THE UNBENDING BLUE LINE: TRANSFORMATIONAL CHANGE IN POLICE ORGANIZATIONS WITH A CASE STUDY OF A WEST COAST CITY POLICE DEPARTMENT PATROL DEPLOYMENT

by

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ABSTRACT

In practice, many police organizations have been slow to adopt real and meaningful change grounded in a sound analysis of current procedures. More often than not, based on routine and lacking any meaningful measures, police organizations are loath to modify their practices, despite an organizational need to make the best use of existing resources. By using data from the Vancouver Police Department, this thesis assesses whether organizational impediments, systemic inefficiencies and a reluctance to employ evidence-based practices identified in police organizational literature, were prevalent in the deployment and scheduling of patrol officers in a metropolitan centre. Utilizing techniques and constructs identified as best practices in evaluative research, the deployment model of the Vancouver Police Department was analyzed in terms of whether it was achieving the most effective and efficient use of their resources. The specific findings of this research indicate that until recently, there was considerable room for improvement in the manner in which the Vancouver Police Department deployed patrol resources. The findings of this study illustrate the larger problems inherent to many police organizations in general and how the adoption of evidence-based practices, grounded in empirical research, can result in greater efficiencies. By examining how police agencies, such as the Vancouver Police Department, deploy and use their resources, and how the Department developed the capacity to assess its effectiveness and efficiency,
recommendations can be developed that challenge outmoded policies and encourage the adoption of clearly defined and progressive organizational objectives.

**Keywords:** Police, Patrol Deployment, Efficiency, Change Management.
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QUOTATION

Five monkeys were placed in a cage. A banana was hung on a string and a ladder was placed below it. Each time one of the monkeys started climbing the ladder, all the monkeys were sprayed with a blast of cold water. This experiment was repeated for several days. Then each of the original monkeys was replaced with a new one. The experimenter did not need to spray the new monkeys because, as soon as any new monkey proceeded towards the ladder, all the other monkeys attacked it simply for the fear of being sprayed.

Finally, all the original monkeys were replaced with new monkeys that had never been sprayed; yet all the monkeys attacked any monkey that dared climb the ladder. Now you may ask why those monkeys that had never been sprayed would attack their fellow monkeys without any rationale for their acts? The monkeys were just following the policy laid down for them. They had no clue as to the origin of the policy.¹

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# Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>At Scene Time</strong></td>
<td>The time when a police unit arrives at a call for service.</td>
</tr>
<tr>
<td><strong>Available Unit Minutes</strong></td>
<td>The total number of minutes that a patrol officer is available for work. This is a key indicator of patrol resources available to respond to calls within each hour interval.</td>
</tr>
<tr>
<td><strong>CAD</strong></td>
<td>Computer Aided Dispatch. The computer system used to track and manage calls for police attendance.</td>
</tr>
<tr>
<td><strong>Call for Service</strong></td>
<td>A call to the Emergency Communication Centre through the 911 call system requesting police attendance at a location.</td>
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<tr>
<td><strong>Call Stacking</strong></td>
<td>A situation where there are emergency calls requiring police attendance waiting in a queue to be dispatched, but there are no police units available to respond to the call.</td>
</tr>
<tr>
<td><strong>CET / BET</strong></td>
<td>The City-wide Enforcement Team, which was renamed to the Beat Enforcement Team. Both terms are used synonymously for the same unit that operates in the Downtown Eastside.</td>
</tr>
<tr>
<td><strong>Clear Time</strong></td>
<td>The time when a police unit completes a call and is available to attend another call for service. Also termed in-service time.</td>
</tr>
<tr>
<td><strong>Consumed Unit Minute</strong></td>
<td>The total number of minutes in the period from when the unit is dispatched to a call until the unit is cleared and available to take another call.</td>
</tr>
<tr>
<td><strong>Dispatch Time</strong></td>
<td>The time when a call is dispatched to an available police unit to attend a call for service. Factors such as units unavailable to take a call can account for the difference between when a call is initially received and when it is dispatched.</td>
</tr>
<tr>
<td><strong>E-Comm</strong></td>
<td>Emergency Communication Centre. The regional dispatch centre and location for all regional police records systems.</td>
</tr>
<tr>
<td><strong>Extended Tour</strong></td>
<td>Overtime used when a shift ends to address unfinished business that cannot wait for another shift to assume responsibility.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
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</tr>
<tr>
<td>In-Service Time</td>
<td>The time when a police unit completes a call and is available to attend another call for service. Also termed clear time.</td>
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<tr>
<td>Licensed Premises</td>
<td>Cabarets, bars, nightclubs, restaurant bars, pubs and lounges that are licensed to serve alcohol.</td>
</tr>
<tr>
<td>Minimum Staffing</td>
<td>The minimum number of officers that a patrol team can deploy for duty based on safety and collective agreement standards.</td>
</tr>
<tr>
<td>MPP</td>
<td>Managing Patrol Performance</td>
</tr>
<tr>
<td>NCO</td>
<td>Non-commissioned officer. A police team supervisor usually of the rank of sergeant.</td>
</tr>
<tr>
<td>OT</td>
<td>Overtime hours. Time worked by officers outside of their scheduled shift.</td>
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<tr>
<td>PAM</td>
<td>Police Allocation Manual</td>
</tr>
<tr>
<td>PCAM</td>
<td>Patrol Car Allocation Model</td>
</tr>
<tr>
<td>Planned OT</td>
<td>Overtime that is anticipated and scheduled in advance of a shift deployment. Planned overtime is usually used to address vacancies due to leave and illness when there is insufficient officers to meet minimum staffing.</td>
</tr>
<tr>
<td>PRIME</td>
<td>Police Records Information Management System, which is also termed an RMS system.</td>
</tr>
<tr>
<td>Priority 1</td>
<td>The most serious emergency call that police respond to. Typically involves a life threatening situation requiring immediate police attendance.</td>
</tr>
<tr>
<td>Queueing Delay</td>
<td>The time between when an emergency 911 call is identified as requiring a police response and the time when a police unit is available to respond to the call.</td>
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<tr>
<td>Received Time</td>
<td>The time when a call is initially received by the E-Comm 911 dispatch centre.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Response Time</td>
<td>A calculated value on the difference between when a call is received at the 911 dispatch centre and when a unit arrives at the call for service.</td>
</tr>
<tr>
<td>RMS</td>
<td>Records Management System, also termed PRIME. The central repository of all police records.</td>
</tr>
<tr>
<td>Service Time</td>
<td>A calculated value of the difference between clear time and dispatch time. Also termed consumed minutes.</td>
</tr>
<tr>
<td>SQL Server</td>
<td>Vancouver Police extract of the E-Comm RMS and CAD records.</td>
</tr>
<tr>
<td>Total Time Deployed</td>
<td>A calculated value based on the difference between when an office logs into RMS at the beginning of shift and the time the officer logs out of the system at end of shift.</td>
</tr>
<tr>
<td>Unavailability Factor</td>
<td>Accounts for one, 60 minute meal break and two, 15 minute rest breaks during an 11 hour shift that render a unit unavailable to attend calls.</td>
</tr>
<tr>
<td>Unit</td>
<td>A police patrol unit comprised of one or two officers. A unit can be vehicle or foot patrol based.</td>
</tr>
<tr>
<td>Unit Utilization Rate</td>
<td>The percent of the available time consumed by calls for service (calculated as: consumed patrol unit-minutes/available patrol unit-minutes).</td>
</tr>
<tr>
<td>COV</td>
<td>City of Vancouver</td>
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<tr>
<td>VPD</td>
<td>Vancouver Police Department</td>
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1. INTRODUCTION

1.1 Overview

Since the creation of the first metropolitan police department by Sir Robert Peel in London England in 1828, the debate has persisted as to determining the right deployment and allocation of police officers within a city environment. Two key questions arise when examining this issue. First, which shift model best meets the demands for service placed on patrol officers? Second, how many officers are needed to staff this model in order to meet demands of service? Once these factors have been determined, the more pressing challenge for most police organizations is to implement real and meaningful change. Unlike private sector organizations, where change is a normal course of doing business in a competitive market place, police organizations typically resist change and any external influences to the way they conduct their operations (Bayley, 1998; Berkshire, 2004; Rosenbaum, 2006). In some respects, the mechanics of determining resource efficiency is secondary compared to an assessment of an agency’s ability to evaluate its own operations using evidence-based practices. More telling, is the manner in which an agency reacts to attempts at reform-based evaluations and the action it takes with the information once obtained.

There are rare instances where empirical-based evaluative practices are mandated as part of an external audit, or some other imposed process to assess
the effectiveness and efficiency of an entrenched police practice. The results are often indicative of whether the organization bases its operational decisions on an evaluative framework that uses a measurable criterion to assess outcomes (Bellmio, 2004; Berkshire, 2004; Mazerolle, 2002, Sullivan, 2002; UWUCPS, 2004). Those that do not, are clearly identified by the extent of inefficiency noted and the absence of internal processes and management strategies that support the overall goals and objectives of the organization. Before delving into the characteristics of police organizational dynamics and the challenges to effecting reform, a brief exploration of police operations and patrol deployment will help frame the discussion.

Police patrol is regarded as the core responsibility of police departments, consuming 60% to 80% of a department’s resources (Loveday, 1998). It is the most important and visible operation of a department and is typically associated to the emergency response to life threatening incidents. Patrol answers calls such as 911, delivers service to the community and to some degree, prevents crime. It is one of the more demanding jobs in a department, as every patrol officer must be a generalist, meaning to be all things to all people. Past studies have found that patrol officers only spend approximately 10% of their police activity actually performing law enforcement duties (Krajick, 1978). Depending on the department, patrol typically involves spending 15% to 30% of their time responding to calls and the remaining time doing community policing, problem oriented policing projects and general crime prevention patrol (Bellmio, 2004;
Historically, police agencies have used various measures to justify, in a rational way, their need for additional funding and an increase in the number of officers. The effort was usually based on some measure of workload, including but not limited to, new and additional responsibilities assumed by the agency. Increased responsibility and administrative duties imposed by the courts have been used as arguments for additional funding. As well, police services selected other indicators of productivity and workload, often utilizing figures for calls for service, crime rates, traffic accidents, response times and special events (Bayley, 1998; Mazerolle, 2002, Sullivan, 2001). Despite the fact that sound data analysis could potentially influence funding decisions and the allocation of officers within patrol, the arguments and justifications have often been mitigated by the quality of the analysis and type of measures used; typically hampered by the use of poor indicators of workload (Greene, 1986; Sullivan, 2001).

Intrinsic to any examination of organizational change and reform is the question of maximizing efficiency while reducing costs. In a sense, the degree of efficiency and the effectiveness of a police service are directly related to the core capacity of the organization to facilitate meaningful change and evaluate its own operations using evidence-based practices. When this evaluative approach is applied to the largest concentration of resources within a police service, namely patrol operations, a very revealing representation of the entire organization develops. Those police services that apply sound strategies that support patrol
meeting its objectives and goals will apply these principles throughout the organization and embrace a reform agenda. By examining reform and progressive management practices, as observed in the efficiency of patrol deployment, a comprehensive representation of the entire organization takes shape. Innovative techniques and approaches aimed at making the best use of existing resources and retaining highly skilled officers within patrol are characteristics of reform-based practices that support the overall efficiency of the police service.

