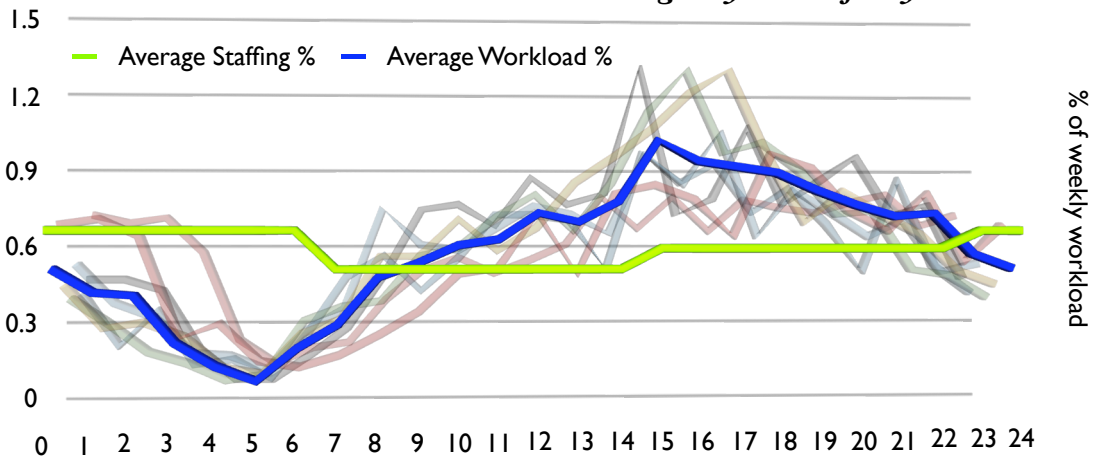


Chart 15 shows a slightly similar workload by hour of the day for each day of the week in District 6. The two curves that start high in the early morning hours are for early Saturday and early Sunday mornings. The highest peaks for 2007 data occurred on Monday, Tuesday, and Friday afternoons at approximately 5p, 4p, and 3p respectively. It can be seen that there is a consistently high workload in the late afternoon and early evening hours consistent with commuting times on the east side of the city. Comparing the average workload curve (blue) to the average staffing curve (green) shows that the current staffing practices are not consistent with workload. The staffing percentages are too high in the morning hours and then remain too low in the afternoon and evening hours until approximately 11p. Reallocation of officers by shift is necessary in this district to create a closer correlation between workload and staffing.

Chart 16.

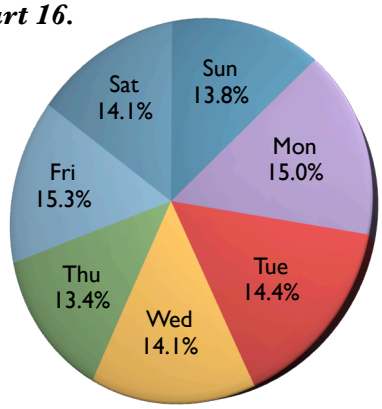


Chart 16 on the immediate right shows a similar workload by day of the week in District 6. Workload in this district can be accommodated with consistent staffing by day of the week. District 6 could be staffed appropriately using an unlocked rotating schedule as long as all squads are assigned the same number of officers. Since the workload by hour of the day varies throughout the day in a predictable manner, supplemental power shifts added to the three traditional shifts may assist in meeting the peak workload times between 7a and 3a without overstaffing during the low activity times between 3a and 7a. The three workload spikes observed in chart 15 occur on three non-consecutive days and appear at different times each day. Attempts at creating supplemental shifts that would specifically cover these peaks would be counter-productive on the days when the peaks did not occur.

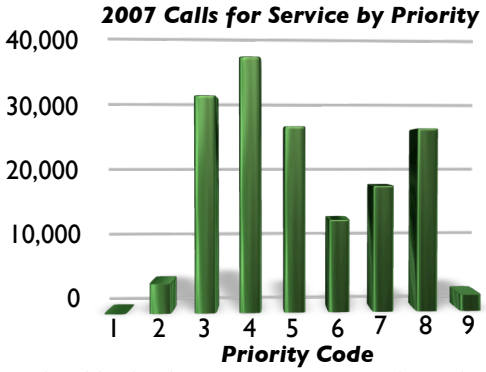
Current Response Times

Earlier in this report, the process for calculating processing times, travel times, and response times from the original CAD database was explained (pages 9-10). Those times can now be used to compare the response times of the various districts under the existing schedule and deployment practices. Response times for calls for service are broken down in this section into processing times and travel times. The ***processing time*** is the time span between the initial call for service and the time the first officer was dispatched to the call. The ***travel times*** are the average time spans between dispatch and arrival for each officer. These two times are helpful in determining the efficiency of patrol operations. Long processing times indicate that calls may be holding due to a lack of officers available. Long travel times may indicate an inefficient deployment of officers which requires longer distances for response or cross-beat dispatching.

The ***response times*** are the average time spans between the time the call is arrived in the dispatch center until the first officer arrives on the scene. This provides a more realistic metric from the citizen's perspective. It should be noted that the response time does not necessarily equal the sum of the average processing times and the average travel times. It is possible for a secondary officer, who is dispatched after the primary officer, to have a shorter travel time and still arrive long after the initial officer is on-scene. This scenario would cause the average travel time for the call to be shorter than the actual travel time of the first arriving officer. Therefore, travel times and processing times are provided for internal use and the overall response time is provided to reflect the citizen's experience. The sum of the average processing times and average travel times should not be expected to equal the minimum response times.

The priority code given to a particular call for service, such as a burglary or an alarm call, is based on a number of influencing factors beyond just the type of call. The urgency of the matter, the presence of injuries, and the risk to people and property are just a few of the criteria that may cause a call for service to be elevated beyond its default priority code. Therefore, even though call types have a default priority code, each call type will be seen in the CAD database as being dispatched at various priority code levels.

Chart 17.



A call may be dispatched under an original call type and then changed to a more serious or a less serious type once the officer is on scene and completes the report. For example, a homicide call may be originally reported as a "check welfare" call if the victim's family is unable to reach them after several days. The call would originally be dispatched as a priority 7 or 8 call. The call type would be changed in the records division after the officers respond and the initial report is submitted. While the call type is updated in the database, the priority of the initial response is not. Therefore, it is possible to see a call in the CAD database, such as a homicide call, that is dispatched as a priority 7 or 8 call.

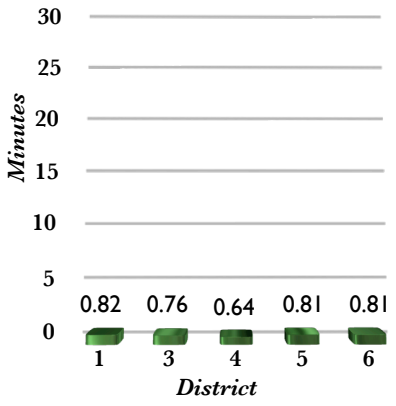
In order to determine the most appropriate priority code to use for each call type, the CAD database containing all calls for service in 2007 was sorted by call type and a median priority code was determined for each. This provided an estimation of the types of calls that would most likely be seen at a particular priority level. The database was sorted again based on priority levels and average processing times, travel times, and average minimum response times were calculated for each priority level. Due to the small number of priority 1 calls in the database, there were no call for service categories with a median priority level of 1. The following charts show the average processing times, average travel times, and average minimum response times for each district based on priority levels 2-9.

Priority 2

Calls for service dispatched most often at this priority level

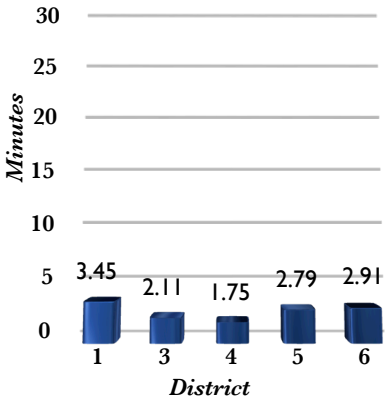
Accident with injuries
Fight Call
Weapons Offense

Chart 18a.
Average Processing Times



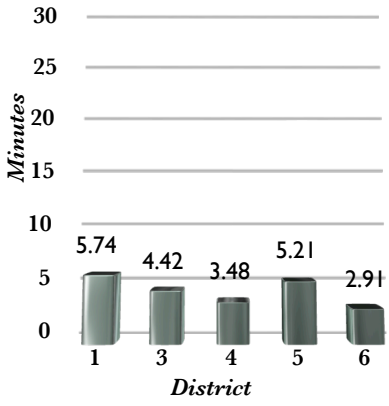
Bicycle Accident
Person with a gun

Chart 18b.
Average Travel Times



Emergency
PNB/AED Response

Chart 18c.
Average Minimum Response Times



Priority 3

Calls for service dispatched most often at this priority level

911 Disconnect	Aggravated Battery	Alarm
Assist Fire/Police	Assist K9	Attempted Suicide
Bomb Threat	Death Investigation / Suicide	Disturbance Call
Domestic / Family Trouble	EMS Assist	Fire Investigation
Homicide	Injured Person	Overdose Investigation
Person Down	Prowler Complaint	Robbery-Armed
Robbery - Strong Armed	Unknown Trouble	

Chart 19a.

Average Processing Times

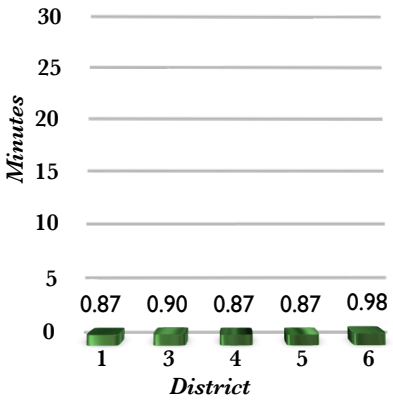


Chart 19b.

Average Travel Times

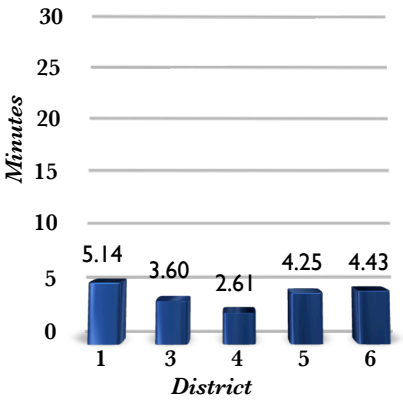
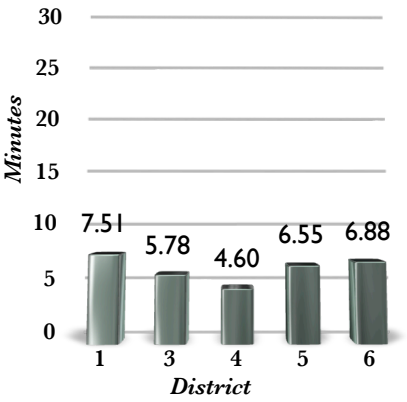


Chart 19c.

Average Minimum Response Times



Priority 4

Calls for service dispatched most often at this priority level

Accident - Hit & Run	Accident - Property Damage	Accident - MV/Deer
Animal Complaint - Bite	Arson	Battery
Check Person	Drug Incident	Enticement/Kidnapping
False Alarm	Intoxicated Person	Local Ordinance Violation
Miscellaneous Sex Offense	Missing Adult	Neighbor Trouble
Odor/Smoke Complaint	OMVWI Arrest/Intoxicated Driver	PC Conveyance / Commitment
Prostitution / Soliciting	Retail Theft	Sexual Assault / Rape
Sexual Assault of a Child	Stalking Complaint	Suspicious Person
Suspicious Vehicle	Unwanted Person	

Chart 20a.