In contrast, there are many entrenched inefficient practices that permeate throughout police services, serving to reinforce the status quo and thwarting the adoption of innovative strategies and solutions. For example, one of the key justifications police departments use for obtaining additional resources is the perception that patrol is understaffed. Interestingly, the growth of specialized units and professional investigation sections, such as highly regarded homicide squads, has probably contributed to this predicament (Berkshire, 2004; Broom, 2004; Jones, 1980; NWUCPS, 2004). The increase in specialized units has seen a gradual exodus from most police departments patrol areas. In his study of police staffing of patrol, Jones discovered that the shortage of staff, of which police services had complained for years, only applied to uniform patrol divisions (Jones, 1980; Loveday, 1998; Martin, 1969; NWUCPS, 2004). Jones found that while there was always insufficient staff for patrol activity, there rarely appeared to be a shortage of officers for the more prestigious postings. The growth in
specialized units therefore undermined the police ability to sustain uniform police patrol response (Jones, 1980; Loveday, 1998).

Shift modelling, a sophisticated method for analyzing current and predicted resource usage, is one technique used to determine how an organization can maximize the use of existing resources (Bellmio, 2004; NWUCPS, 2004; Sullivan, 2001). Similarly, the same techniques and methods can be used to measure and evaluate the level of efficiency, or lack of, that exists within the current business model. A highly efficient shift schedule will allocate officers to those days and times requiring the most resources. Conversely, times of low calls for service require fewer officers and therefore an efficient shift model will adjust deployment accordingly. It is also worth noting that creating a workable shift model involves looking beyond mere efficiency and taking into account issues such as progressive internal processes, supportive business practices, organizational learning based assessments and long-term sustainability, to name a few.

While shift modelling and an analysis of existing patrol deployment can have a beneficial effect on an organization by identifying more efficient models and staffing deployments, few police organizations engage in this practice. The reasons are complex and intricate, and include resistance to change, lack of technical understanding and expertise, limited strategic planning and the absence of oversight and review to ensure accountability in the way resources are utilized (Bellmio, 2004; Sullivan, 2001; Tan et al., 2001).
In the following study, the core capacities to facilitate change management within the policing milieu are examined and then applied to a review of the deployment of patrol officers in Vancouver Police Department (termed VPD). The analysis of the VPD patrol deployment has two distinct objectives. First, to identify existing inefficiencies and impediments to the most effective use of current patrol resources. This includes correcting for any shortcomings by illustrating a modified shift deployment model that is optimized for efficiency and makes the best use of resources. The optimized deployment model demonstrates how empirical-based evaluations and the use of other innovative techniques can maximize organizational efficiency. Second, to examine some of the organizational causes as to why patrol operations were not evaluated at regular intervals, policy decisions and business practices that have contributed to the current issues in patrol, and the reluctance to adopt empirical-based evaluative practices. It is asserted that the research findings of this multifaceted evaluation and analysis approach are illustrative of the larger problems inherent to many police organizations. Furthermore, the adoption of evidence-based practices, grounded in empirical research, particularly those highlighted and employed in this project, could result in substantial efficiency gains by progressive police services. The study is organized into seven distinct chapters.

The Change and Reform in Police Service Chapter Two, outlines both police and academic research conducted on the topic of change management and organizational reform in police services. Other progressive approaches to police management are discussed, including *organizational learning* as it relates...
to police services relying on evaluative research to help guide and develop strategic plans and capitalize on successful initiatives. Conversely, impediments to change are also scrutinized, with special attention given to those practices that prevent many organizations from moving forward.

Patrol Deployment: The Literature Chapter Three examines how past research on police services have attempted to measure efficiency, with a particular focus on how patrol operations have been evaluated and which evaluative tools were most effective. Conversely, those tools that have been criticized in the academic literature as being overly simplistic and inadequate were also reviewed. Given the wide-range of approaches and measurements of organizational efficiency, this chapter also explored the more innovative management strategies for leveraging resources and those methods that are considered best practices in the field of policing.

The Organizational and Operational Structure of the Vancouver Police Department Chapter Four, provides a framework from which the case-study analysis takes place. Details of the Vancouver Police Department organizational structure and the milieu in which it provides services to the community are detailed. This section also looks at how the VPD currently addresses crime control issues with the current deployment configuration and special consideration for diverse areas of the city. It is also noted that in the years subsequent to those covered by the data set (2000-2005), the VPD has developed significant capacities to assess the effectiveness and efficiency of how patrol resources are deployed.
In the Method Chapter Five, the data gathered for the project are identified, as well as the analysis conducted. Specifics are provided on how the data were collected and analyzed, including the statistical and modelling techniques employed. The array of data required to conduct an analysis of patrol deployment is defined in this section, as are the techniques used to analyze and interpret the findings.

The Findings Chapter Six details the outcome of the analysis organized by patrol district and by the overall city. The variables explored range from overtime to patrol resource usage.

Chapter Seven, reviews the findings within the context of the police organization and interpret the results, factoring in past research and objectives of the analysis. Based on this analysis, a practical alternative to the current patrol deployment model is developed, with a case example of an optimized model presented. The optimized model is premised on balancing organizational change and maximizing efficiency with the resulting improvements examined in detail. Beyond the pragmatics of shift modelling, Chapter Seven also examines potential changes to organizational practices that can significantly influence productivity. This incorporates an exploration of the trend towards specialized units that may have a negative influence on patrol deployment, but also addresses more widespread problems with how organizations respond and adapt to change. A general resistance to adopting evidence-based evaluative practices is shown to hinder the development of improved strategies aimed at maximizing patrol effectiveness.
The final chapter of the thesis reviews the major findings of the study, sets out the limitations of the project and contains a discussion of the policy implications of the findings. In concert with the limitations of the research is an open-ended invitation for future research and the direction that it may take. The possible policy implications of the research are also discussed, as it pertains to changes in police planning and development. It brings together the case study of the VPD patrol deployment, specifically examining how the VPD experience corroborates the literature on police change and evaluative practices. In particularly, the ad hoc methodology in which processes are established and maintained, such as the manner in which the VPD deployed its patrol resources in the years prior to 2006, lends credence to prior research that found police simply implemented strategies without proper analysis or evaluative processes in place. As well, it illustrates some of the systemic issues and organizational dynamics facing police organizations attempting to bring about transformational change. In some instances, this requires an agency to completely redefine its organizational priorities, establish clearly articulated strategic goals and objectives, and a commitment to adopting a culture of change.
2. CHANGE AND REFORM IN POLICE SERVICES

The primary objective of this project is to examine the processes and mechanisms that affect organizational change within a police agency. The following literature review examines a range of factors that contribute to police organizations lacking progressive management practices. Factors such as core capacities that would facilitate change management, and an ability to assess effectiveness and efficiency on an ongoing basis, using evidence-based evaluative processes, are identified as essential to organizational reform. On the other hand, factors and influences that contribute to a police service maintaining the status quo and failing to embrace change are also identified. The study of these issues is necessary for the subsequent analysis and evaluation of the Vancouver Police Departments’ patrol operations for the period of 2000 to 2005. Patrol operations account for the majority of activity that a police service engages in and is the most important function a police service provides. The manner in which this critical service is managed and deployed is indicative of organizational practices and overall efficiency. An analysis of the efficiency and effectiveness of patrol operations provides firsthand insight into whether one particular police service, in the years prior to 2006, embraced progressive management practices and whether it based its decisions on evidence-based processes.

However, for the purposes of this thesis, this chapter will first review the research and literature on organizational change and reform. This incorporates
topics such as police culture, organizational learning, specialization and challenges to implementing organizational change. The review will also examine internal resistance and organizational impediments that police services have traditionally encountered when faced with challenges to entrenched structures and attempts to bring about real and meaningful change. For instance, a lack of fiscal accountability and an ability to leverage public sympathy, including appealing for more staff to solve efficiency issues, have helped ensure these arrangements have remained ingrained. As this represents the realities of many police organizations, it is important to contextualize the environment before considering the more pragmatic elements of patrol deployment research in the subsequent chapter.

2.1 Police and Change

Descriptions of police culture from an outsider perspective often use words like order, conservatism, and reluctance to change (Reiner, 1992; Sullivan, 2001). Many observers have argued that the police are, “reluctant to contemplate innovation, experimentation or research” (Malesan, 2004, p.5) and the barriers to change include, “a machine bureaucracy with entrenched structures and culture not ordinarily conducive to learning and adaptation” (Tan et al., 2001, p.362).

While no single description of culture, mores and structure can be universally applied to every police organization, police services do share a number of common attributes. The goals, priorities, management style and strategic focus of an organization will have a direct bearing on the manner in
which it views and embraces change. Police departments, are by their very structure, para-military organizations. As such, they are based on an established chain of command, hierarchical decision making and a bureaucratic process premised on meeting statutory and judicial requirements, as well as fulfilling their own defined organizational goals and objectives.

It is no surprise that this environment produces and propagates employees whose values and persona mirror those of the organization in which they operate. Police officers that excel within this milieu typically embrace the hierarchical structure, top-down decision-making process and conservative culture. This in turn layers an organization with managers and line-level staff that support the status quo and who are equally resistant to organizational risk-taking and innovation. Yet, police officers engage in personal risk-taking and are expected to make life and death decisions without hesitation and consultation. Critical incidents aside, police officers regularly exercise discretion throughout the course of their duties and rarely consult with superiors when interacting with the public on a daily basis. This creates an interesting mixture of empowerment and contradictions, which at times seems counter-intuitive. Entrusting individuals with the very important job of ensuring the safety and security of a community brings with it responsibilities and accountability to the individual level. Yet, the organizations where these women and men work, by their very structure, do not operate in a manner conducive to independence and exercising initiative.

Some may argue that recent practices have worked at breaking down these structural limitations through empowering line-level police officers,
flattening the rank structure and encouraging proactive problem-solving (Mastrofski, 2006; Rosenbaum, 2007). Yet, how real are these changes, and have they made a difference in modifying the culture of an organization to embrace change and accountability? As Mastrofski has noted:

Just how much have they changed police organizations and the practice of policing? If police organizations are changing in fundamental ways, researchers should be able to observe and measure these changes (2007, p.33).

While many in the police culture would argue yes, those on the outside looking in and a few reflective police leaders would say no (Bellmio, 2004; Sullivan, 2001). In fact, even progressive police leadership encounter challenges when attempting to bring about organizational change. Research on the issue identified that, "some police departments may be so intransigent that the 'reform' chief's task is like bending granite" (Mastrofski, 2006 p.25). Others have found inadequate change premised on the onerous and gradual replacement of staff-members with a more skilled cadre or alternatively, the ineffectual process of upgrading of officers' expertise through professional development:

Changes in the bureaucracy of the VPD do not sweep in from the actions undertaken by new managers. Rather, change seeps in by the slow process of changing the nature of the VPD staff member and his/her skill set. This evolves painfully slowly (Malesan, 2004, p.25).

However, the upgrading of police officers' education and the influx of highly skilled employees does not guarantee a police service will develop core capacities that facilitate change management and an ability to assess the effectiveness and efficiency of police operations. Change management
techniques and the skills-sets for evaluating current practices are not part of most educational programs or management curriculum. Therefore, it is unrealistic to expect that higher education standards and the encouragement of professional development will result in a greater organizational capacity to embrace change and break from entrenched structures.

This raises some interesting issues in terms of outcomes when change is attempted. The question is not whether change was attempted, but rather, the outcome of this change and the quality of outcome. If an agency embarked on a new and innovative approach, such as adopting a Compstat model (a management approach that uses statistics and mapping to target crime) of crime control, questions need to be asked as to the success of this undertaking. This requires the project to have predetermined goals and objectives, with clearly defined benchmarks and measurables identified in advance of the initiative. From this framework, an organization could then determine whether it met its stated ambition and what areas encountered difficulties or problems that require further attention.

When these issues are examined, it is clear that very few police agencies attempt to systematically evaluate their utilization of resources and investigate the reasons for any problems they encountered (Broom, 2004; Gaunt, 2007; Jacobs et al., 2006; Sullivan, 2001). This is an important point, as few police departments assess or explore potential shortcomings while operating within a bureaucracy whose main characteristics are still firmly rooted in the nineteenth century. Characteristics such as an entrenched para-military structure, a remnant
of nineteenth century policing, does not promote a way of thinking that encourages officers to continually challenge organizational practices and champion new methods, ideas and tools for improving efficiency and effectiveness. More than likely, the opposite is observed, such as a resistance to change and an outlook that perpetuates paradigm blindness. Paradigm blindness refers to a belief that "the way we do it is the best because this is the way we've always done it" (Kozak, 2004, p.12). Concepts such as goal attainment, performance measures, quality indicators and benchmarking become undesirable concepts, falling away to spurious justifications that are used to reject experimental evidence and best practices that contradict the status quo (Gaunt, 2007; Kozak, 2004; Sullivan, 2001).

In recent years, there has been a movement by some police services to attempt to develop strategic plans, organizational goals, measurable objectives and performance measures (VPD, 2004; VPD, 2005). However, many of these initiatives are still in their infancy and fail to meet even basic expectations, such as clearly defined measurables and core capacities to assess whether the projects are achieving their stated goals and objectives on an ongoing basis.

It is simply not enough to know whether a police department has adopted a given program or practice; we need to know much more about the dosage of that implementation. How many resources have been committed?... How faithful has the execution of program protocols been? (Mastrofski, 2007, p.34).

Police managers who attempt to facilitate organizational change are now expected to exhibit many features of the private sector, including some elements
of an entrepreneurial approach. Consideration of cost efficiency and
economizing, including the development of a sound business case before any
changes and funds are even contemplated, are necessary to ensure the initiative
is a prudent undertaking. Furthermore, the systematic evaluation of police
initiatives requires adherence to research methodology, such as pre-initiative,
control measurements and precise measurables based on project goals and
objectives. Once implemented, the initiative must also include a predetermined
strategy and process to examine and measure at regular intervals, whether the
program is meeting its stated goals, and organizational objectives are being met
(Mastrofski, 2007).

Police managers who see the ever-increasing competition for scarce
resources may support reform and the movement towards a private sector model
of business. Yet, given many police agencies' past performance of substandard
or non-existent evaluation, there is a healthy dose of scepticism from police
oversight bodies, city managers and elected officials. As Greene found in an
examination of power and resource acquisition by law enforcement agencies:

Budget officials thought that criminal justice agencies rarely
examined traditional ways of doing things critically, that their
analyses and arguments were selective... to justify convenience
and tradition (1986, p.541).

The police were viewed as needing modern management techniques that
have largely been developed for the private sector, further adding to the
resistance from within. Consequently, the modernization of police bureaucracies,
through initiatives such as those that promote fiscal accountability, justification of
resource requirements and programs that require predetermined goals and objectives, has not been widely accepted. The use of management jargon such as “benchmarking”, “control groups” and “quantitative assessments”, has further added to the scepticism on the part of many police officers who resent being the object of a reform agenda (Gaunt, 2007; Greene, 2006; Jacobs et al., 2006; Sullivan, 2001).

As is evident by its character and structural composition, police agencies do not lend themselves to adopting to change well. Change is an illusive commodity within many police agencies that are more likely to maintain the status quo than venture into unknown territory. Moreover, on those occasions when change is attempted, it is rarely premised on sound analysis, often resulting in the merits of the change itself coming into question. The perception is that police agencies appear to lack the proficiency and cultural mindset to implement organizational change, which is more readily observed in organizations that operate with greater fiscal accountability.

2.2 Organizational Learning

Organizational learning builds on past successes and failures, and features those initiatives that offer the best potential for future organizational efficiency and effectiveness. Part of the problem with the way organizational change is dealt with by police organizations is the haphazard manner in which it transpires. It has yet to be realized by many police services that clearly articulated, long-term, strategic planning and departmental priorities help instil a
shared vision from within the organization and help establish common values and
organizational philosophy (Malesan, 2004). However, this is best accomplished
when an organization reviews its past practices and performance measures to
identify the most successful initiatives and programs to support in the future. It
has been said that effective organizational learning is widely seen as a key to
sustainable competitive advantage and necessary for organizational survival
(Broom, 2004; Tan et al., 2001). The goals of organizational learning include,
"the development of insights, knowledge and association between past actions,
the effectiveness of those actions, and future actions (Fiol & Lyles, 1985, p.43 in

Crucial to any discussion on organizational learning is the notion of
feedback into the learning cycle. Learning is not a linear process of education
and then application of knowledge, but a reoccurring process whereby processes
are constantly evaluated against expected goals and objectives. Goals then
serve as a means to replace unproductive behaviour by providing direction as to
where efforts should focus (Bratton, 1995; Broom, 2004). The system of
feedback ensures desired outcomes and stimulates a process of learning
through experience, resulting in adaptation, growth and change. Yet, how
commonplace is the application of this system within the policing community? As
Tan discovered when probing the activities of the Singapore Police Force:

Despite changes made over the decades, the force was an entity
with a very entrenched organizational culture and established
practices. Structurally, it operated according to authoritarian chain
of command and a disciplined hierarchy (Tan et al., 2001, p.368).
His description of the Singapore Police Force is not isolated and could be applied to many police agencies in North America as well, where cultural and organizational change are complex and laborious processes.

Progressive decision makers rely on evaluative processes, benchmark studies and ongoing research to determine which programs are successful and which should be terminated (Broom, 2004). Police programs, however, are rarely scrutinized due to the lack of substantial evaluative research to support their activities. It is suggested that many police programs fail to supply empirical documentation outlining whether or not the program is accomplishing its objectives. For example, the patrol deployment models of many metropolitan police departments are premised on an array of anecdotal evidence; including a failure to adequately provide empirical support as to whether they meet even basic efficiency standards (Bellmio, 2004). This can be summarized by the statement, “in spite of many program assessments, research on police resource efficiency today is a mile wide but only an inch deep” (Reiner, 1992, p.139).

In terms of an evaluative framework for patrol deployment, the use of measurable criteria to assess outcomes of deployment goals is a good starting point. For instance, an appropriate evaluative framework for shift modelling should measure the time allocated to problem-oriented policing, community satisfaction with police services, time spent on proactive policing activities and reductions in overtime usage (Broom, 2004). In the end, one fundamental question must be answered: did the initiative work? Yet the answer is more
elusive than one might think. Mastrofski noted that some of the issues with current assumptions is that they are based on unsubstantiated strategies.

Do they produce desirable results? Any undesirable results? ... There simply is not enough evidence to say conclusively that these innovations work and under what conditions. And there are other innovations where the evidence is mixed or virtually non-existent about the effects of the innovation (community-policing, broken-windows policing, Compstat and evidence based policing) (Mastrofski, 2007,p.35).

These findings apply equally to other areas of police operations as well. In order to establish an empirical basis in which to determine patrol deployment efficiency, researchers must advance a comprehensive evaluative framework. Thus, patrol deployment reviews must demonstrate their ability through an empirical analysis of their stated objectives rather than simply through anecdotal evidence. Effective programs should be able to measure and establish their net benefits in defendable terms or risk undermining the organizations' standing. Given the general lack of empirical evidence and objective evaluations of patrol deployment, for the immediate future, “the practice of deploying policing efficiently remains more an art form than a science” (Moonen, 2005, p.32).

2.3 Challenges

Apart from issues related to a lack of transformational change and a reluctance to employ evidence-based evaluative practices, police organizations have encountered further challenges that touch on the very core of their services. Police agencies, more than ever before, are being asked to provide a greater range of services, faster response to emergencies and to significantly reduce
crime (Mastrofski, 2007; Mazerolle, 2002; Rosenbaum, 2007). Some would even argue that the police are being asked to address the root causes of crime. 

Couched in the provisions and expectations of *community policing*, agencies have broadened their scope to take on issues related to poverty, substance abuse, wayward youth and dysfunctional families (Loveday, 1998; Rosenbaum, 2007). For the most part, these societal ills and systemic community problems have, by default, fallen on the shoulders of police agencies.

These demands are made under the backdrop of reduced budgets and greater accountability to political governance. Given these conditions, it stands to reason that some police agencies are looking for ways to improve efficiency and effectiveness. On the other hand, as some political and academic commentators have noted, there is also the potential that many of these touted improvements are more *perception* than *actual* improvements in efficiency. Before addressing the issue of budgets, politics and reform, further background on the topic of police demands for service will help frame the discussion.

Since the advent of the 911 emergency call system, police services have been under increasing pressure to provide a rapid response to public demand for police attendance. While many praise the virtues of the 911 emergency system, and the countless lives saved through its use, the police have grown to regard it as an unwieldy albatross. Past studies have shown approximately 70% of all calls to 911 emergency services are for police assistance, and as such this single technological advancement has had a significant influence on police deployment and patrol operations (Mazerolle, 2002; Skolnick, 1986). Based on the volume of
911 calls police agencies were receiving, police patrol began curtailing its preventative work. Police were simply too busy responding to 911 calls to delve into the root causes that perpetuated the calls in the first place (Skolnick, 1986).

The growth in the number of 911 calls police receive had a marked impact on the way patrol operations were staffed, deployed and tasked. Patrol evolved from a primarily community-based service to a rapid response to calls for service. In turn, the number of officers required to respond to these increasing demands also increased accordingly. An immediate response capability to 911 emergency calls evolved to become a core service of virtually every police agency. In an effort to address this growing demand, several management strategies were employed, the most common being improved patrol shift scheduling. The rationale being that a more efficient and effective police patrol would be better able to handle an increased workload and demand using existing resources (Mazerolle, 2002; Skolnick, 1986). Questions as to whether police agencies were prepared to reallocate patrol resources and adopt organizational reforms were never raised; at least initially.

However, other demands also continued to rise, such as the publics’ expectation of police participation in community-based initiatives. The trend was for police to evolve to become all things to all people, as scarce resources were drawn into new and expansive roles. As Mastrofski noted:

On the one hand, community policing calls on police to broaden the mission of the police – embracing a host of order maintenance and service activities to which the public usually attaches high value (Mastrofski, 2007, p.19).
These competing agendas and goals created a resource crisis in many organizations. Management was challenged to follow through with community-policing strategies with overworked patrol members that were struggling to meet demands of the emergency 911 system.

On the other hand, community-policing did not deliver the expected reductions in crime, despite consuming large segments of a police organization’s precious resources. At best, its effectiveness was limited to reducing the public’s fear of crime, but little else (Weisburd et al., 2006). From the perceived shortcomings of community-policing emerged several alternative crime control agendas driven largely by the police themselves. Intelligence-led policing, broken windows policing and Compstat looked at ways to use technology to enhance the effectiveness of police organizations at controlling crime. Yet, technology and policing have never had much success in the past, and the same issues of the past emerged with these new models.

In my own field work on Compstat, I have been impressed by the size of the gap between the willingness and capacity of most police middle-managers to use mapping and other crime analysis methods and the capacity of those systems to analyze data (Mastrofski, 2007, p.30).

There were three main issues that negatively influenced the effectiveness of these new initiatives. First, was the lack of interoperability between computer systems. With the introduction of computer-based dispatch systems and police records management systems, police agencies were instantly provided a wealth of statistical data on their operations. However, few systems could make use of
this data in a meaningful way, nor could they communicate with the disparate systems used to collect the information (Rosenbaum, 2007). Second, police themselves lacked the technical abilities to use the systems in the manner for which they were designed. The recent trend towards hiring civilian specialists with the technical expertise to use these systems is a positive step in overcoming this impediment. Yet, this process of professionalization is also fraught with issues, such as removing police participation from the analysis process.