Average Processing Time

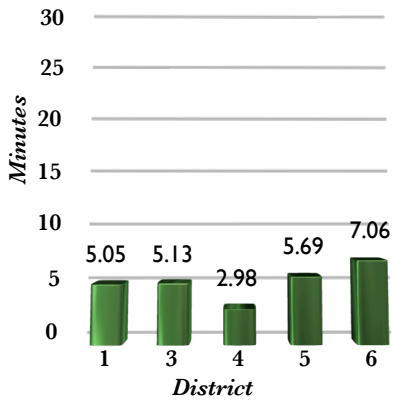


Chart 20b.

Average Travel Times

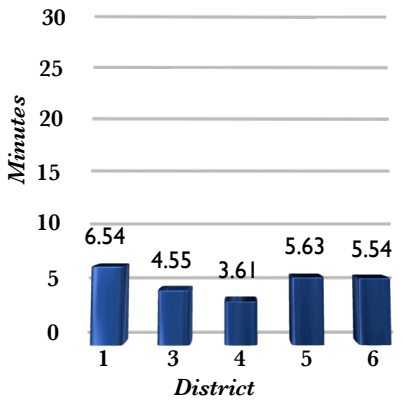
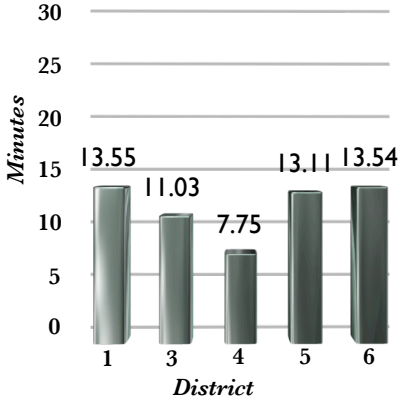


Chart 20c.

Average Minimum Response Times



Priority 5

Calls for service dispatched most often at this priority level

Adult Arrest	Arrested Juvenile	Check Property
Child Abuse	Child Neglect	Damaged Property Complaint
Exposure	Extortion	Forgery
Fraud	Graffiti Complaint	Juvenile Complaint
Landlord Tenant Trouble	Liquor law Investigation	Non-Residential Burglary
Preserve the Peace	Recovered / Stolen Outside Agency	Residential Burglary
Safety Hazard	Significant Exposure (Officer)	Stolen Auto
Stolen Other Vehicle / Cycle	Threats Complaint	Traffic Arrest
Trespassing Complaint	Violation of Court Order	Voided Case / Incident Number

Chart 21a.

Average Processing Times

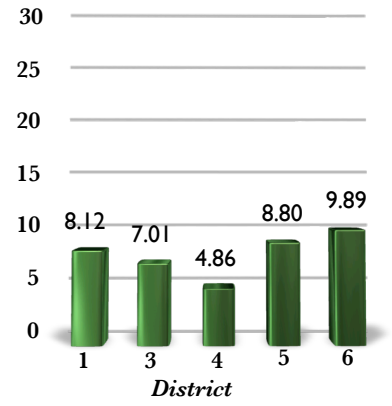


Chart 21b.

Average Travel Times

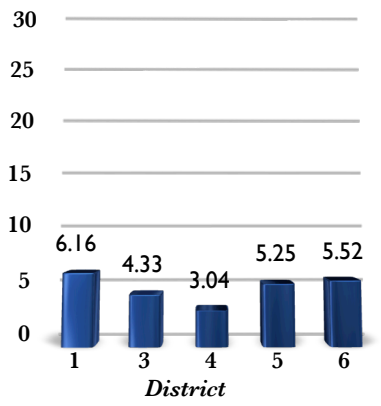
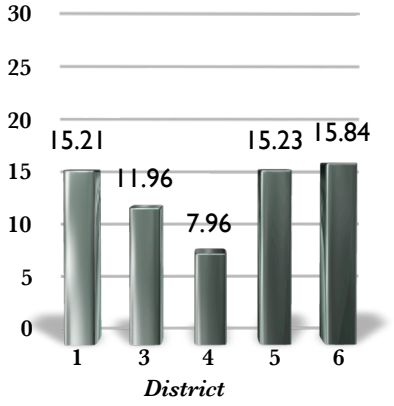


Chart 21c.

Average Minimum Response Times



Priority 6

Calls for service dispatched most often at this priority level

Accident - Private Property	Assist Citizen	Attempt to Locate Person
Civil Dispute	Escort Conveyance	Found Person
Missing Juvenile / Runaway	Theft	Theft from Auto
Towed Vehicle	Worthless Check	

Chart 22a.

Average Processing Times

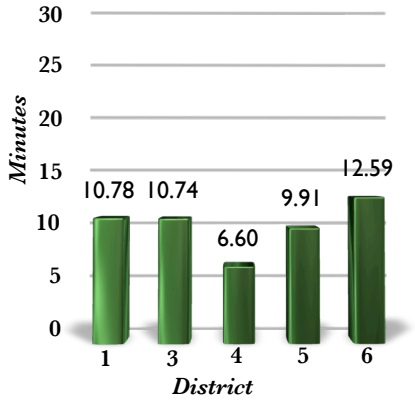


Chart 22b.

Average Travel Times

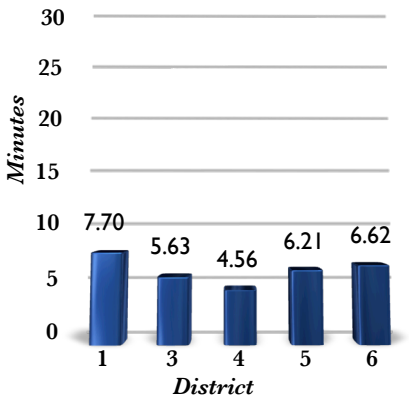
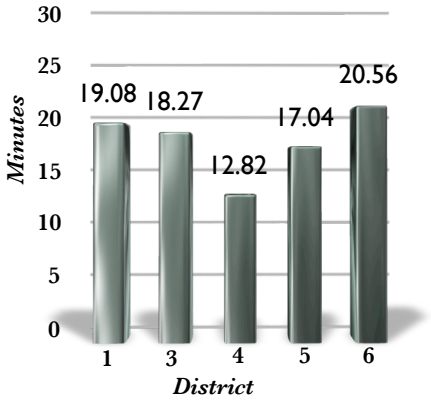


Chart 22c.

Average Minimum Response Times



Priority 7

Calls for service dispatched most often at this priority level

Accident - Citizen Report	Animal Complaint - Disturbance	Animal Complaint - Stray
Information	Liquor Law / Bar Check / Other	Lost Property
Noise Complaint	Problem Solving - Person	Problem Solving - Property
Silent Case Number	Solicitors Complaint	Stolen Bike
Towed Vehicle / Abandonment	Traffic Complaint	Traffic Incident
Traffic Incident / Road Rage		

Chart 23a.
Average Processing Times

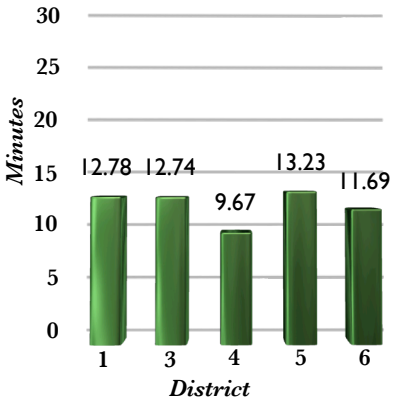


Chart 23b.
Average Travel Times

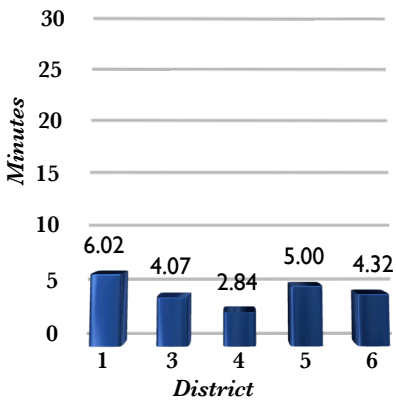
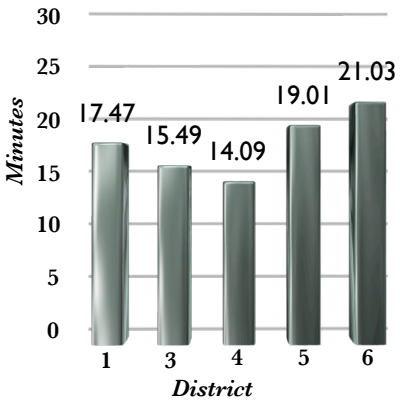


Chart 23c.
Average Minimum Response Times



Priority 8

Calls for service dispatched most often at this priority level

Annoying / Obscene Phone Calls	Found Property	On Street Parking Complaint
Phone Call	Private Property Parking Complaint	Serving legal papers
Special Event	Street Storage and Storm Notes to Utilities	

Chart 24a.
Average Processing Times

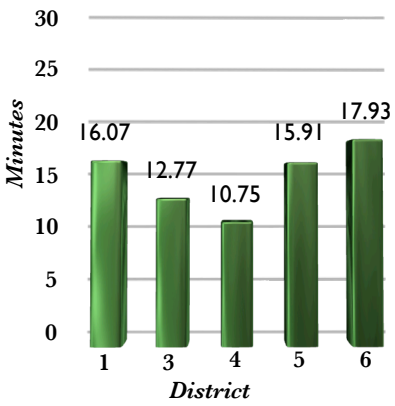


Chart 24b.
Average Travel Times

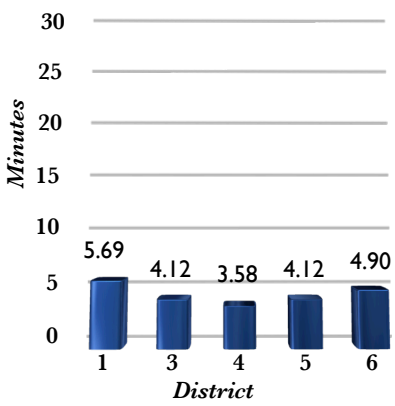
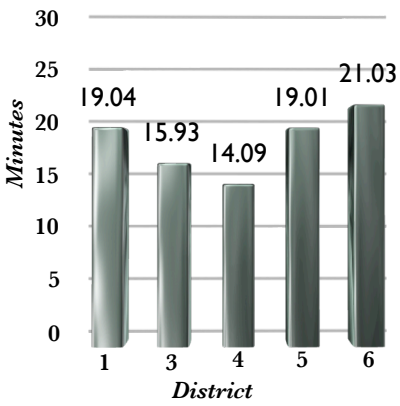


Chart 24c.
Average Minimum Response Times



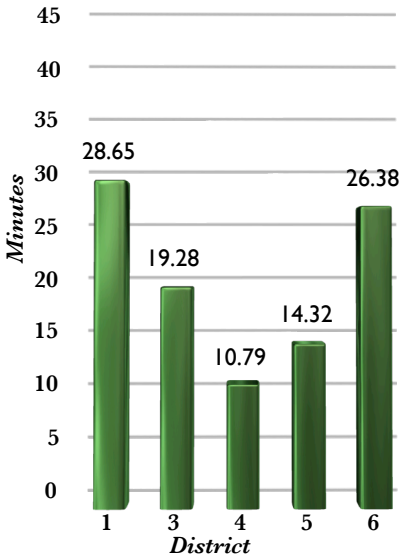
Priority 9

Calls for service dispatched most often at this priority level

Check Parking Postings
Repossession

Chart 25a.