Third, and probably most important, is the lack of ‘consumers’ for the information analyzed (Mastrofski, 2006). Police have long been resistant to technological answers to crime control, and are more comfortable using intuition and gut instinct to determine where to focus attention and resources. The old adage, statistics lie is a common response to crime analysis wizardry, and captures the inherent cultural resistance to complex, technological solutions. Other research studies have noted:

Police agencies were not well-prepared to become effective users of the more timely crime-data that their Compstat programs generated, because managers were not experienced or trained in how to use the technology of modern crime analysis for strategic decision making (Weisburd, 2006, p. 286).

Therefore, while police verbiage touted many advancements in crime control techniques and technological advancements, very few organizations could demonstrate real and transformational change. Even when those agencies that implemented Compstat are examined, either they fall short of the actual features or they eliminate the components that promote organizational flexibility and
innovative problem solving; instead, reverting to those features that reinforce a traditional paramilitary approach to management (Weisburd, 2006). In short, the organizational change and reform necessary for the complete implementation of a new crime-control model were rarely observed, and Compstat in particular, has been shown to concentrate power and reinforce traditional bureaucratic hierarchies (Rosenbaum, 2007). The end result was a departure from innovation and a reversion to traditional, reactive, crime control methods such as surveillance, increased patrols and aggressive enforcement tactics.

Under the guise of new window dressing, in the form of technology dependent crime control models, police agencies were still confronted with the familiar issues of requiring additional resources to support their inefficient operations and deployments. Fuelled by the need to maintain emergency response capabilities and embark on new crime control initiatives with newly minted specialty units, police agencies entered into the realm of funding justification. Competition for scarce funding was a harsh and cruel arena, where shrinking municipal budgets meant a reduced share of the budgetary pie for police agencies (Broom, 2004; Greene, 1986). With this came increased scrutiny by budget officials demanding hard facts and defendable analysis as to the steps taken to ensure optimal efficiency of existing resources and future organizational planning aimed at progressive and accountable change. As Broom noted in her audit:

The absence of a structured approach to staffing, whether it is a complex computer program or just a systemic approach to monitoring a few significant workload and performance indicators,
prevents the Sheriff's Office from documenting its staffing needs and demonstrating how patrol resources are being managed (Broom, 2004, p. 23).

Central planning, adoption of performance measures of existing initiatives and the deployment of resources became conditional to the release of much needed funds. Police agencies that saw utility in presenting arguments to justify additional resources and funding were more likely to embark on some form of program review and analytical activity (Sullivan, 2001). Even when police agencies could make cost-effective arguments for increased resources, there was still the perception that funding decisions were political, arbitrary and deceitful (Greene, 1986). An interesting phenomenon was observed by many police agencies with something Greene termed "loss of fact" whereby grounded and extensive analysis supporting funding requests rarely influenced decisions. Rather, politicians lost sight of the issues along the way, ultimately resorting to partisanship and a cost savings agenda (Greene, 1986). It makes sense that police agencies that experienced this firsthand would be less likely to engage in further planning, reform and analytical activity in support of future budgetary processes.

In the final analysis, the challenges facing police services were a culmination of many diverse factors. A demand for greater police services, partially a consequence of the 911 emergency call system, and partially because of the public's demand for community-based initiatives, contributed to the emergence of alternative crime-control models. Operating with reduced budgets, many police services turned to technology to solve their resource issues and to
help advance their new crime control models. Unfortunately, the expected efficiency gains never materialized, all the while municipal governments continued to impose greater fiscal accountability, with some funding decisions based on an arbitrary criterion. However, police services continued to demand and require additional resources to maintain diverse crime-control initiatives, and as illustrated in the following section, staff specialty units created to undertake these initiatives. The question then becomes, where were these officers to come from, if not from newly funded police positions?

2.4 Diminishing and Devaluing Patrol

Operating with minimal increases to annual budgets, police services turned to the largest contingent of police officers within their organizational structure. Patrol typically contained the largest concentration of officers in a police service and therefore made a lucrative place to look for supplementary officers to staff specialty units. This practice brought into question organizational policies, including the value police services place on patrol and its decisions regarding resource allocation. The answers to these questions have a profound influence on whether patrol will have sufficient personnel to meet demand and the performance of front-line officers.

While management in most police agencies publicly asserts that patrol operations are the backbone of an organization, the first point of contact with the public and the most important function an agency can provide, there invariably appears to be a disconnect between the message and reality (Jones, 1980;
Sullivan, 2001). In fact, patrol has typically been the first place from where the best and brightest were whisked away to more prestigious and upwardly mobile specialty units, both on a permanent and temporary basis. Due to the high value and promotional opportunities afforded within specialty units, patrol officers themselves, pursued every occasion to transfer out of patrol. Patrol operations were then left with the least experienced, least qualified and a constantly depleting number of officers in the force (Bellmio, 2004; Berkshire, 2004; Jones, 1980).

This practice created the unintended trend and consequence of a rise in specialty units at an organizational level and the serious issue of understaffing in the number of patrol officers (Bellmio, 2004; UWUCPS, 2004). A reoccurring theme of many police agencies was the difficulty they encountered in staffing and maintaining patrol service levels. Despite the fact that patrol response to 911 emergency calls was a core service of most agencies, many struggled to maintain minimum staffing levels. However, these same difficulties were not replicated within specialty units that were able to attract and retain their full complement of officers. In essence, the resource shortages many police agencies encountered were position dependent, with uniform patrol selectively encountering chronic deficiencies (Loveday, 1998; Martin, 1969). Jones further noted that:

The principal cause of depleted uniform branches both in quantitative and qualitative terms, is the effects that specialization has upon the distribution of manpower within the police organization (1980, p.92).
The staffing of specialty units was accomplished at the expense of patrol operations by perpetually draining patrol staff and generating vacancies that remained unfilled. This situation adversely affected the ability of agencies to meet minimum staffing levels and to respond to calls for service. As Loveday discovered, unfilled vacancies and chronic shortages in patrol were, “solved by regular provision of overtime duty, which increased overall police expenditure” (1998, p.170). Excessive overtime usage in patrol was indicative of chronic shortages and unchecked specialization. Overtime temporarily addressed the symptom, but did little to solve the problem.

On closer examination, Jones discovered that patrol operations themselves, were not immune from specialization as, “many patrol constables are performing duties other than patrol, although the records and statistics show the contrary” (1998, p. 97). The performance of specialized duties was not limited to specialized units that comprised part of the organizational structure, but included ad hoc duties and unofficial units that were not part of an agency’s authorized strength (Jones, 1980). Despite officers having job assignments in patrol, this did not guarantee they were performing this function, as patrol officers were found performing other specialized, non-patrol duties. This was a troubling discovery, as official police records did not accurately document how officers were actually deployed and the duties they were tasked with performing. These practices could result in patrol units operating well below minimum levels, with official records indicating the opposite. In fact, given these conditions,
specialization and diversion from patrol duties was even more prevalent than many agencies were prepared to acknowledge.

The classic response from many police agencies was to request additional resources and funding to fill the shortages in uniform patrol. However, as police departments continued to grow in number of officers it, “did not necessarily lead to an increase in the numbers of police patrol officers. Police patrols actually fell” (Loveday, 1998, p.166). This was a result of an expanding bureaucracy and a growth in the number of specialty units relative to organizational growth.

Bureaucratic expansion was tightly linked to a program of increasing specialization and a reinforcement of the hierarchical nature of police agencies. As well, the growth in specialization propagated the need for bureaucratic support, such as promotional opportunities and supervisory roles (Bellmio, 2004; Berkshire, 2004; Loveday, 1998).

Consequently, the role of the patrol officer became marginalized and devalued, as specialists were required to address an ever-increasing range of compartmentalized problems (Bellmio, 2004; Berkshire, 2004; NWUCPS, 2004). Any lingering scepticism could be quickly dispelled by perusing a handful of police organizational charts, where a listing of specialty units ranging from youth crime to homeland security fills the pages. As a result, patrol work became associated to mundane and rudimentary labour and those that were fortunate, escaped to specialty units (Jones, 1980). Those that remained suffered from low morale, declining productivity and a degrading skill-set (Bellmio, 2004; Berkshire, 2004; NWUCPS, 2004). The rampant practice of creating specialty units
established an organizational policy, whether planned or not, that an agency places a low value on patrol.

Few agencies were prepared to examine their own organizational practices through systematic analysis, internal monitoring of operations, and organizational policy review. Moreover, there were indications that some police agencies were not prepared to take action when they were aware of the problems. Specialization had become entrenched into the police culture and the notion that patrol was more valued and more deserving of resources than a specialized unit was inconceivable. Loveday discovered that:

Evidence suggests that, despite the recognition of these problems, internal police organizational policies continue to contradict the claim that patrol is the most important police function (1998, p. 188).

Therefore, the message that patrol is the most important function within a police agency does not have merit when an organization's management and the policies they endorse, continue to expand apparently less important specialty units by depleting patrol operations. The Northwestern University Centre for Public Safety conducted an evaluation of the Scottsdale Police Department's patrol efficiency and noted that the, "key to obtaining more efficient and effective processes is, in fact, largely determined by department policies" (2004, p.1-2). Essentially, organizational practices, internal processes, and policy decisions influence many of the issues facing patrol, some specifically contributing to a shortage of officers. As will be shown in the next section, influences on organizational practices are not limited to management decisions, but includes
relationships with police unions and collective agreements. This adds a new
dimension to any study of patrol efficiency, whereby analysis must expand
beyond mere shift modelling and address these broader systemic issues facing
police organizations.

### 2.5 Union Complexities

Modern police organizations operate within the confines of legislative
authority, police board policies and to an extent, based on the relationship forged
with the police union. The nature and role that a police union occupies has a
direct and profound bearing on organizational change, the implementation of
performance-based initiatives and the responsiveness of a police service to
organizational learning.

While few would argue the merits of police unions and the importance of
ensuring the best interests of the police membership are protected, the
complexities of collective bargaining, arbitration, grievance mediation and dispute
resolution can influence the responsiveness of an organization to change. In
situations where labour and management relations are positive and productive,
the participation of the union in organizational change is also usually a positive
and constructive venture. While participation in the process may add an extra
layer of complexity, it also ensures the interests of the police members are
represented and appropriately considered (Degnegaard, 2006). This also
ensures organizational change does not lose sight of the fact that policing is a
human enterprise, and maximizing efficiency cannot be accomplished by
unhealthy practices that ignore quality of life considerations. While efficiency calculations and modelling techniques can produce optimized models, the productivity of the models are ultimately based on the human equation and not some vague machine-like bureaucracy.

Conversely, where management and labour relations are adversarial, the potential change management outcomes are not as positive. Implementing change and bringing about progressive reforms requires cooperative police labour-management relations. However, traditional police labour-management processes are by design, adversarial, with each side attempting to maximize its position and gains at the expense of the other. The arrangement is built on ‘winners’ and ‘losers’ with the side that makes the most gains, triumphing (Polzin & DeLord, 2006). As mentioned, this is not always the case, with progressive unions and management putting aside the adversarial agenda and working towards establishing cooperative interactions that extend to the collective bargaining process, grievances or arbitration. Relations built on mutual respect have greater success in setting aside their differences when it is clear the intention of the reform agenda is to build a safer community (Degnegaard, 2006). Interestingly, those police services that display constructive labour-management relationships are more likely to embrace progressive management practices and build capacity to implement change (Polzin & DeLord, 2006).