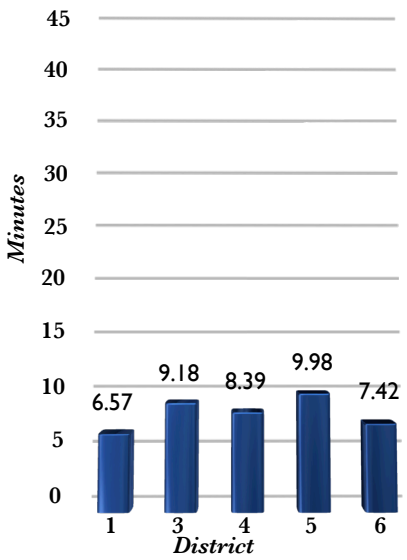
Average Processing Times



Non-urgent Notifications
Request for Highway / Streets Department

Chart 25b.

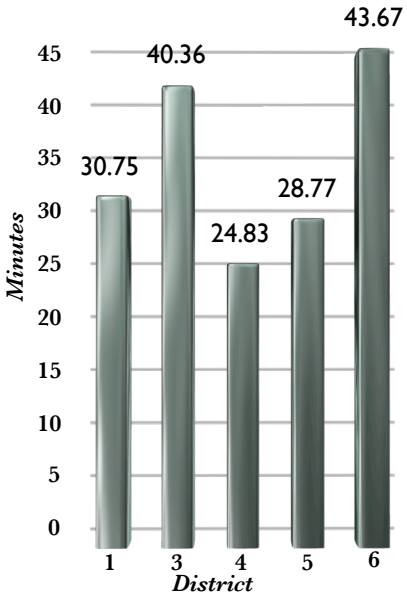
Average Travel Times



Parking Street Storage

Chart 25c.

Average Minimum Response Times



A number of trends can be observed in the three time spans as the priority level increases. It should be noted that the processing time includes the time required to receive the necessary information from the caller, enter the information into the CAD system, and to dispatch an available officer. If there are no officers readily available at the time of the call, the call will either be sent to another officer in a neighboring sector (cross-beat dispatched) or it will be held in the dispatch queue until the officer is available (stacked). The time that a call sits in the dispatching queue is counted as part of the processing time and as part of the average minimum response times.

Looking at the processing times for priority 2 and 3 calls, the processing times remain consistent among all 5 districts. Dispatchers will exhaust all options for finding an available unit to respond immediately before stacking a call at these levels. Since these priority levels are associated with the more serious crimes and the more life-threatening situations, officers may be asked to clear from their current activities and respond immediately to the call or officers will be cross-beat dispatched out of another neighboring sector in order to handle the call immediately.

For the higher priority levels, non-urgent calls will most likely be held at the dispatch level (stacked) until the sector car becomes available. Therefore, as the priority status of the call gets lower (showing a higher numerical value), the processing times and the minimum average response times get progressively higher. The time required for actually entering the data is approximately the same for all priority levels, the difference in the processing times is most likely due to the included stack time when the dispatcher is waiting for an officer to become available for the next call. The rise in the minimum average response times for the higher priority levels are effected by the longer stack times but could also be effected by longer travel times since the officers are not responding with lights and sirens at these priority levels.

As the various districts are compared against each other, District 4 stands out as having consistently lower processing times, travel times, and minimum response times. Table 15 shows that District 4 has the fewest number of sectors, the fewest street miles, and the most assigned officers of all MPD districts. Their lower response times, travel times, and minimum response times come as a result of higher levels of availability due to higher staffing. This is consistent with tables 10 and 11 which show District 4 to have the lowest patrol interval and the lowest probability of saturation among all districts.

Travel times in District 1 are consistently higher than the average. Table 12 shows District 1 to have the most sectors, a significantly higher number of street miles, the highest workload as measured in hours spent on calls for service, and the second highest number of officers. Minimum response times in District 6 are the highest for priority levels 5-9, most likely contributed to their higher travel times due to the street miles in the district. Table 7 shows District 1 to have the two highest patrol intervals among all districts per shift, due to the large amount of street miles.

Redeploying staff across the districts and shifts in proportion to the hours spent on calls for service should bring the response times and processing times to a more even distribution. Travel times may still be uneven among districts due to the variance in street miles.

Review of Current Patrol Schedule

If the agency were using a fixed day off schedule, officers would be deployed across the seven days of the week within each of the three shifts. However, the patrol division utilizes an unlocked rotating schedule of 6 on-duty days followed by 3 off-duty days. This nine-day duty cycle pattern causes the officer's days off to constantly change as they float across the seven days of the week. The agency assigns the officers to one of three rotations and each rotation has different days off. On any given day, two rotation will be working and one rotation will be off. If the rotations were of equal size, the agency would have uniform staffing by day of the week. Table 13 shows the agency rotation assignments per district and detail as of October 30, 2007. The number of officers is listed first, followed by the number of sergeants. For instance, "3+1" indicates 3 officers and 1 sergeant.

Table 13. **Rotation Assignments by District and Detail**

	West	South	Central	North	East	Total
1st Detail						
Pink	3 + 1	3	3	3	3 + 1	15 + 2
Yellow	4	2 + 1	4 + 1	3	2	15 + 2
Blue	4 + 1	1	3	2 + 1	3	13 + 2
2nd Detail						
Pink	7 + 1	2	5 + 1	4	3 + 1	21 + 3
Yellow	6 + 1	3 + 1	5 + 1	5 + 1	3	22 + 4
Blue	6	4 + 1	4	4 + 1	4 + 1	22 + 3
3rd Detail						
Pink	2	3 + 1	6 + 1	3 + 1	3	17 + 3
Yellow	4 + 1	4	7 + 1	4	3 + 1	22 + 3
Blue	4 + 1	4	5 + 1	3 + 1	4	20 + 3

Unequal size rotations, as shown in Table 13, produce unequal staffing by day of the week. In addition, since the days off float across the seven days of the week, heavy and light staffing times become uncontrollable. When the pink squad is off-duty in West District on the 3rd detail, the staffing is 3 officers higher than when the yellow or blue squads are off-duty. A squad's three-days off may fall on a weekend during one rotation and mid-week on the next.

Sergeants are on the same rotation as the officers and their days off change from week to week. The coverage they provide is non-uniform and uncontrollable. During the first detail, there are only 4 sergeants to cover 5 districts. On the second detail there will be either 6 sergeants scheduled or 7 sergeants, depending on the day off rotation. The third detail will have 6 sergeants assigned each day to cover 5 districts. This coverage is under ideal scheduling conditions and does not consider leave time used by the sergeants such as sick days, vacation, holidays, and compensatory leave.

The current 6 on 3 off schedule is not compatible with the management concept of "unity of command." Unity of command infers that all officers will report to a single supervisor consistently. This concept is possible with some rotating schedules. In this case, there are 45 groups of officers who share days off together (5 districts x 3 details x 3 off-duty groups). Only 25 of those 45 groups have a supervisor assigned to rotate with them. The other 20 groups report to one supervisor for their first three workdays and a second supervisor for their last three workdays. Furthermore, there are six details that have only one sergeant assigned. When that sergeant is off-duty, a sergeant from a neighboring district is responsible for supervising both districts. Therefore, officers on these details have the possibility of working for up to a minimum of four different supervisors.

"***Unity of command***" provides three important benefits to the operation of the patrol bureau; a clear chain of command, consistent lines of communication, and comprehensive supervision. Past studies in large agencies have shown that an unclear chain of command can lead to increased stress on the officers and a lack of unity within the police department. The military has recognized the need for a clear chain of command as a necessity for improved performance and job completion. A clear chain of command leads into the second benefit, consistent lines of communication. When officers work a portion of their workweek under one supervisor and the remainder of their week under another, it is very easy for the officer to get two separate messages concerning the goals of the agency. Patrol priorities may differ among the two supervisors leaving the officer guessing what the expectations upon them are for that particular day. Finally, comprehensive supervision means that when an officer consistently reports to one supervisor, the supervision and evaluation of that officer can be

completed in a more thorough manner. If officers report to multiple supervisors over the course of a single bid period, their evaluation should include input from all supervisors involved. This practice is seldom done and noteworthy accomplishments or deficiencies in the officer's performance are overlooked. Unity of command provides the greatest opportunity for a supervisor to provide meaningful and comprehensive feedback on an officer's overall performance.

"***Team integrity***" is another valuable benefit to the operation of the patrol bureau. Team integrity infers that officers will work with the same group of officers each day and take their days off with the same group of officers. When officers work in a unified squad, their comfort level in the expectations of each other improves and non-verbal communication improves. This can lead to increased productivity for the agency and increased safety for the officer. While the current schedule utilizes a "squad" system, the 6-on-3-off duty cycle schedule prevents the agency from obtaining complete team integrity in patrol. In addition to working with the members on their day-off rotation squad, an officer will also be working with a second squad for the first three days of their workweek and a third squad the last three days of their workweek. This schedule provides more team integrity than a fixed day off schedule would provide (such as a 5-on-2-off 8-hr shift or a 4-on-3-off 10-hr shift), but less than a number of 12-hr possibilities.

The current 6-on-3-off schedule provides "***schedule equity***" for all officers in patrol. Since it is an unlocked rotating schedule, all officers are given the same opportunity for a periodic weekend off. Although fixed days off are not able to be chosen, officers are able to chose their desired district, detail, and sector in which to work based on their seniority within the department.

The current 6-on-3-off schedule has been in use by the MPD patrol division for over a decade. Based on the data used in this study, however, it is not an optimal schedule for the workload indicated by the 2007 CAD data. If the color rotation groups were of equal size, the schedule would provide uniform staffing by day of the week. This would be acceptable for districts 1,3, 4, and 5. District 4 would be better staffed using a fixed day off schedule so that Friday, Saturday, and Sunday could be staffed at higher levels. The supervision structure could also be improved with a different schedule. Unity of command is lacking on almost half of the details. With only 25 sergeants to cover 15 details per day, the current schedule leaves many supervisory vacancies that must be filled by other supervisors. When supervisors assume responsibility over two districts at a time, their span of control greatly increases making it more difficult to maintain consistent supervision and to be present on the more serious calls. A different schedule may also provide increased team integrity if the number of rotations per detail could be decreased from 3 rotations (8-hr shifts) to 2 rotations (12-hr shifts).

Deployment Optimization

Serious consideration should be given before changing a work schedule that has been in place for a long time, such as the MPD patrol schedule. Schedules and rotations have a major impact on the health and family life of those officers who work them. Changing the length of the shift, the number of consecutive work days, or the frequency of off-duty weekends can affect childcare arrangements, off-duty jobs, contract overtime opportunities, and continuing education plans. More than anything else, moving from one schedule to another presents a ***major change*** for the officers and is not always greeted with open anticipation. This section presents three methods for improving performance objectives within the patrol division such as response times, patrol intervals, and cross-beat dispatching.

- The first method involves a redistribution of officers among the existing districts and details to gain a closer correlation between workload and staffing. This is the least invasive way to improve performance with a minimal impact on the officers. However, the issues with a lack of team integrity and a lack of unity of command will still be present.
- The second method involves a redistribution of officers among the existing districts and details with supplemental "power" shifts created during peak times. The existing shifts still remain for those who have seniority or scheduling conflicts. Additional shifts will be added during times of peak activity to allow smaller staffing sizes during times of lower call volumes. Again, team integrity and unity of command will still be violated under this schedule recommendation.
- The final method is to transition to a new schedule that will provide the staffing necessary to correlate with the workload, yet still provide benefits to the officer and agency such as team integrity, unity of command, and schedule equity.

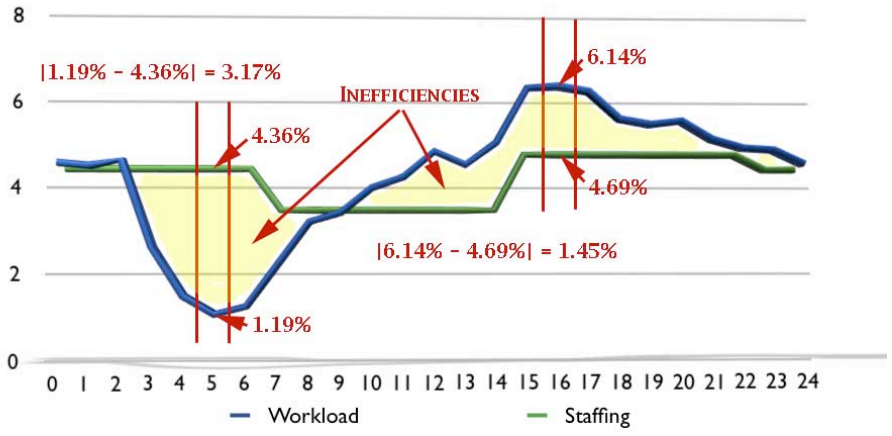
Redeployment with current schedule

The CD-ROM that accompanies this report contains an Excel spreadsheet titled "Madison Deployment.xls." The spreadsheet converts the number of hours spent on calls for service by district and detail into overall percentages. A redistribution of the 155 patrol officers was completed matching the percentage of staff per district and detail to the percentage of overall workload per district and detail (defined by hours of work answering calls for service). The optimized deployment is shown in Table 14..

Table 14.	Current Officers Assigned	Current Sergeants Assigned	Optimized Officer Assignment	Optimized Sergeant Assignment	Change in Officer Assignment	Change in Sergeant Assignment
District 1	**37**	**6**	**39**	**6**	**2**	**0**
Detail 1	10	2	13	2	3	0
Detail 2	18	2	18	3	0	1
Detail 3	9	2	8	1	-1	-1
District 3	**23**	**4**	**26**	**4**	**3**	**0**
Detail 1	6	1	8	1	2	0
Detail 2	8	2	12	2	4	0
Detail 3	9	1	6	1	-3	0
District 4	**38**	**6**	**34**	**6**	**-4**	**0**
Detail 1	10	1	9	2	-1	1
Detail 2	13	2	12	2	-1	0
Detail 3	15	3	13	2	-2	-1
District 5	**30**	**5**	**31**	**5**	**1**	**0**
Detail 1	8	1	10	2	2	1
Detail 2	12	2	14	2	2	0
Detail 3	10	2	7	1	-3	-1
District 6	**27**	**4**	**25**	**4**	**-2**	**0**
Detail 1	8	1	8	1	0	0
Detail 2	9	2	12	2	3	0
Detail 3	10	1	5	1	-5	0

In order to gauge the effect of the optimized deployment, the area between the existing staffing curve and the workload curve was compared to the area between the optimized staffing curve and the workload curve. The area between each set of curves was measured by calculating the absolute value of the difference between the percentages of the two curves for each hour of the day (see Chart 26.) Summing the absolute values of the differences for all 24 hours and subtracting that sum from 100% produced an overall efficiency score for

Chart 26

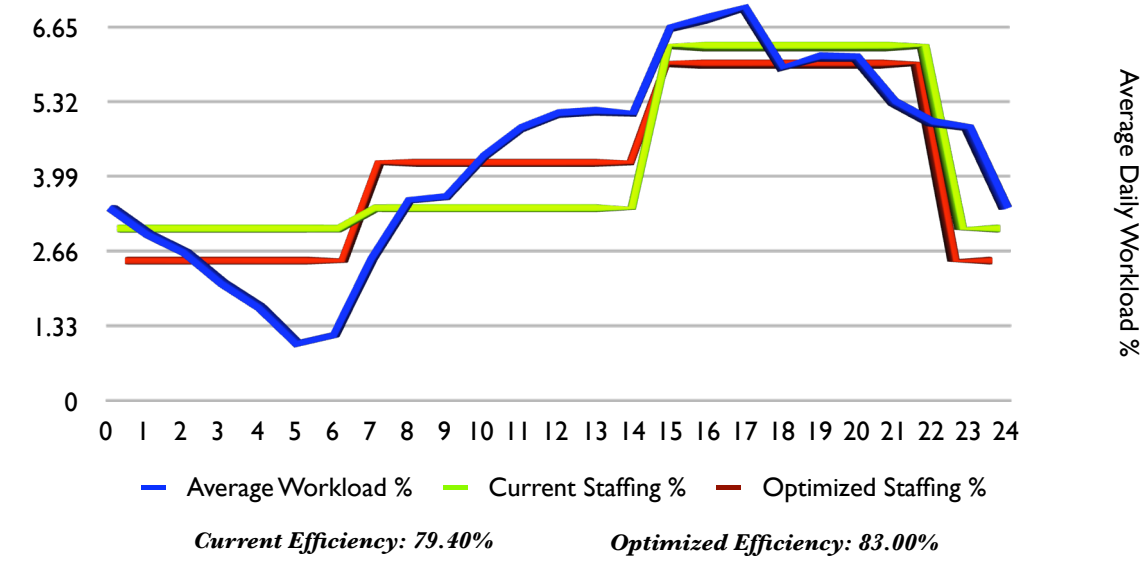


each curve as it is contrasted to the workload curve. Under this methodology, if the two curves were perfectly aligned, the efficiency score would be 100%.

The following charts depict the average daily workload curve (by percentage) in each district as a dark blue line. The current average daily staffing configurations (by percentage) are depicted as a bright green line. The optimized average daily staffing configurations (by percentage) are depicted as a deep red line. The efficiency scores for each staffing curve are provided for each district.

District 1: West

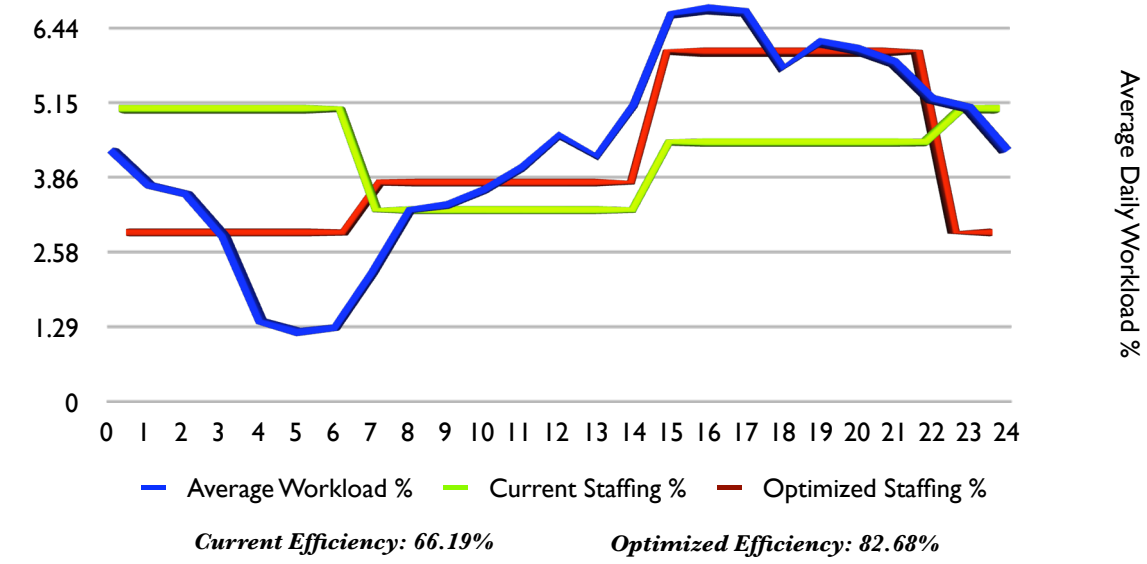
Chart 27. ***Average Daily Workload & Staffing by Hour of Day***



Current Efficiency: 79.40% ***Optimized Efficiency: 83.00%***

District 3: South

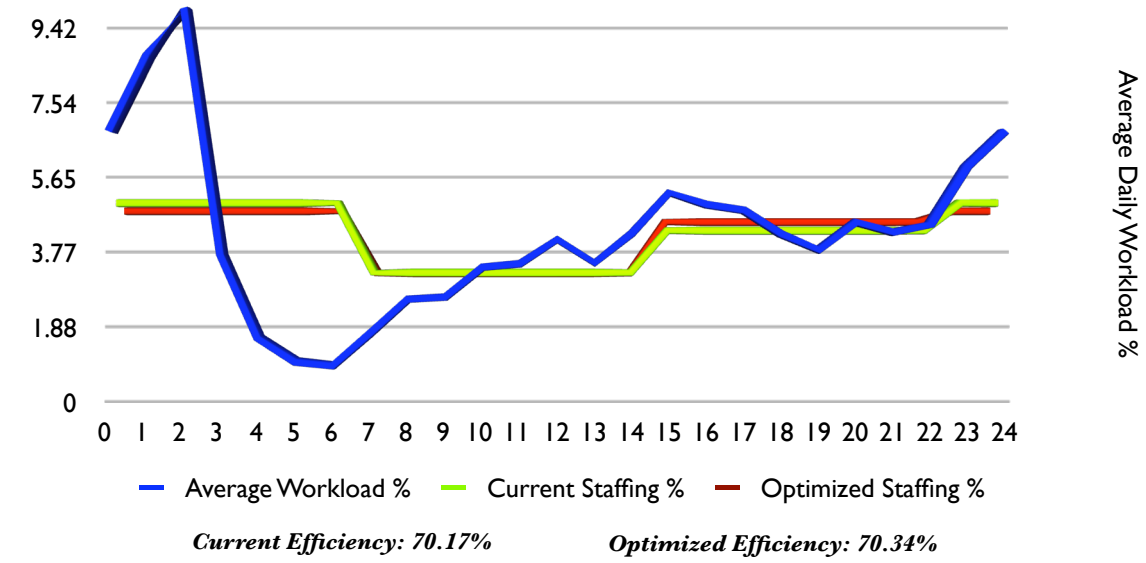
Chart 28. ***Average Daily Workload & Staffing by Hour of Day***