However, the capacity for transformational change and a willingness to champion progressive initiatives, have been stymied by labour-management relations that are non-participatory and divide police members. The polarization
of reform policies and the politicization of the process are well known to policing. These situations demonstrate a breakdown in communication from both sides of the agenda and an intransient strategy for reform. In Thacher's case study of organizational reform in the Portland Police Bureau, the author identified a police service in transition organizationally, strategically and most importantly, managerially (1998). During a period of transition, several Chief's were replaced, and the police bureau officer's union rejected most attempts at reform, threatening to sue the bureau in one instance. Consequently, management backed away from some of its reform initiatives, choosing instead to focus on budgetary considerations (Thacher, 1998). While the case study by no means represents the norm in police labour-management relations, it does illustrate the importance of power relations and the influence of non-management groups on organizational reform and policy decisions (Degnegaard, 2006; Polzin, 2006; Thacher, 1998). Furthermore, the complexities of initiating transformational change within a framework of divide authority requires an acute sensitivity to compromise, coalition building and reconciling conflicting purposes (Polzin, 2006; Thacher, 1998). It is only after these issues have been addressed and resolved that an organization can then make progress in operational efficiency and meeting organizational priorities.

2.6 Theory and Practice in Policing

One of the goals of most police agencies is to ensure efficient operations that meet the objectives and priorities of the organization while staying on track
and within the annual agency budget. This is best accomplished through proper planning and review of two significant issues. The first issue delves into the way resource allocation is managed within a police agency, by examining ways to maximize efficiency through scheduling and deployment. The second looks at enhancing effectiveness, which can be accomplished through the use of internal processes and management strategies. Foremost are processes that address systemic issues, such as a dwindling officer count in patrol due to an expansion in specialized units or by modifying managerial approaches to encourage innovative solutions and problem-solving at the patrol officer level.

When discussing performance and practices of police agencies, it is important to remember that this information is most relevant when used to develop mechanisms and strategies to facilitate progressive change, such as greater efficiency, and improved policies and procedures. Factors that distinguish a police department as a leader in policing is an agency that scrutinizes best practices and applies those that advance the goals and objectives of the organization.

In terms of evaluating an agency’s patrol operations, the standard is far more evident. Patrol units that simply respond to calls, in a relentless pursuit of trying to catch-up with the incoming calls for service, will never be in a position to solve the underlying issues that are driving these calls. As Mazerolle noted in his research, patrol officers were, “too busy handling 9-1-1 calls to address the problems that give rise to these calls” (2002, p.101). “Pro-active policing”, or “problem solving-policing” requires a deployment model that provides officers the
ability to develop strategies and plans that will encourage officers to take responsibility for issues. As part of a proactive policing approach, officers can direct and focus their efforts on addressing crime prone areas, apprehending repeat offenders and targeting problem premises responsible for a disproportionate number of calls for service (Broom, 2004). These approaches have shown the greatest promise in reducing crime and making the best use of patrol resources when not responding to emergency calls.

A deployment model must not only provide adequate time for officers to engage in problem solving, but the quality of the time is an important factor as well. By quality of time, it is meant that an officer cannot effectively use unallocated time unless it is grouped in usable segments or blocks. For example, if an officer had 30 minutes that were unallocated within an hour, but were in three minute segments spaced in ten intervals, then the value of the unallocated time would be virtually meaningless in terms of problem-solving. As well, the total unallocated time must be sufficient to permit the officer to engage in pro-active activities. Mazerolle noted the minimum value for unallocated time blocks as, "we mean substantial blocks of time (more than thirty minutes in duration) where patrol units are uncommitted to any type of recorded task" (2002, p.113).

To obtain accountability in patrol, it must flow from management as part of the overall goals and objectives of the organization (Skolnick, 1986). In order to empower officers to act as problem-solvers, they must be given the opportunity to get to know their local community, its individual needs and issues, and to develop an awareness of the broader context in which they operate (Mazerolle,
2002). This is not accomplished by responding to calls while working a patrol shift each day. Adequate time, support from supervisors and individual ability come into play. Grimshaw et al., in his sociological exploration of policing culture, noted how freedom from responding to calls for service enabled officers to interact with the community and pursue a range of styles, the most noteworthy being consensus building (1987). Other less tangible issues, such as two-officer units versus one, impact effectiveness and the ownership officers feel over a particular problem. While progressive organizational practices play an important role in ensuring efficiency, as will be come evident in the following chapter, innovative strategies, and an evaluative process that empirically analyzes predetermined performance measures, are equally important.
3. PATROL DEPLOYMENT: THE LITERATURE

The previous chapter examined many of the core issues confronting police services with a focus on those issues that can influence a police reform agenda. In contrast, this chapter will study the capacity of police services to measure performance, with an emphasis on the practical measures in use within policing. Performance measures are addressed for mainly illustrative purposes, as this aspect of police operations is the focus of further analysis into efficiency and the capacity to implement reformist practices. The research in this chapter will illustrate how the capacity to measure efficiency and then apply this knowledge to transformational change, is reflective of organizational capacity for change management. Specifically, the later case-study of the Vancouver Police Department, covering the years prior to 2006, will build on this research as part of an examination of the level of efficiency recorded in patrol. As a core service of any police organization, it can be extrapolated from the deployment model whether an organization adheres to progressive management practices and the use of valid performance measures to assess efficiency. Therefore, the performance measures in use within policing play a critical role as to whether there exists a capacity to measure efficiency and the important next step of how an organization will respond to this realization.

The following chapter on patrol deployment literature further discloses some of the evaluative practices employed on previous studies, but also includes
the reasons why past studies have encountered difficulty measuring police performance. By extending the course of study into performance measures, this chapter looks at how patrol operations have been evaluated in the past and which approaches garnered the most reliable data. Given the competitive marketplace in which evaluative software and service packages are bought and sold, the chapter also contains an analysis of the most commonly available products. Based on independent evaluations and academic reviews, there were a surprising number of commercially available packages that were deemed inadequate and flawed for most efficiency audits. The review of commercial products, evaluative approaches and performance measures were in turn used to shape and develop a unique evaluative strategy that is detailed within the methodology chapter. Grounded in a review of efficiency literature, the analysis conducted later in this study draws on three diverse evaluative approaches, particularly queueing modelling, simulation modelling and performance measures that are reviewed in detail in the following discussion.

Closely related to patrol deployment efficiency is the application of innovative management strategies for leveraging existing resources. The use of these strategies within an operational framework that supports the goals and objectives of the organization, can also contribute to greater efficiency and improved effectiveness. The range of topics covered in this chapter includes beat assignments, roving metro-patrols, and scheduling dynamics. Each has its merits and specific areas for targeting efficiency gains, which are re-examined and applied later in this study within the context of the VPD case-study.
3.1 Evaluative Practices

Considering metropolitan policing has been around in some form or another since the 1800’s, one would think it is safe to assume that the issue of patrol efficiency had been thoroughly examined and perfected to a science. Unfortunately, this could not be farther from reality, as many of the current methods used to determine both shift-models and resource deployment are ad hoc and simplistic. For example, some agencies measure the response time to emergency calls. When the response times drop below an arbitrary threshold, more officers are requested for assignment to patrol (Broom, 2004; UK National Audit Office Comptroller and Auditor General, 1995). This approach fails to capture non-emergency calls, officer-initiated calls and those calls that require additional investigative follow-up, thereby overlooking some significant demands for resources.

Other agencies base deployment on crime rate and clearance rates, which in itself has many inherent problems. While crime rates and clearance rates can influence demands for service, this fails to take into account the plethora of other tasks assumed by police patrol officers (Bichler, 2005). Historically, property offences have had notoriously low clearance rates when compared to violent offences. Depending on demographic composition, large urban areas typically suffer from higher rates of property offences than suburban and rural settings. As well, crime rates fluctuate over time and are not a stable indicator of workload (Bichler, 2005). In fact, a police service that is performing at optimal efficiency and has successful crime reduction strategies will typically see a reduction in the
crime rate (Clarke, 1980). However, a reduction in the crime rate does not necessarily translate into a reduced need for patrol officers. Therefore, by reducing officers in response to a drop in the crime rate will likely cause a spike in offences and a reversal of the gains made by implementing successful crime reduction programs (Clarke, 1980).

Still other agencies simply summed the total number of calls for service and used these figures to allocate resources and as a basis for funding requests (Bellmio, 2004; Sullivan, 2001). Yet, calls for service, examined in isolation, fail to capture the true characteristics of demands for services placed on patrol officers. This is due to the variation in types of calls within certain hours of the day and days of the week, and the range of time required to address different call types. Calls that are more serious typically require more officers and take longer to investigate. Therefore, an aggregate of calls for service fails to address these issues and is a poor measure of workload.

The most common and flawed approach looked at the number of police officers per thousand population (Sullivan, 2001). The ratio has been used to determine the overall staffing of a police agency and as a method for comparing staffing between police agencies. The major weaknesses with this measure are that it fails to account for the actual service demands placed on an agency, it does not take into consideration police response times and most importantly, it is based on a municipal population estimate. Municipal population estimates are problematic when used for metropolitan centres that suffer from what is commonly described as core city syndrome (BC Prov. Gov., 2006). A detailed
explanation of this effect is covered later in the thesis, but in brief, a residential population of an urban centre can be significantly underestimated when influenced by a large number of commuters and tourists. Therefore, performance measures based on this figure misrepresent the actual population policed. Regardless, the number of officers per population contributes very little to an understanding of workload, police performance and issues that contribute to resource utilization (Sullivan, 2001). In reality, the ratio is likely a better indicator of political factors that have historically influenced police funding decisions than providing any enlightenment on workload.

Research that examined the range of methods used to quantify workload revealed vast and ill-conceived approaches that fell short of the intended objectives. Greene noted that:

Police agencies frequently cited calls for service, crime rates, traffic accidents, response times, and special events as proper criteria for measuring workload and, hence, for determining their funding (1986, p.541).

This issue was further exacerbated by police agencies that lacked awareness of their substandard analyses and flawed conclusions drawn from their own evaluations. It has not been uncommon for agencies to tout the merits of their findings in order to generate support for additional officers and funding, only to have encountered resistance and ridicule from budget officials (Broom, 2004; NWUCPS, 2004).

The core issue confronting most police departments' attempts at conducting sound analysis was an inability to measure their effectiveness and
efficiency in responding to calls for service. While this may seem like a basic requirement, few departments have the ability to collect and analyze the appropriate data necessary to determine whether their respective agencies are functioning at peak efficiency and meeting basic responsibilities (Broom, 2004; Sullivan, 2001). In some jurisdictions, the problem has developed to the point where an immediate response was merited. For example, in the United Kingdom, a Police Numbers Task Force was created to examine this issue and other data collection problems. The Task Force stated:

However, it has been recognized in the course of this review that there exists an additional business need for broader resource information in order to understand the efficiency and effectiveness of the deployment of police resources (Research Development Statistics (RDS), 2001, p.3).

While it may have been understandable to lack such information before the age of computers, the UK Task Force completed its report in 2001. Since the 1980's, Computer Aided Dispatch (CAD) systems emerged as a way to enhance the ability to dispatch, route and track how police respond to an event such as a 911 call. Major benefits of these systems included streamlined communication and increased speed in responding to a call. An ancillary advantage to the acquisition of this technology was the wealth of information tracked and recorded for each event ranging from dispatch to completion. Unfortunately, few resources have been expended in analyzing and exploring this data (Mazerolle, 2002; Sullivan, 2001).
One such endeavour was undertaken by the Scottsdale Police Department in 2004. The approach taken involved analyzing CAD data and making deployment decisions based on how many units (police cars) should be fielded to accommodate workload based on the day of the week and the time of day (NWUCPS, 2004). Consideration was given to the type of priority calls being responded to and matching staff to workload. Efficiency was also examined through modified and flexible scheduling to ensure staff were available at peak call-load times (NWUCPS, 2004).

Nonetheless, studies of this type and nature are rare in policing. Generally speaking, police agencies encounter difficulty when it comes to determining how many officers they require to staff their patrol operations (Broom, 2004; Harris, 2001). The subsequent question being equally difficult to answer: what are the operational goals of patrol? The answer to both these questions shapes and defines how patrol officers are deployed, how many officers are deployed, the expectations of the officers working, and how calls for service are managed.

Investigations targeting the ability to measure workload demands have highlighted difficulty in procuring evaluative data. Broom of the King County Audit Office, conducted an in-depth evaluation of the Sheriff’s Office and came up with a series of findings that have been reiterated in other police research literature (2004). Namely, Broom found the King County Police Department had a limited amount of outcome measures and information on effectiveness, thereby rendering an analysis of workload and performance nearly impossible (2004). With a limited ability to measure workload demands, it further restricted the ability
to manage staff deployments in relation to operational goals and objectives (Bellmio, 2004; Broom, 2004; Sullivan, 2001).

Interestingly, the audit not only established methods to obtain patrol performance measures, it also incorporated a detailed examination of specific policy and operational goals that were deemed to influence efficiency and cost-effectiveness. Noteworthy was a review of overtime usage, such as the practice of using overtime to staff unfilled vacancies (Broom, 2004). Even more innovative was the manner in which the examination of patrol efficiency delved into relationships and factors not commonly explored. The audit looked at how overtime usage, organizational practices, staff allocation and shift deployment were interrelated and codependent (ibid.). Typically, audits of this sort only examine a handful of easily obtainable performance measures as an adjunct to how patrol staff are deployed. As will be illustrated later in this study, evaluations that are limited in scope often fail to take into account discrete and elusive factors that can have a profound influence on effectiveness, meeting organizational goals and achieving transformational change.

Regardless of the approaches taken, it was clear many police agencies were ill equipped to identify meaningful performance measures that could help guide and shape an agency’s future direction and assist in determining the effectiveness and efficiency of operations. Coupled with this inadequacy was the common obstacle of being unable to obtain the data necessary to conduct meaningful analysis, even when professional audits were attempted. The
conspicuous line of inquiry then turns to ‘why’ police agencies encounter such
difficulty in evaluating their effectiveness?

3.2 Measuring Effectiveness

An efficient use of resources will not ensure there are sufficient officers
available to deal with emergency calls. Efficiency can only go so far to improving
service delivery. Complementary to maximizing efficiency is an assessment of
the effectiveness of existing resources to respond to calls for service, factoring in
response times, and the balance between the ability to respond to emergency
calls and the demand created by emergency calls. Within the realm of police
resource effectiveness, these variables are measured as available unit minutes
and consumed unit minutes, respectively. The ratio of the two variables is called
unit utilization and is represented as a percentage. This ratio is a good indicator
of how busy patrol officers are at a given time and day and whether there is
sufficient time available to engage in proactive policing activities. The
methodology section provides a detailed explanation of the terms and the
calculations involved in generating these figures. Most police agencies strive for
a utilization ratio that ranges from 40% to 50% at the extreme high end (Bellmio,
2004; Broom, 2004; Sullivan, 2001). For example, the Shreveport police
resource study indicated that the standard for most organizations, taking into
account the actual time available to respond to calls, was 50% (Bellmio, 2004).

While issues such as crime rate and crime types are not directly evaluated
by this type of review, it is generally accepted that these issues will be indirectly
incorporated into the data when calculating the total *consumed minutes*. In brief, *consumed minutes* are calculated as the total time it takes for each unit to respond, resolve and clear each call within an hour block of time. This data is expressed as the total *consumed minutes* per hour of the day and day of the week. Therefore, the total *consumed minutes* will reflect the type of calls responded to within a given hour. This type of calculation is more accurate than a simple total of the calls for emergency services because it accounts for calls that require more than one police unit to respond. *Consumed minutes* is an aggregate of every minute consumed by every police unit that responds to calls within a given hour of the day. This is a concise figure that accounts for every minute that patrol units spend dealing with emergency 911 calls. As there are only a finite number of available minutes to address emergency calls for service, the utilization ratio is a good indicator of how busy patrol units are at different times of the day and days of the week. As well, it provides a good indication of how effectively patrol is carrying out its duties and meeting its objectives. Certain performance thresholds in the *unit utilization*, as established in advance by a police service, will indicate when staffing levels should be increased, reduced or left unchanged.

When examining deployment, scheduling and effectiveness, invariably the question arises as to the best way to make use of existing resources before considering additional resources in the equation. Herein lies one of the most difficult issues with reviews of efficiency and effectiveness. There are basically two ways to address inefficiency that exist in scheduling. First, you can redesign

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the existing deployment model to fix inefficiencies. Second, you can add additional shifts and staff more teams to correct inefficiencies. Both options have benefits and disadvantages. The scheduling section looks at these issues in detail, but for discussion purposes, it is important to bear in mind the costs associated with creating more shifts and additional teams, such as supervision, administrative support, equipment, vehicles and scheduling difficulties. One of the understated goals of deployment modelling is to create the best level of efficiency using the least resources possible; essentially applying a cost benefit analysis within a policing environment.

3.3 Patrol Deployment Measures

The methodology employed in the VPD case-study of organizational change is a hybrid of diverse approaches, some of which are identified in the patrol deployment literature detailed below. While empirical evaluation of patrol deployment and resource efficiency remains a scarce practice amongst police organizations in general, there are those who have embarked on the process using an array of widely available tools and methods. Interestingly, the VPD, as part of an organization-wide review undertaken at the end of 2005, conducted an in-depth study of its patrol deployment using innovative analysis techniques. Each share the same objectives, which is determining staffing needs of a police service by analyzing various duties performed by patrol. Analyzing patrol staffing needs also involves a determination of the most efficient scheduling model that
maximizes the use of existing resources. These decisions are based on an analysis of how time is spent on each patrol function.

The methods used to explore and analyze how patrol officers spend their time is typically based on some form of modelling. Modelling a police agency's patrol deployment can take several different approaches, the most common being queueing modelling, simulation modelling, and performance measure analysis (Bellmio, 2004). Depending on the goals and objectives of the analysis, researchers employ either descriptive or prescriptive modelling techniques. Each has its advantages, meeting different needs. A descriptive approach can provide valuable insight of expected results given predefined variables and allow for comparisons (Moonen, 2005). Prescriptive models are better suited for optimizing an existing process and have less value from a policy perspective (Moonen, 2005). Regardless of the approach taken, each share a common goal of evaluating various performance measures and workload to accurately forecast future outcomes.

The strengths and function of each also influences the approach taken. Queueing modelling is generally considered a prescriptive model and is more appropriate when researchers are interested in scheduling police patrol cars per hour according to predetermined performance measures. Simulation falls within the realm of descriptive models, as it offers the ability for researchers to experiment with factors and variables that influence deployment. Possible scenarios and influences can be incorporated into a hypothetical model, revealing the overall affect on the system before any actual changes are
implemented. Similarly, the analysis of performance measures falls into the descriptive modelling category, as it explores the relationships between variables and a multitude of qualitative factors. By manipulating performance measures according to possible patrol patterns, the model's improvements and trade-offs can be calculated. In this manner, a hypothesis of how the system will operate and react to circumstances can be examined.

Researchers have used one or more of these evaluative approaches to examine police efficiency and effectiveness, depending on their intended analysis and the direction of enquiry. As will be illustrated in the following review, no single approach satisfactorily isolates the entire breadth of influences on patrol deployment. Consequently, regardless of the model approach chosen, each fails to sufficiently analyze what is found to be an incomplete set of variables and provide a comprehensive representation of efficiency and effectiveness. This is an important distinction to make, as the advocates of each approach typically fail to acknowledge the shortcomings of their model, while touting its universal application. Further, the lack of acceptance of any one approach hinders the application of a standardized evaluative model that could assist police agencies in embracing an organizational learning framework. While the scope of this study is limited to police change management and organizational reform, it is important to note that the lack of an industry standard further contributes to the current crisis affecting many police services.

Many police services are looking for a 'quick fix' solution to their efficiency problems and the prospects of a 'scientific' evaluative tool that is marketed as a
fix-all solution holds considerable appeal. However, this course of action is wrought with pitfalls and negative consequences. Not only does it hold the illusionary goal of optimized efficiency based on flawed products, but also it falsely misguides police services into ignoring the equally important aspects of efficiency, namely the establishment of clear organizational goals and objectives, and the elimination of entrenched inefficient practices such as unit specialization. With these issues in mind, each model approach will be scrutinized below.

3.3.1 Queueing

Queueing modelling is used to make predictions on a particular process or system using mathematical models. It is primarily concerned with how long it takes to serve a customer, how many resources are needed to process a select number of customers at a specific time and how many people are expected to be waiting in a queue at a set time. When applied to this situation, the analytical solutions are used to optimize the system, minimize wait times and allocate servers (resources) to meet demand (Moonen, 2005). Several industries use queueing to optimize service delivery and maximize efficiency based on consumer demand; the most common being airline scheduling, telephone companies and the computer industry.

As well, queueing has been modified and adopted for analysis of police patrol operations. Much of the police queueing modelling research was initiated in the 1970's, with Richard Larson leading the development in the field and the introduction of a new evaluation tool called Enforcement Manpower Resource
Allocation System (LEMRAS) (Chaiken, 1978; Larson, 1972). Iterations of LEMRAS were first operationally used for allocating resources for the St. Louis Police Department, which then opened the door for further research and development based on this research. Shortly after, the Police Resource Allocation Program (RAP), PCAM and a host of other programs that were custom created for police agencies, became readily available. Most were extensions of LEMRAS and Larson’s research, and all had the capability to describe performance statistics for allocation purposes, but they differed in their capabilities to accurately allocate patrol resources (Chaiken, 1978).

During this period of growth in analytical strategies, no single program or modelling technique was universally accepted and implemented, “as each had virtues as well as suffering from inadequacies not present in the other” (Chaiken, 1978, p. 1280). This lack of consistency and questionable solutions also impacted acceptance by law enforcement, as “police departments considering a patrol allocation program had several competing alternatives, none of which was entirely satisfactory” (Chaiken, 1978, p. 1280).

From the 1970’s onward, further research was conducted on patrol deployment, additional queueing models were created and private sector companies began creating their own proprietary models for the police market. However, the main objectives of patrol deployment remained constant, as did many of the tradeoffs between the benefits and deficiencies of each new queueing model. In short, queueing analysis continued to be used by police agencies on a limited basis and was typically restricted to a determination of the
number of officers needed to ensure a high probability that an officer will be available to respond to an emergency 911 call. This was based on the ability to provide the number of police units available at a given hour for every day of the week. Other variables considered included the shift scheduling of officers, whether that be a four-day cycle of work or a five-day cycle. As well, certain assumptions were made, for computational reasons. These generalizations, in turn, affected the overall accuracy of the model.

Currently, there are several commercially-available programs that perform queueing analysis and several private companies that will conduct patrol audits on behalf of the police service. This provides an organization with a set figure on what its deployment profile should look like. Most of these options are quite costly and only provide a one-time analysis of deployment.