Current Efficiency: 66.19% ***Optimized Efficiency: 82.68%***

District 4: Central

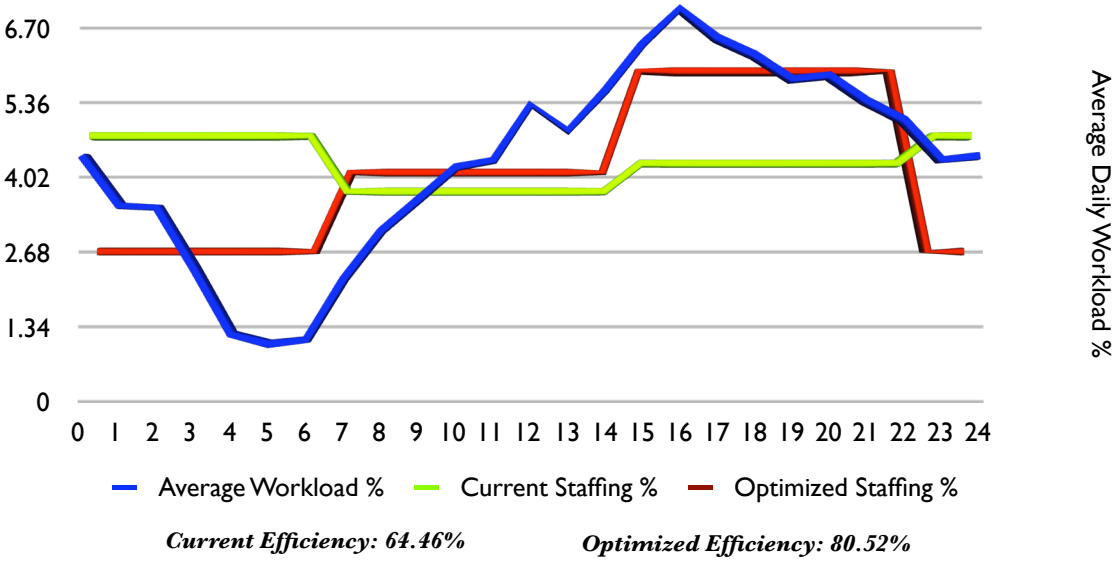
Chart 29. Average Daily Workload & Staffing by Hour of Day



Current Efficiency: 70.17% ***Optimized Efficiency: 70.34%***

District 5: North

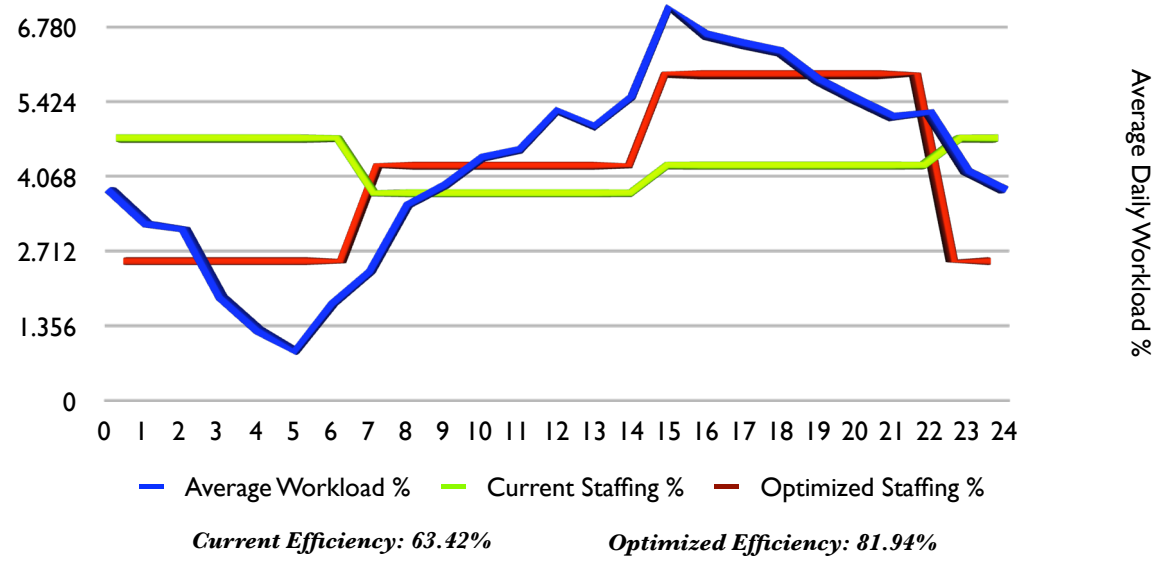
Chart 30. Average Daily Workload & Staffing by Hour of Day



Current Efficiency: 64.46% ***Optimized Efficiency: 80.52%***

District 6: East

Chart 31. Average Daily Workload & Staffing by Hour of Day



Current Efficiency: 63.42% ***Optimized Efficiency: 81.94%***

As stated earlier, this deployment alternative presents minimal change to the patrol division and causes the least amount of stress on the patrol officers involved due to family obligations and outside activities. However, the boundaries of the existing shifts have not changed and the 6-on-3-off duty cycle schedule still creates a lack of unity of command and team integrity. This change may be able to be incorporated at the next shift bid cycle without necessary modifications to contracts with employee unions or benevolent organizations. As the number of patrol officers change, the inputs to the "Madison Deployment" spreadsheet can be changed to reflect an updated proportional deployment plan for each district and detail. While this schedule creates significant increases in efficiencies for 4 of the 5 districts, it can be improved upon by using supplemental shifts.

Redeployment with current schedule and supplemental "power" shifts

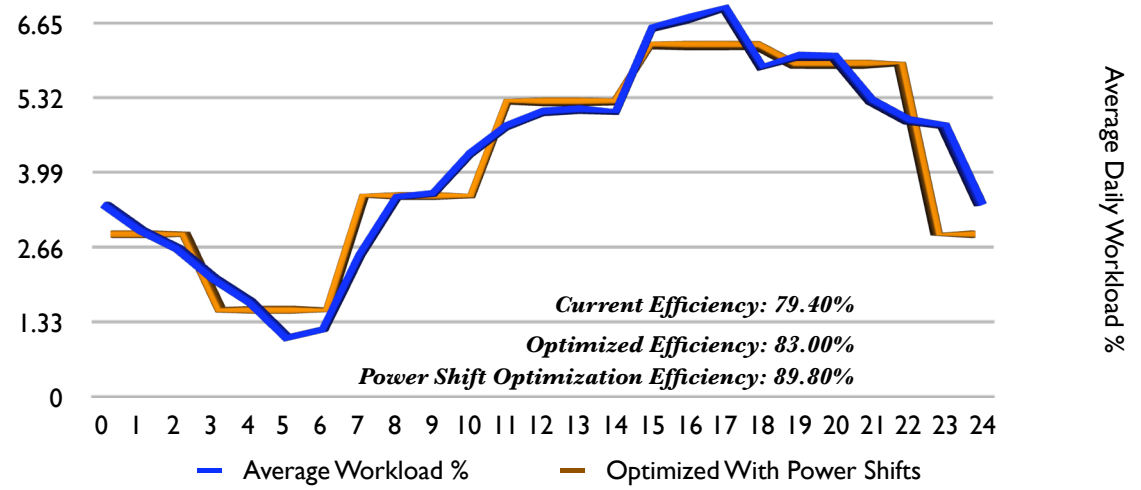
Matching a workload curve that changes from hour to hour with only three definitive shifts limits the agency's flexibility for scheduling. This problem is most prevalent on the 3rd detail in each district. A high call volume at 11 pm when the shift begins requires the agency to staff a large number of officers. By 3 am in most districts, the workload begins to dip to its lightest level for the entire 24 hour period, yet the shift remains heavily staffed. The greatest inefficiencies are usually found between the 2 am and 7 am hours for most agencies.

As seen from the previous workload and staffing charts, when an agency staffs a higher percentage of officers to workload during one time period, it must be accompanied somewhere else in the day with a period of a lower percentage of officers to workload. The ramifications of this overstaffing in the early morning hours is felt in the evenings between the hours of 1 pm and 11 pm when the patrol bureau is understaffed. An alternative to this is to staff the three traditional shifts with a lower percentage of officers and then use the remaining staff to create supplemental "power" shifts during times of peak activity. For times of high call volume that last for less than 8 hours, two power shifts can be overlapped. As the workload decreases in the early morning hours, the power shifts are ending their duty and the staffing reverts back to the 3rd detail officers only. This alternative provides greater scheduling flexibility for the agency without altering the current duty cycle schedule or shift length. This alternative impacts the starting and stopping times for those officers assigned to the power shifts but leaves the remaining officers unaffected. Additional supervisors will be required under this optimization plan since additional shifts are being created. Spanning one power shift over two traditional shifts without assigning a supervisor to the power shift leaves the officers in limbo without a dedicated supervisor or consistent communication from administration.

The following charts reflect an optimized deployment utilizing one or more power shifts in each district. The total staff in each district is consistent with the earlier optimization shown in Table 14. The efficiency scores of each optimized staffing curve is shown along with the starting and stopping times and the number of officers to be assigned to each of the shifts to be used in that district. Finally, a recommendation is offered for the number of supervisors in each district based on the optimized deployment.

District 1: West

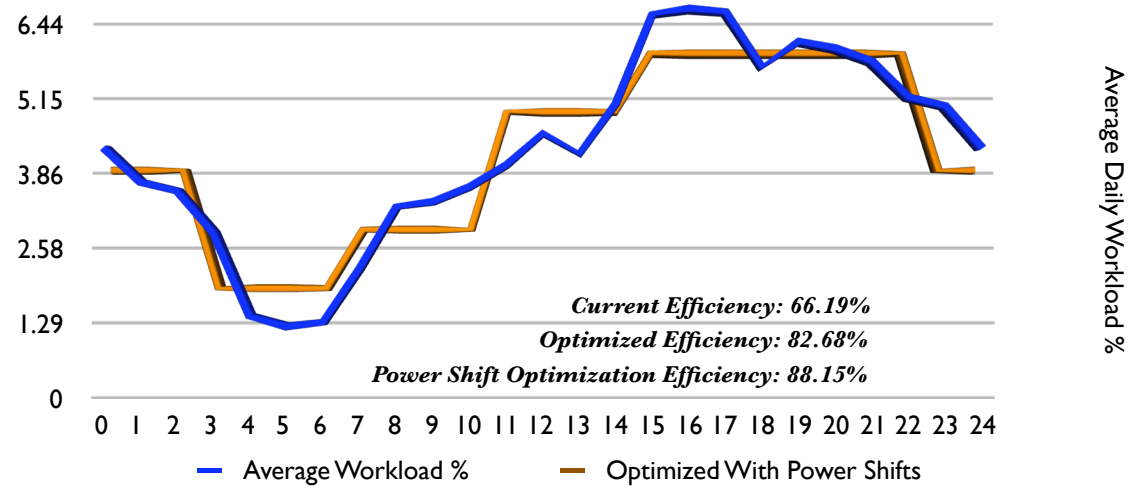
Chart 32. *Average Daily Workload & Staffing by Hour of Day*



Shift	*Hours*	*# Officers Assigned*	*# Sergeants Assigned*
Detail 1	7 am - 3 pm	11	2 (Red, Blue)
Early Power Shift	11 am - 7 pm	5	
Detail 2	3 pm - 11 pm	14	2 (Yellow, Red)
Late Power Shift	7 pm - 3 am	4	
Detail 3	11 pm - 7 am	5	2 (Yellow, Blue)