There is also queueing modelling software available that falls within the public domain, with no purchase fee attached to its use. One such modelling software is called QTP, which was designed under the auspices of the University of Alberta Teaching Research Fund and Natural Sciences and Engineering Research Council of Canada with the most recent development engineers, Armann Ingolfsson and Fraser Gallop. Queueing modelling software performs a series of statistical calculations to determine factors like wait time, length of time expected in a queue and model efficiency. As well, most queueing models can determine the resources required to prevent stacking and possible schedules that can optimize efficiency.
However, there are shortcomings in many of the queueing models in use for police patrol. Primarily, there are a limited number of variables examined to make recommendations (Moonen, 2005). While queueing models can be adapted to incorporate more extensive modelling criteria, this is a costly enterprise and one where many police organizations do not have the statistical data available to enhance these models reliability and validity. For example, QTP uses average ‘service time’ as a base factor for the models calculations. Yet, from a policing perspective, there is no realistic value that can capture a standardized average service time for a call. This value fluctuates on an hourly, daily and seasonal basis and any attempt at averaging would seriously undermine the accuracy of the model (Green, 1989).

Other criticisms of queueing modelling stem from the inflexible nature of the models that are confined by mathematical rules and assumptions that cannot wholly adjust for real-world situations. These mathematical assumptions are necessary for modelling, yet are often unrealistic. For example, queueing models assume there is an infinite capacity within a system to accommodate demand (Green, 1989; Moonen, 2005). In other words, queueing models assume there are an infinite number of servers (police units) available to respond to calls for service. While in some modelling situations this assumption may be statistically insignificant, in others it can have a dramatic effect, rendering the analysis meaningless. Moonen’s exploration of the merits of queueing for police patrol analysis identified a series of shortcomings:
This comes as no surprise, because analytical models (queueing) require stringent assumptions to remain tractable. But these assumptions are sometimes in conflict with practice... rendering classical queueing models useless (Moonen, 2004, p.12).

Assumptions and practices that Moonen identified as problematic for queueing models were priority designations of emergency 911 calls, the practice of pre-empting lower priority calls, travel time, and travelling from one emergency call to another, to name a few (2004).

Reviews of the widely used queueing model for police patrol called Patrol Car Allocation Model (PCAM) identified similar shortcomings. For example, New York City initiated a review and assessment of its own queueing based patrol car allocation system, which it routinely relied upon to allocate patrol resources (Green, 1989). In testing the validity of PCAM, several issues emerged. Most notable was the queueing model significantly underestimated delays and the "nonstationarity of the call arrival process may distort the predictions" (Green, 1989, p.146). By nonstationarity, Green was referring to call rates being influenced by season, weekday versus weekend, geographic location and time of day. While these factors have a strong influence on the distribution of calls, mathematical models and subsequent forecasting encounter difficulty when confronted with nonstationarity. Even though there are statistical methods available to control for nonstationarity, these processes can negatively influence the accuracy of predictions. Similarly, Larson noted that PCAM distribution of service times was a very crude fit for most cities (1972). Moonen’s evaluation of PCAM identified further issues with the queueing model in use by police
agencies. In his research, he noted PCAM failed to account for and subsequently measure travel time as a component of total service time (Moonen, 2004). In metropolitan centres where travel time was a factor in responding to calls for service, this would be a significant shortcoming. Moonen also identified other issues with PCAM that influenced its reliability for patrol deployment. Specifically, the level of detail provide by PCAM was far below the level required to make informed organizational changes:

PCAM works at a rather too aggregated level to fit our definition of patrol deployment, although it is claimed that PCAM is an allocation model. After all, PCAM is insensitive to the actual locations of the patrol units (Moonen, 2004, p.16).

Interestingly, Green noted the absence of research literature that examined the validity of queueing models where human behaviour was a major factor in the system (1989).

There are many influences on patrol deployment that go beyond call-rate and number of units available to respond to calls that are not captured through this type of analysis used in isolation. Qualitative analysis of policy decisions, reviews of organizational practices such as the creations of specialty units and factors influencing overtime, cannot be examined using a strictly mathematical approach. Therefore, agencies that turn to queueing modelling to solve their problems are short-sighted by limiting their review to only one factor that influences organizational efficiency. Systemic issues are rarely addressed by examinations that are severely limited in scope and fail to touch on broader influences and implications that more globally affect organizational efficiency. At
a pragmatic level, there is resistance by police agencies to explore queueing theory-based approaches, as it is difficult to use and understand, even more difficult to explain the results and it requires substantive data extracted from police dispatch systems in order to function (NWUCPS, 2004). While queueing modelling does have value to the field of patrol deployment and shift scheduling, it cannot be used as a standalone solution and must be part of a more detailed evaluative process.

3.3.2 Commercial & Public Domain Products

There are at least four well-known, commercially and publicly available products that claim to analyze patrol workload and facilitate the building of shift schedules using queueing modelling and statistical computations. The four software products are Managing Patrol Performance (MPP), Staff Wizard, Police Allocation Manual (PAM) and Patrol Car Allocation Model (PCAM). Each product is premised on establishing patrol staffing requirements based on an analysis of a variety of variables extracted from CAD. However, each approach has many of the inherent weaknesses identified in the previous discussion, such as failing to address travel time, using assumptions and averages that can skew data results, applying theoretical relationships that have not been fully validated in police operations, and neglecting to account for seasonal variations (Chaiken, 1978; Green, 1989; Larson, 1972; Moonen, 2005). Regardless, the use of the products can still provide valuable insight into general areas of concern and inefficiency. Agencies that lack the analytical and technical capability to examine their patrol
operations in detail, can benefit greatly from an off-the-shelf solution. Most commercially available products are relatively easy to implement, do not require a highly skilled staff to operate and provides user-friendly reports for management that are easy to understand. Considering each product is marketed on the pretence that it can provide an optimized deployment model, including the number of officers required to staff these models, they are considered prescriptive models.

MPP is one of the foremost commercially available products that use queueing modelling to determine deployment schedules that can match existing workload. MPP has gone through multiple iterations and has benefited from advances in police deployment research in the field of queueing modelling, most having been conducted by academic researchers. MPP was developed by a private consulting company, Police Management Advisors, to simulate how workload and police resources affect patrol performance (Broom, 2004; Sullivan, 2001). Key features of the software include a capability to model a police agency’s staffing requirements in a specific geographic area, by day of week and time of day.

To perform calculations that comprise part of the mathematical model, MPP requires a significant number of variables from CAD and very specific organizational goals and targets in order to function. Specifically, it requires response time targets and policy expectations and benchmarks to be established in advance by the organization (Broom, 2004; Sullivan, 2001). The amount of time available to engage in proactive policing, otherwise known as unallocated
patrol time, must be established by the organization and the optimal response
time to priority calls must also be determined by the police agency. Common *pre-
canned* settings include a 7-minute priority-1 response time, 40% proactive time
and 2 units free at any given time (Harris, 2001; Sullivan, 2001). The
recommended deployment to achieve these results are based on mathematical
solutions using queueing modelling, specifically, the well-known Hypercube
queueing model, which simply evaluates the performance of a user-specified
district design and allocation (Chaiken, 1978; Moonen, 2005).

The variables that MPP uses are gleaned from an agency's CAD system.
They include average travel time, average call rate, percentage of calls requiring
multiple units, average time spent on calls, average number of units fielded,
average administrative time, percentage of priority type calls and the total area of
the policing jurisdiction (Calgary Police Service, 2005). With this data, MPP is
able to make predictions, run hypothetical scenarios and determine the effects of
a variety of factors on patrol performance. As a prescriptive model, MPP can
project potential response times to a range of priority calls and test potential new
staff deployment levels in policing districts, in advance of the actual
implementation. Essentially, MPP provides a means to predict staffing levels
based on the data collected from the organization in order to achieve the most
efficient deployment.

However, caution is warranted before rashly accepting these capabilities
and results. As mentioned, MPP uses a computerized mathematical model that
employs queueing theory to generate results. Issues associated with police patrol
and queueing bring into question some of the assumptions and generalizations that queueing models require in order to perform its calculations. For example, police focused queueing models universally fail to address travel time in a meaningful and reliable manner (Chaiken, 1978; Larson, 1972; Moonen, 2005). Other shortcomings stem from the lack of transparency afforded in commercial products. Trade secrets and proprietary technology prevent open style architecture that is more conducive to customization and a review of a program's underlying assumptions. From this follows a lack of flexibility, whereby MPP was not designed to account for budget constraints, socio-economic factors and police overtime usage. As will be explored later in this study, the use of overtime can significantly alter and skew performance measures. These performance measures form the basis of the queueing modelling calculations and assumptions in which the mathematical models are built. Therefore, it makes sense that results based on flawed data would be erroneous as well.

**Staff Wizard** is another commercially available queueing software program that is distributed by Corona Solutions, a consultancy and development company that focuses exclusive on emergency services clients, with many products tailored for law enforcement purposes (NWUCPS, 2004). Even though Staff Wizard is currently distributed by Corona Solutions, it was originally developed and built using public domain technology created for the National Institute of Justice in the 1990's for a patrol queueing program called *Patrol/Plan* (NWUCPS, 2004). As with other queueing based software programs, it relies on
extensive extracts of CAD data to generate optimized schedules to meet predetermined organizational objectives.

Limitations of the software include those already identified in the preceding discussion on queueing modelling in general, but also encompass specific issues related to the program itself. For example, Staff Wizard lacks a capability to incorporate performance objectives related to officer-initiated calls, likely a result of the software not being improved on its basic capabilities since the original Patrol/Plan program in the 1990's. This shortcoming can result in estimates of patrol intervals that are unrealistically low (NWUCPS, 2004). Other limitations rest with the substantive cost associate with the software, which can run in the hundreds of thousands of dollars, depending on the size of an organization.

Similar to MPP, Staff Wizard lacks transparency, in that the software performs predetermined calculations and queueing modelling that the researcher cannot modify, nor evaluate. Because Staff Wizard is a commercial product, the underlying structure of the queueing model is not user accessible (NWUCPS, 2004). This raises concerns as to the results provided and the ability to adopt the software for more strategic analysis. Unanticipated influences, such as irregular shift distributions and organizational demands, would require customization of the software and the underlying assumptions of the queueing model. This brings into question the flexibility of the software to meet an agency's patrol analysis needs beyond the software's predetermined query capacity.
PAM was developed by the Northwestern University Centre for Public Safety with the purpose of creating a user friendly method for estimating the number of officers required to staff patrol (NWUCPS, 2004). PAM was first introduced as a staffing and allocation manual in the early 1990's after several years of research and development where the product was tested and validated in the policing community (NWUCPS, 2004). The main goals of PAM were to provide management with the ability to determine how many officers it required to staff patrol and how these officers should "be allocated by geographic regions or time periods to maximize agency productivity" (NWUCPS, 2004, p. B-3). The PAM model is a compilation of various procedures used to determine deployment and staffing levels, which are packaged in a series of worksheets with accompanying methods for collecting and interpreting the results. Compared to MPP and Staff Wizard, the PAM model is quite transparent, with its assumptions, formulas and mathematical calculations clearly articulated, in a user-friendly and accessible format. With ease of use, a primary consideration in its development, the manual only requires rudimentary patrol-based data that are then used in fairly straightforward and coherent calculations.

However, the manual still suffers from some of the same issues as other exclusively mathematical approaches in that it offers a very generic model that cannot be expected to accurately analyze urban police agencies that range in size, composition, geography, crime control issues and management styles. Further, PAM is limited in its capability to provide estimates of the average number of patrol officers required for each day and district. As a strictly
descriptive model, there is no capacity for determining the ideal number of patrol members required when variables, such as workload, fluctuate because of organizational changes or crime control strategies. The inability to compensate for an oscillation in performance variables precludes Staff Wizard from optimizing patrol performance. Similarly, evaluations of the current state of patrol efficiency or in many cases, the lack of deployment efficiency, cannot be performed using PAM. Other prescriptive outputs, ranging from the redistribution of patrol boundaries for optimal efficiency to optimization of shift schedules, are not possible with PAM. This further limits its value as a comprehensive analytical tool for patrol deployment.