District 3: South

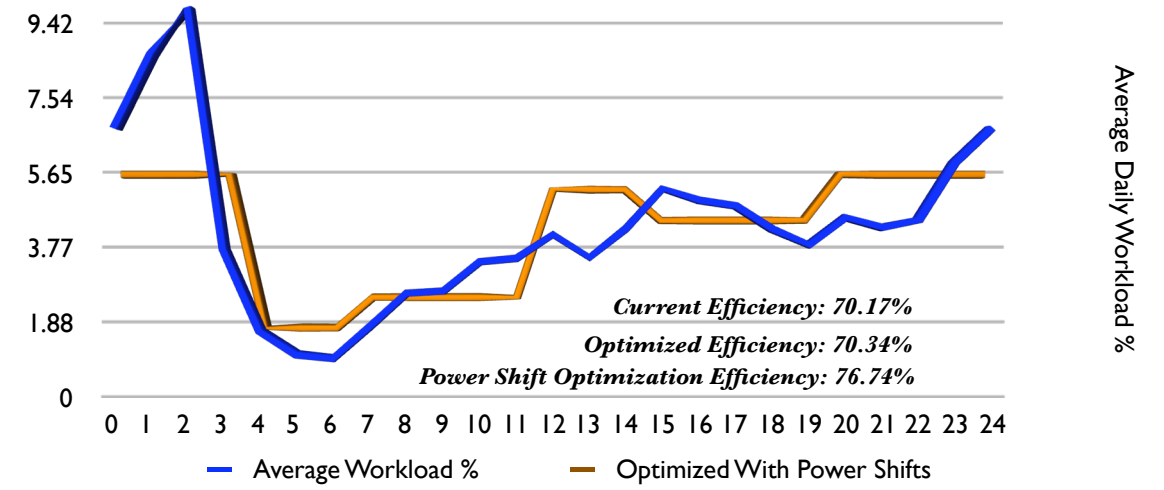
Chart 33. *Average Daily Workload & Staffing by Hour of Day*



Shift	*Hours*	*# Officers Assigned*	*# Sergeants Assigned*
Detail 1	7 am - 3 pm	6	1 (Yellow)
Early Power Shift	11 am - 7 pm	4	
Detail 2	3 pm - 11 pm	8	2 (Blue, Red)
Late Power Shift	7 pm - 3 am	4	
Detail 3	11 pm - 7 am	4	1 (Red)

District 4: Central

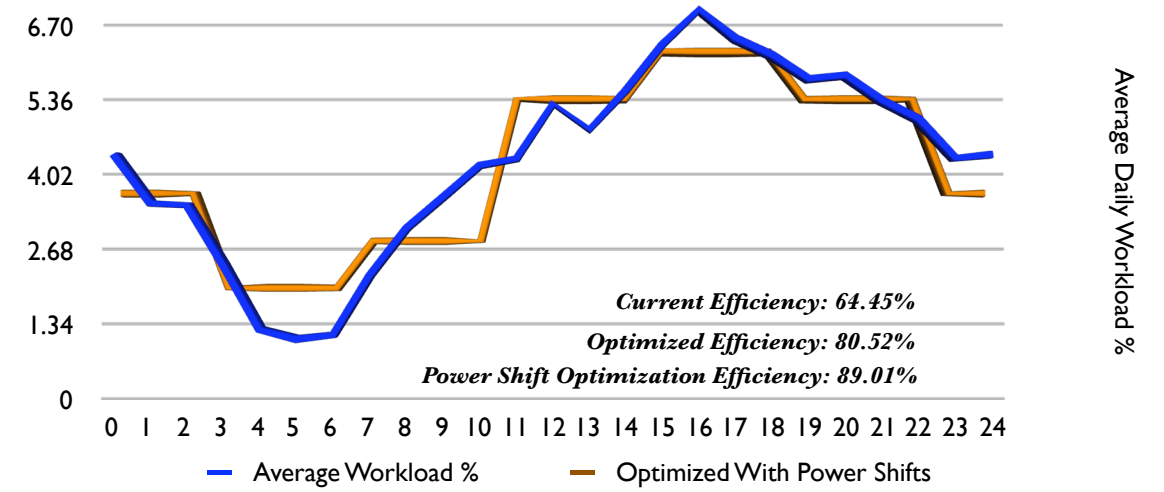
Chart 34. Average Daily Workload & Staffing by Hour of Day



Shift	*Hours*	*# Officers Assigned*	*# Sergeants Assigned*
Detail 1	7 am - 3 pm	7	2 (Red, Blue)
Early Power Shift	12 pm - 8 pm	7	
Detail 2	3 pm - 11 pm	5	2 (Yellow, Red)
Late Power Shift	8 pm - 4 am	10	
Detail 3	11 pm - 7 am	5	2 (Yellow, Blue)

District 5: North

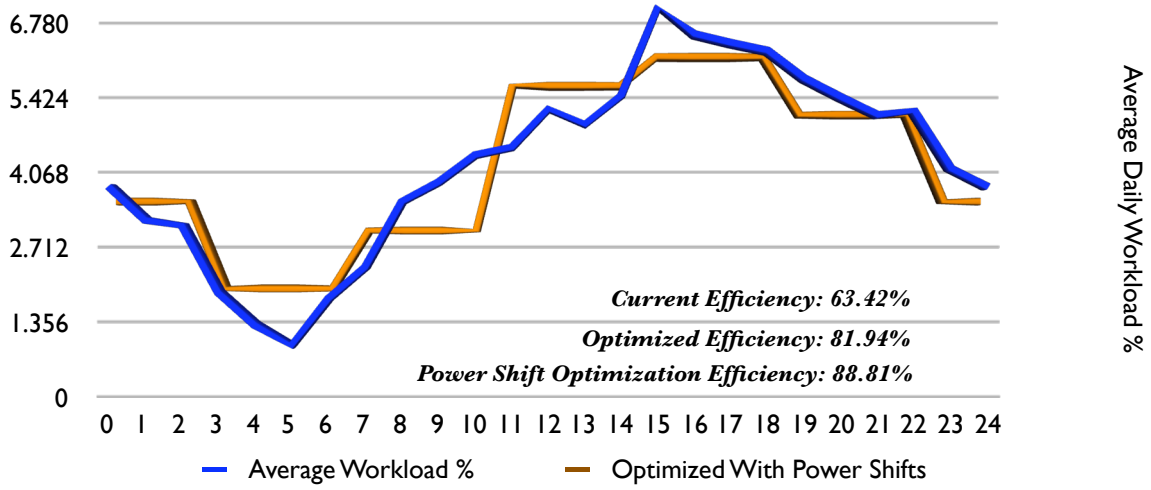
Chart 35. Average Daily Workload & Staffing by Hour of Day



Shift	*Hours*	*# Officers Assigned*	*# Sergeants Assigned*
Detail 1	7 am - 3 pm	7	2 (Red, Blue)
Early Power Shift	11 am - 7 pm	6	
Detail 2	3 pm - 11 pm	9	2 (Yellow, Blue)
Late Power Shift	7 pm - 3 am	4	
Detail 3	11 pm - 7 am	5	1 (Yellow)

District 6: East

Chart 36. ***Average Daily Workload & Staffing by Hour of Day***



Shift	*Hours*	*# Officers Assigned*	*# Sergeants Assigned*
Detail 1	7 am - 3 pm	6	1 (Yellow)
Early Power Shift	11 am - 7 pm	5	
Detail 2	3 pm - 11 pm	7	2 (Blue, Red)
Late Power Shift	7 pm - 3 am	3	
Detail 3	11 pm - 7 am	4	1 (Blue)

This deployment alternative provides a noticeably better match between the workload curve and the staffing curve in all districts except the Central district. The disadvantage to this deployment plan is the additional shifts that are created and the need for additional supervisors if unity of command is desired. All officers would still be working the 6-on-3-off schedule and an 8-hour workday. The lack of schedule equity still exists as before but now it is compounded by additional power shift officers added to the three traditional shifts.

As the number of patrol officers change, the inputs to the "Madison Deployment" spreadsheet can be changed to reflect an updated proportional deployment plan for each district and detail.

Alternative Schedule

The third deployment alternative is to transition to a different duty cycle schedule. The possibilities for this alternative are practically endless based on the desires of the agency and the needs of the officers who are actually working the schedule.

The agency could transition to a different duty cycle schedule such as a 4-on-2-off or a 5-on-2-off-5-on-3-off schedule, keeping the same shift length as they currently work, and experience practically no effect on the patrol bureau. The two alternatives have the same average work week as the existing 6-on-3-off and provide the same staffing percentages per day (1/3 off duty and 2/3 on duty per day).

The agency could transition to a fixed day off schedule such as the 5-on-2-off (8-hour shift) and the 4-on-3-off (10-hour shift) and gain greater flexibility in scheduling. Any team integrity that currently exists with the day off rotation system would be lost since there would be 7 combinations of possible days off instead of the existing 3. In addition, the agency would lose the existing schedule equity that exists with rotating schedules. Most senior officers would be eligible for every weekend off while those with less tenure would most likely be working every weekend.

Over the last few decades, a transition has been taking place across the country to "compressed shifts"; schedules that require fewer than 5 workdays per week on average. In a 2006 Police Foundation phone survey of 41 agencies with more than 200 officers, 37% were using 8-hr shifts, 39% were using 10-hr shifts, and 20% were using 12-hr shifts. The most popular compressed shifts are 10-hr, 11-hr, and 12-hr shifts. The most popular 10-hr shift is the 4-on-3-off fixed days off shift. One of the most popular 12-hr shifts is the 2-on-2-off-3-on-2-off-2on-3-off rotation shown in the chart below. This duty cycle schedule provides complete schedule equity and every officer gets every other weekend off. If the officers are scheduled in equal sized squads with two mirrored squads (one am and one pm) assigned each week, the agency will have equal staffing for every day of the week. Fatigue is minimized on this schedule by short on-duty periods of

Chart 37.

	Monday	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
Week 1			*OFF*	*OFF*			
Week 2	*OFF*	*OFF*			*OFF*	*OFF*	*OFF*

either 2 or three days. Two days of leave taken in the middle of the second week yields 7 consecutive days off.

Other 12-hour duty cycle schedules exist, such as the 4-on-3-off-3-on-4-off (Chart 38) that provide consistent days off and no schedule equity. A portion of the officers work Monday - Thursday followed by Monday - Wednesday while the other officers work Friday - Sunday and then Thursday - Sunday. One disadvantage of this schedule is the possible fatigue that night shift officers could experience on their fourth straight work day. Team integrity is obtained and uniform staffing is possible if four equal-sized squads are assigned.

Chart 38.

	Monday	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
Week 1					*OFF*	*OFF*	*OFF*
Week 2				*OFF*	*OFF*	*OFF*	*OFF*

Based on the current workload within the patrol division, a transition to 10-hr or 12-hr shifts would be best accomplished with a fixed day off duty pattern. Given the temporary workload spike on weekend mornings in District 4 and the short spikes seen in the early evenings in the remaining districts, it would be hard to create a 12-hr rotating shift that provides a highly efficient match to workload. Successful implementation of rotating 12-hr shifts would have to include multiple overlapping power shifts.

VI. Recommendations and Observations

The following recommendations and observations are based on a six-month study of the patrol bureau encompassing 4 years of call for service data and two years of officer availability data. All recommendations are based on either direct observations made during the site visits or from the data that was collected and analyzed. It is important to keep in mind that these recommendations and observations are data driven and do not necessarily encompass all possible quality of life issues for the officers or patrol objectives that may differ from a proportional distribution based on workload.

By deploying officers proportionally to calls for service, the outcome equalizes the reactive workload for the officers regardless of the district or detail they are assigned to. When their reactive time is equalized, their proactive time is also equalized. Therefore, while a proportional deployment can greatly enhance response times and patrol intervals, it does not necessarily mean that the recommendations made as a result of this report are going to be consistent with all objectives of the agency.

Data Collection Recommendations

This study has been the first step in the implementation of an overall process of resource allocation and deployment. Many data items that were required were either not in a usable format or had not been collected. The first set of recommendations relate to data collection methods that were currently in place at the start of this study. Some issues have been addressed already and some recommended actions remain.

1. ***Collection of Workload Data*** - At the present time, the CAD software and its accompanying RMS (Record Management System) is only capturing a portion of the workload that is actually being done by the patrol officers. There are a number of factors contributing to this lack of workload documentation.

   a) ***Dispatch Policies*** - Prior to this study, the dispatching policy was to create events in the CAD only for citizen generated calls for service or officer initiated activities that resulted in an arrest or report. The majority of proactive activities being performed by the patrol officers such as routine traffic enforcement, citizen meetings, field contacts, business checks, etc., were not being captured and were unavailable for use in determining necessary staffing. Administrative duties of a routine nature such as shift briefings, refueling the squad cars, checking e-mails, etc., were also not being captured in the CAD. This constitutes a large portion of an officer's time and all activities listed provide a service and a benefit to the community in furtherance of the police department's mission. Therefore, it is recommended that the dispatching policies be changed immediately to ensure that an accurate record is being created in the database for all activities that officers are performing.

   b) ***Officer Training*** - It is our assumption, absent detailed interviews with many patrol officers, that the majority of officers assigned to patrol focus mainly on the daily activities that are occurring around them. Keeping in close contact with the police dispatchers helps to maintain their safety, the safety of their fellow officers, and the safety of the general public. The overall administration of the police department is probably not foremost on their minds, understandably, as they are responding to calls and conducting self-initiated activities. However, the very work they are doing forms the basis of this resource allocation process that is being implemented. Any work that they are performing that is not being communicated to the dispatcher will not be entered into the CAD. Therefore, it is recommended that a series of roll-call training sessions be held with the officers to educate them on the resource allocation process that is being used. This does not have to be exhaustive of every detail, but specific enough that all officers fully understand why all activity needs to be called in to dispatch and how it should be called in. This may be best accomplished by a short video that could be played at roll-call for each shift and then archived for all new employees to review during their field training program.

c) ***CAD Code Review*** - While reviewing the CAD output during this study, there were a number of activities being performed by the officers that never appeared in the activity list. The majority of these activities were missing because they were either not called in to dispatch, or they were not entered into the CAD as an event. A third possible cause could be that certain activities being performed by patrol officers may not have specific CAD codes assigned to them, and therefore they are entered into the CAD under the next best alternative. It is unknown exactly how many types of activities fit this third possibility, if any, but it is recommended that a thorough review of the current CAD codes being conducted to determine if there are any "general" categories which are being filled by diverse activities. If this is occurring, the general codes need to be separated into more detailed codes and used as such. In addition, it is recommended that the officers and dispatchers be surveyed to determine if there are any activities being performed on the street that are routinely recorded under a different CAD code as a matter of past practice. If any exist, separate CAD codes should be created for them as well.

d) ***Report Writing Time*** - It is customary in every agency study that Etico has conducted, for patrol officers to delay writing police reports during times of peak activity in order to answer calls that may be pending. Once the activity level lessens, the officers complete any reports from earlier in the shift. This is an accepted practice and provides a better quality of service for the community. However, it does create difficulty in determining the average time required to complete a particular call for service. Since this process is based on call frequencies and the average time required for each call type, it is imperative that the total time required to fully complete a call by patrol officers is determined, including the time spent writing any reports. Therefore, it is recommended that a process be set in place to accurately capture all report writing times by the patrol officers, preferably by call type or case number, so that accurate average call times can be determined.

e) ***"Priority Calls Only" Documentation*** - It is the practice of the patrol division to initiate a call screening process during times of peak activity to ensure that officers will be available to handle the most serious calls that are occurring. This process was referred to with many titles such as "Emergency Calls Only", "Restricted Calls Only", and "Call Restrictions." The primary reference used was "Priority Calls Only" (PCO). Any patrol supervisor can make a request to the Officer In Charge (OIC) to have PCO initiated. If the OIC approves the request, an individual District will be placed on such status or the entire city will be placed under PCO status (it was reported that in most cases, the entire city is placed on PCO). During this time, the dispatch will only accept calls of violent crimes against persons, serious injury accidents, or forcible felonies. All other callers will be asked to call back at a later time. It is estimated by several individuals that PCO status typically lasts from two to six hours each time it is initiated. It was also estimated, through conversations with supervisors and Dispatch personnel, that PCO status is initiated as few as 4 times a month to as many as 20 times a month. Hypothetically, if 75% of the calls for service are screened out during PCO status, the dispatch center could be deferring as few as 900 calls per year, or a maximum of over 13,500 calls per year.

Our research team was unable to find any logs containing the names or phone numbers of the callers who were asked to call back after the PCO status had been lifted, nor were we able to find any logs of the duration or frequency of PCO events. Therefore, while we were aware that times of PCO had taken place throughout the year, we had no way of identifying how often it was initiated, when or where it was initiated, or how long the PCO status lasted. Furthermore, there is no way of knowing how many times a deferred caller made additional attempts to gain police service or how many gave up with dissatisfaction towards the level of service received. If the agency chooses to maintain the practice of "Priority Calls Only" after a redeployment of personnel, it is highly recommended that a reliable log be maintained in the OIC office and in dispatch of the exact times, locations, and duration of such status so it can be considered in future allocation and deployment plans.

Conversations with dispatchers and supervisors revealed that in some instances, PCO status has continued beyond its necessity due to oversight. At the present time, there is no visible or repetitive indicator given to the OIC to remind them that the agency is under PCO status. There is a possibility that under times of heavy activity in the OIC office, or when PCO extends across shift changes, that the OIC could forget that the PCO status is enacted and fail to clear from such status. One dispatcher interviewed stated that they do not feel they have the authority to remind the OIC that they are on PCO status. It is recommended that a method be implemented to provide a constant or repetitive reminder to the OIC during times of PCO status. This could be done by a phone call from dispatch every 30 minutes or by instituting a "dummy" unit in the CAD system that is logged into the system during times of PCO. The later method would also allow the agency to track the total time spent on PO status throughout the year, including exact dates and times.

f) ***"Injury and Blockage Only" Documentation*** - Similar to the PCO status just described, the agency also uses a call screening process during severe weather referred to as "Injury and Blockage Only" (IBO). During such times, which are predicated by weather conditions such as heavy snow or ice, callers involved in motor vehicle accidents are asked to exchange driver information and are redirected to a self-reporting process where they can file their report at a later time. Officers are only sent on accidents that involve serious injury or street blockage. The same issues of documentation and time keeping are present with

IBO as were seen with PCO. At this time, there are no logs being kept of callers nor are there logs of dates, times, and durations of IBO status. Therefore, it is recommended that a reliable log be maintained in the OIC office and in dispatch of the exact times, locations, and duration of such status so it can be considered in future allocation and deployment plans. Furthermore, it is recommended that a method be implemented to provide a constant or repetitive reminder to the OIC during times of IBO status.

2. ***Collection of Officer Availability Data -*** After working with a number of agencies in the past, the process used by MPD for tracking officer leave times and non -patrol time data appears to be a best practice in the industry. The capabilities of the Telestaff system, based on the functionality of the software, the way it has been implemented, and the ability of those in charge of the system to extract information, made this study much easier and assisted greatly in creating a reliable shift relief factor for the agency. It is highly recommended that the TeleStaff system be kept in place and that those in charge of maintaining the system in the future continue to be given the proper training and time to keep it in its present state of functionality.

Patrol Staffing Recommendations

Recommendations for patrol staffing are based on the available CAD data for the agency and the shift relief factor determined from the Telestaff system. It can never be overemphasized that this study and the subsequent report is the first step in a process of change for the MPD. The data that was to be used for this study was not expected to be perfect nor complete. In many conversations with department administrators, this process was compared metaphorically to agricultural initiatives in underdeveloped countries. The first several years of agricultural initiatives are designed to improve and condition the soil without expectation of a plentiful harvest. In the same way, this process begins with the identification of available data and the cultivation of additional data that is not currently in place. The final staffing numbers produced by this process in the first couple years are expected to be low estimates of necessary staff. As additional methods of capturing legitimate workload are developed and existing methods are improved, the number of officers needed for patrol, as indicated by this methodology, will increase. With that said, the following staffing recommendations are offered.

1. At the time of this study, there were 155 officers assigned to the patrol division. Based on the data collected, officers were spending an average of 32.5 minutes per hour on reactive time ($M_R = 32.5$) and the balance on proactive time. While this M_R level does not indicate severe understaffing, it does rank on the higher end of the recommended range for effective community policing. Given the emphasis placed on community policing within the City of Madison and the level of service that the agency attempts to provide to the citizens, it is recommended that the agency make every attempt to target an M_R value between 28 and 30 minutes per hour. To reduce the current M_R value to 30 minutes, the agency would have to add an additional 13 officers to the patrol division. To reach an M_R value of 28 minutes, the agency would have to add an additional 25 officers. Since it is known that the workload data is underestimated based on collection practices, it is recommended that the agency favor the M_R goal of 28 minutes.

2. While examining the current deployment of the agency across districts and shifts, the number of available sergeants on patrol came into question. At the current time, there are 25 sergeants assigned to patrol as first line supervisors. Although there is a lieutenant assigned to each district, the lieutenants fulfill more of a management role as opposed to a first line supervisory role. The current span of control is 6.2 officers per supervisor, an acceptable span of control based on averages from past studies. However, when viewed from a temporal perspective, and evaluating the ability to keep a supervisor on duty in each district at all times, the agency needs a minimum of two sergeants per detail, or a total of 30 sergeants. Under the current schedule, six out of every nine days the sergeants assigned to Detail 1 (day shift) in districts 3-6 are required to cover two districts. Likewise, three out of every nine days, Districts 3 and 6 must be covered by a neighboring sergeant while their assigned sergeant is on a regularly scheduled day off. This increases their span of control and reduces their ability to be present with officers on calls to perform their supervisory function. It also violates the concept of unity of command when a sergeant from a neighboring district is in charge. To enhance the agency's efforts at community policing and a decentralized structure, it is recommended that the agency attempt to gain consistent supervision across all districts and all details by adding an additional five sergeants to patrol.

Patrol Deployment Recommendations

The current deployment of officers within the Patrol Bureau is not consistent with the workload curve indicated by the CAD data. As shown in the various charts on pages 24 through 41, reassigning officers to the existing districts and details in proportion to the hours of workload generated in that district and detail would provide a significant improvement in the correlation between the workload curve and the staffing curve in four of the five districts. Furthermore, by adding two supplemental "power" shifts to each district, the correlation between staffing and workload is greater still. By implementing the power shifts, the number of officers between 3 am and 7 am is reduced to correlate with the lowest times of activity while peak times will enjoy additional staff.

At the present time, 12-hr rotating shifts are not recommended due to the variability of the workload curve by hour of the day and the variability of the workload curve in District 4 by day of the week. A 10-hr fixed day off schedule would work for the agency but it would not allow all officers the same opportunity for an occasional weekend off.

It is the recommendation of this research team that the agency remain with the 6-on-3-off schedule, for now, until the agency has been able to put better data collection methods in place. However, it is recommended that the agency implement the two power shifts per district indicated on pages 39-41 and reassign officers across the districts and details as indicated in Table 16. This recommendation should improve response times by staffing more officers when the workload is at its highest and reducing the subsequent stack times. The agency should also see a decrease in overtime by staffing the officers proportional to workload.

Observations Made During This Study

The process used by the MPD for dictating reports is intriguing. In the past 13 years of staffing studies and teaching law enforcement administrators, this approach to improving efficiency is rarely seen. Sine this study began, the process used by MPD has been mentioned in many Resource Allocation courses and has garnered great interest by a number of students as a unique way to reduce the workload on their patrol officers. The way in which MPD has structured their dictation system, allowing officers to call into a dictation server without the need for individual voice recorders or the constant transfer of tapes and/or files, makes this another best practice in the industry. While it did not contribute directly to this study, the time spent dictating reports by officers was made available to the research team. The average times spent by officers was considerably less than that required of officer who must type or hand write their own reports.

VII. Conclusion

It has been our pleasure working with the Madison Police Department over the last eight months as this study has progressed. We received great assistance from all members of the agency that we came in contact with and timely submission of necessary data. The agency held true to its ideals of progressive policing by open acceptance of new thoughts and ideas concerning shifts schedules and deployments.

One last time, it should be reiterated that this is the first step in a continual process of improvement. The process will continue to improve as additional workload is uncovered and methods are implemented for enhanced documentation. With multiple years of solid workload data, the agency may want to revisit the possibility of compressed shifts from time to time in keeping with the national trends in law enforcement staffing.

Undoubtably, questions will arise in the future as data collection methods are developed and improved. It is our hope that Etico Solutions will remain a trusted resource to address those questions and encourage your inquiries.

Appendix A:

Units included in the CAD database after Unit ID filtering

Executives
1101
1102
1103
1110

Captains
1201
1202
1203
1204
1205

Lieutenants
1206
1207
1208
1209
1210
1211
1212
1213

Sergeants
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247

Neighborhood Officers
A40
A41
A42
A43
A61
C40
C41
C42
C61
D40
D42
E40
E61
F40
F61

K-9 Officers
1290
1291
1292
1293
1481

Traffic Services
1301
1302
1303
1304
1305
1306
1307
1313
1314
1315
1317
1318
1319
1320
1321
1322
1323
1324
1340

Community Policing Teams
1602
1603
1604
1605
1610
1611
1612
1613
1614
1630
1631
1632
1633
1634
1641
1642
1643
1644
1645
1660
1661
1662
1663
1664
1665

Beat Units West
1A1
1A2
1A3
1A4
1A5
1A6
1A10
1A11
1A12
1A13
2A1
2A2
2A3
2A4
2A5
2A6
2A7
2A8
2A9
2A10
2A11
2A12
2A13
2A14
2A15
2A20
2A22
3A1
3A2
3A3
3A4
3A8
3A9
3A10
3A11
3A12
3A13
3A14
3A17
3A20

Beat Units South
1C1
1C2
1C3
1C4
1C5
1C10
1C11
1C12
1C13
1C14
1C20
1C21
1C22
1C23
1C24
2C1
2C2
2C3
2C4
2C5
2C6
2C10
2C11
2C12
2C13
2C14
2C15
2C16
3C1
3C2
3C3
3C4
3C10
3C11
3C12
3C13
3C20

Beat Units Central
1D3
1D4
1D7
1D8
1D10
1D11
1D12
1D13
1D20
1D21
1D22
1D23
1D24
1D25
1D54
2D1
2D3
2D5
2D6
2D7
2D8
2D10
2D11
2D12
2D13
2D14
2D16
2D17
2D18
2D19
2D20
2D21
2D54
2D55
2D95
3D1
3D3
3D4
3D5
3D6
3D7
3D8
3D10
3D11
3D12
3D13
3D14
3D15
3D16
3D18
3D19
3D20
3D21
3D22
3D95

Beat Units North
1E1
1E2
1E3
1E4
1E10
1E11
1E12
1E13
1E20
1E21
1E22
1E23
2E1
2E2
2E3
2E4
2E5
2E6
2E10
2E11
2E12
2E13
2E14
3E1
3E2
3E3
3E4
3E5
3E10
3E11
3E12
3E13

Beat Units East
1F1
1F2
1F3
1F4
1F10
1F11
1F12
1F13
1F14
1F15
2F1
2F2
2F3
2F4
2F5
2F10
2F11
2F12
2F13
2F15
3F1
3F2
3F3
3F4
3F10
3F11
3F12
3F13
3F14
3F15

Appendix B.

Patrol Incident Categories and Frequencies for 2003 through 2007

Incident Type	2003	2004	2005	2006	2007
911 Disconnect	4277	4230	3868	4596	4504
Accident - Hit & Run	1716	1764	1521	1179	1277
Accident - Private Property	803	756	728	646	783
Accident - Property Damage	4519	4417	4519	3400	4385
Accident w/ Injuries	1266	1325	1258	983	1222
Accident-Citizen Report	8	2	6	10	18
Accident-MV/Deer	49	44	35	32	28
Adult Arrest	1407	1177	1114	961	1107
Aggravated Battery	353	359	343	355	356
Alarm	4672	4494	4250	4457	1578
Animal Complaint - Bite	29	32	19	23	23
Animal Complaint - Disturbance	687	660	730	791	812
Animal Complaint - Stray	410	447	541	467	348
Annoying/Obscene Phone Calls	792	668	568	570	560
Arrested Juvenile	79	60	42	56	46
Arson	106	76	53	64	65
Assist Citizen	2944	2799	2654	2848	3279
Assist Fire/Police	2748	2719	2583	2309	2279
ASSIST K9	0	0	0	4	18
Attempt to Locate Person	308	401	481	365	338
Attempted Murder	0	1	0	0	0
Attempted Suicide	135	130	120	124	127
Battery	1440	1400	1403	1370	1435
Bicycle Accident	5	6	4	1	2
Bomb Threat	23	24	18	25	26
Check Parking Postings	0	0	0	5	0
Check Person	5744	5968	5866	5900	6267
Check Property	4810	4358	4169	4375	4316
Child Abuse	127	126	123	117	135
Child Neglect	76	65	76	72	51
Civil Dispute	293	350	397	444	452
Damaged Property Complaint	1989	1821	1619	1539	1598
Death Inv/Suicide	194	189	192	171	195
Disturbance Call	4125	4344	4312	4447	5203
Domestic/Family Trouble	3075	3422	3525	3427	3600
Drug Incident	960	997	1147	1105	1064
Emergency	5	1	6	1	1
EMS Assist	522	723	980	960	990
Enticement/Kidnapping	17	33	37	32	44
Escort Conveyance	329	297	294	291	327
Exposure	44	102	91	136	191
Extortion	0	4	4	2	1
FALSE ALARM	0	0	0	0	469
Fight Call	611	754	767	730	749
Fire Investigation	42	35	51	32	40
Forgery	137	120	129	118	88
Found Person	40	33	37	45	34
Found Property	1028	1061	1084	973	981
Fraud	829	962	1019	1057	1027
Graffiti Complaint	176	125	414	397	295
HANG UP OF 911 CALL	1	1	0	0	0
Homicide	6	3	4	4	7
ICE RESCUE	1	6	1	1	0
Information	5771	5942	5671	5455	5232
Injured Person	110	119	87	89	69
Intoxicated Person	764	450	444	421	494
Juvenile Complaint	2012	1930	1835	1657	1631
Landlord Tennant Trouble	165	142	145	168	164
Liquor Law Investigation	557	682	701	718	956
LIQUOR LAW/BAR CHECK/OTHER	0	0	0	34	144
Local Ordinance Violation	0	0	0	0	5
Lost Property	110	101	105	98	103
Miscellaneous Sex Offense	56	13	8	8	10
Missing Adult	131	178	250	223	250
Missing Juvenile/Runaway	852	1013	1038	817	845
Neighbor Trouble	530	529	501	462	434
Noise Complaint	4842	4615	4400	4244	4108
Non-Residential Burglary	428	298	390	544	753
NON-URGENT NOTIFICATIONS	52	68	42	50	56
Odor/Smoke Complaint	6	4	4	7	5

Patrol Incident Categories and Frequencies for 2003 through 2007 (Continued)

OMVWI Arrest/Intoxicated Driver	304	437	379	393	383
On Street Parking Complaint	563	462	486	515	530
Overdose Investigation	108	102	121	113	111
PARKING STREET STORAGE	0	0	3	10	17
PC Conveyance/Commitment (Chptr 51)	1312	1659	1647	1546	1509
Person Down	116	122	102	103	103
Person with a Gun	23	19	35	46	26
PHONE CALL	61	142	220	340	239
PNB/AED Response	22	40	64	37	53
Preserve the Peace	865	755	891	829	856
Private Property Parking Complaint	1166	1081	1125	1064	972
PROBLEM SOLVING-PERSON	0	0	0	0	4
PROBLEM SOLVING-PROPERTY	0	0	0	0	1
Prostitution/Soliciting	60	103	117	94	132
Prowler Complaint	185	135	105	136	81
Rec/Stolen Outside Agency	90	78	113	121	172
REPOSSESSION	8	6	7	14	14
Residential Burglary	1227	1206	1213	1212	1453
Retail Theft	1790	1862	1988	1890	2388
Robbery-Armed	158	126	164	196	169
Robbery-Strong Armed	140	170	165	183	191
Safety Hazard	1139	1320	1348	1427	1758
Serving Legal Papers	260	240	334	316	336
Sexual Assault 1-2-3-4-/Rape	157	178	190	164	169
Sexual Assault of a Child	68	128	124	108	91
SIGNIFICANT EXPOSURE (OFFICER)	0	3	7	3	0
Silent Case Number	23	16	9	23	32
Solicitors Complaint	16	26	30	25	15
Special Event	11	5	5	9	6
Stalking Complaint	92	130	122	105	104
Stolen Auto	748	738	783	694	767
Stolen Bike	67	55	73	64	69
Stolen Other Vehicle/Cycle	161	146	193	82	76
Suspicious Person	2039	1804	1876	1843	1909
Suspicious Vehicle	1198	1126	1141	1177	1342
Theft	2157	1655	1711	1665	1722
Theft from Auto	567	640	732	622	557
Threats Complaint	984	950	975	1028	1038
Towed Veh/Abandonment	34	31	7	5	8
Towed Vehicle	216	227	262	168	209
Traffic Arrest	759	1132	1073	889	880
TRAFFIC COMPLAINT	0	0	0	0	1
Traffic Incident	872	666	736	962	816
Traffic Incident/Road Rage	78	73	88	83	76
Trespassing Complaint	593	724	852	840	990
UNKNOWN	19	14	8	19	18
Unwanted Person	1109	1194	1291	1286	1408
Violation of Court Order	520	676	834	850	927
Weapons Offense	256	264	333	326	307
Worthless Check	32	45	33	25	9
	92742	92704	92945	90673	93044

[1] Madison, Wisconsin (WI) Detailed Profile. Retrieved May 30, 2008 from the World Wide Web: http://www.city-data.com/city/Madison-Wisconsin.html

[2] U.S. Department of Justice Federal Bureau of Investigation. Crime in the United States 2005; Retrieved June 22, 2007 from the World Wide Web: http://www.fbi.gov/ucr/05cius/police/index.html