As noted in the preceding discussion on queueing, PCAM is another popular queueing model that examines and analyzes police performance measures. PCAM attempts to identify the best delineation of police district boundaries using sophisticated algorithms. The results of this geographic analysis are then used to optimally assign patrol cars within these districts according to a prescribed performance measure. By applying this approach, the model claims to balance the effective use of patrol cars to workload according to geographic location. The main benefit of the model is the ability to minimize disparity between the maximum workload and the minimum workload of patrol officers distributed throughout a metropolitan centre. However, as illustrated in the queueing discussion, PCAM shares many of the inherent weaknesses associated with queueing modelling, not the least of which are questionable
reliability, a dependency on averages and assumptions for base calculations, and computations that do not address all aspects of travel time.

### 3.3.3 Simulation

Simulation modelling is another form of analysis that has been adopted for examining police deployment. This approach differs from a strictly mathematical model, as it can model far more complex systems with extensive possibilities and address multiple influences on a system that does not remain constant (Moonen, 2005). Influences such as seasonal variations, inconsistent demands and a range of outcomes can generally be addressed with this approach. By manipulating variables, researchers can understand how a modelled system may respond to organizational policy decisions (Larson, 1972). Simulation modelling is not constrained by mathematical assumptions that are required for queueing models. Therefore, simulation models have been used, “when the mathematical models are unsolvable or when necessary assumptions of the mathematical and analytical models are violated” (Moonen, 2005, p. 12). Due to the nature of simulation modelling, it is limited in its ability to provide tangible solutions as a strictly descriptive approach. While it can describe the expected results of a change in practices, it does not result in an optimized solution, such as in queueing modelling (Larson, 1972; Moonen, 2005). Despite the benefits, the use of simulation modelling for patrol analysis has been somewhat limited to-date, with recent developments in emergency services dispatching strategies emanating from the private sector (Larson, 1972; Moonen, 2005). Interestingly,
police agencies themselves have not capitalized on the analytical approach to patrol deployment.

3.3.4 Performance Measures

The general category of performance measures captures a whole host of analysis techniques that have been employed over the years; some dating back to the 1960's (Larson, 1972). While generally falling within the realm of descriptive models, these techniques commonly analyze the interrelationships between different parameters that influence time spent on calls for service and the distribution of workload over time.

While this approach avoids the limitations placed on a strictly mathematical formula, it relies essentially on descriptive statistics and interpretation to generate alternative models. As well, the analysis of performance measures can incorporate some elements of prescriptive modelling by examining ways to optimize officer time spent on calls. Determinations are commonly based on the interrelationships between utilization of patrol resources and time, measured against performance criteria, such as thresholds for unallocated time, and efficiency targets (Larson, 1972). Other variables that can be considered range from response times by priority, organizational practices and agency structure. Therefore, more approximate and less optimized results are generated, but with the added benefits of considering variables and influences on workload that cannot be accommodated or reliably calculated through a strictly mathematical queueing model. Factors such as overtime
expenditures and less tangible qualitative variables, such as an organization’s policy framework and collective bargaining constraints, can be integrated into the analysis.

Given these conditions, a non-queueing based analysis of performance measures is not considered a true analytical allocation model. This categorization does not, however, negate the merits of this type of analyses, which relies on a more comprehensive and flexible approach.

3.3.5 Summary

In spite of the fact that evaluations of police resource efficiency have been infrequent and inadequate, an equally troubling detail is the trend towards flawed assessments based on commercially available products that are marketed as ‘quick-fix’ solutions. Queueing modelling in general has been shown to fail to address travel time, use assumptions and averages that can skew data results, apply theoretical relationships that have not been fully validated in police operations, and neglect to account for seasonal variations to name a few issues (Chaiken, 1978; Green, 1989; Larson, 1972; Moonen, 2005). The use of simulation modelling is only slightly better and the application of performance measures is so diverse and inconsistent that the results are open to wide interpretation and unreliable model creation. The more troubling aspect of these trends in evaluative practices is that they erroneously manipulate police services into a superficial review of their operations while overlooking issues that are
symptomatic of entrenched inefficient practices and they do nothing to break the cycle of traditional bureaucratic hierarchies.

In the ensuing examination, attention is turned to those best practices that hold the greatest potential for organizational reform in the delivery of patrol services. Unlike a strictly theoretical approach for assessing efficiency and modifying resource deployment, the following best practices have demonstrated real and measurable benefits to police efficiency based on applied, real-world trials.

3.4 Beat Assignment

Recent developments in policing include the assignment of beat responsibility as a way to enhance the effectiveness of patrol officers. The main premise behind beat responsibility is that an officer should attempt to develop a geographic identification within the patrol beat that they are assigned to (Harris, 2001). A beat or sector refers to a relatively small geographic area, usually four to six blocks, where patrol officers are assigned to work on a consistent basis. This facilitates patrol officers becoming familiar with community needs, unique crime patterns, trouble spots and policing issues within their beat (Broom, 2004). Further, any crime reduction or proactive policing initiatives are expected to be led by the officer responsible for that beat. Most calls located within a particular geographic area are fielded by the responsible beat officer. From a tactical perspective, this enhances the ability of officers to respond quickly to calls within their beat, as this is the area from which they operate. Officers who are
consistently assigned to the same beat are more likely to develop a stake and sense of ownership over the area. In turn, officer-citizen information sharing and communication improves (Broom, 2004; Harris, 2001). The result is proactive and focused police attention on problem areas and an increase in the effectiveness of patrol units; often regarded as a best practice by literature on the subject (Broom, 2004; Harris, 2001). This allows police to target recurring crimes, repeat offenders, and problem premises, resulting in a more effective method for reducing crime.

3.5 Roving Patrols

Roving patrols, otherwise known as metro patrols established for cross-district dispatching, are a cost effective way to maximize available resources while not creating a large number of new shifts and teams to staff them. Roving patrol work as a city-wide resource that is available for dispatch to areas of the city that are experiencing the greatest demand for service (Cleon, 1973; NWUCPS, 2004). In circumstances where the call-load is evenly distributed, the roving patrol can also be distributed evenly to the city’s districts. This is a fluid resource that adjusts to call-load variations in a very uncomplicated manner. For example, on any given day, a police district may experience a series of bank robberies that has the potential to monopolize police resources within the district for a considerable amount of time, rendering them unavailable for further emergency calls for service. This can create call stacking and a serious disruption in service for adjacent districts if police units are called from
neighbouring districts to help lessen the resource crisis. In this situation, a *roving patrol* team could be deployed to the district on a temporary basis to assist with taking calls, while the remaining units finish attending the bank robbery calls. Neighbouring districts would be left unaffected and a resource crisis could be averted. This is a very efficient use of resources, as it only requires the creation of two additional teams that can have a similar effect on call utilization issues as the creation of eight new teams (two teams per district using a four district model).

*Roving patrols* can also be deployed according to crime trend analysis to target areas where issues are developing. The fluidity in deployment of the *roving patrols* makes them a crucial resource for selective enforcement without diminishing the ability of neighbourhood and district patrol teams to respond to emergency calls for service. *Roving patrols* are in use by major metropolitan police departments in the United States, as it provides a means to address crime issues with a limited number of officers operating in an environment of reduced organizational staffing (Cleon, 1973; NWUCPS, 2004). In fact, the ability for selective and concentrated enforcement with very few officers, makes this a recognized alternative to the creation of multiple specialty squads based on geography and crime type. Selective creation and deployment of *roving patrol* squads can reduce the total number of squads needed in patrol and reduce the total size of regular patrol squads by providing a backfill capacity where needed (NWUCPS, 2004). However, the success of *roving patrols* is premised on the
ability of a police service to identify crime trends in a timely and accurate manner and deploy the units accordingly.

Despite a past reluctance towards change and reform, in 2007, the VPD proposed the creation of two metro roving teams, with a deployment date set for 2008. While inconsistent with previous organizational practices identified from 2000 to 2005, the most recent changes seen in the VPD indicate a movement towards progressive change. The most recent adoption of evidence-based practices within the VPD will be examined in detail within the Epilogue.

3.6 Shift Scheduling

A detailed analysis of efficiency looks at ways that scheduling can improve patrol efficiency. Modification of an existing deployment model, or the complete redesign of the way officers are scheduled, depends on whether the analysis indicates a very low level of efficiency or whether only minor modifications are necessary to optimize the current system. Another factor to consider is the level of efficiency desired. No deployment model can achieve perfect efficiency, as there are always tradeoffs between gains in one area and losses in others. Less tangible issues such as quality of life, which can have a detrimental effect on morale, must also be weighed when any proposed changes are considered. Efficiency gains must also be weighed against costs associated with certain proposed deployment models.

Typically, an eight-hour shift creates the best options for scheduling resources to meet demands for service (Bellmio, 2004; Broom, 2004; Sullivan,
2001). The creation of eight-hour shifts results in more shifts available within a 24-hour period, providing management with more shift deployment alternatives. However, in a large department this can create an undesirable consequence of a prohibitively large infrastructure requiring a large number of managers, support services and equipment. As well, it creates a substantial number of shifts to cover a 24-hour period; far more than is cost effective compared to efficiency gains that are acquired. Conversely, twelve-hour shifts provide less flexibility for managers to schedule shifts to maximize efficiency and match resources to service demands (Bellmio, 2004; Broom, 2004; Sullivan, 2001). Yet, twelve-hour shifts require the least amount of infrastructure to support, making it cost effective and easier to manage. Therefore, a compromise between the two extremes is the most desirable option, taking advantage of the best each has to offer.

A common problem with police agencies is the deployment of an equal number of officers on different shifts to simplify shift rotation. Few agencies have an equally distributed workload throughout a 24-hour period. In fact, it is widely accepted that there is more criminal activity at night than during the morning or afternoon (Harris, 2001). This equates to a higher demand for more patrol officers during busy times than at slower times. Despite this, the practice of rotating an equal number of officers through a new shift cycle at regular intervals is common. The easiest solution to this dilemma is to have 'fixed shifts'. Fixed shifts refer to the practice of assigning a fixed number of officers to work a specific shift on an indefinite basis. This bypasses the need to cycle through
shifts and permits the allocation of a specific number of patrol officers according to demand for services (Harris, 2001). There is no longer a need to have an equal number of officers assigned to each shift, as the shifts no longer rotate or cycle.

Another important factor to consider when developing a deployment model is the total police resources available. Independent of considerations for the total number of officers available to respond to calls, scheduling must account for the workload variation and take steps to equalize these fluctuations by adjusting deployment. One of the main goals of scheduling is to even out workload across the hours of the day and days of the week, and to establish a deployment model that assigns officers to work at times of greatest demand. A further difficulty is designing a shift schedule that does not artificially create times of peak inefficiency during shift changes.

The elimination of gaps between the end and start of shifts is a complex endeavour. Several competing issues must be addressed for everything to function smoothly. For example, multiple shifts should only provide coverage during times of high demand for service. At times of lower call demand, a reduced number of resources should be scheduled. While at first glance the concept appears reasonable, it is the transition between the two that can be problematic. Even during times of low demand, an improperly scheduled shift transition can create chaos for the oncoming shift. Inadequate overlap can create a substantial spike in the utilization ratio, where the oncoming shift can spend a considerable amount of time playing catch-up with stacked calls. This artificially
created inefficiency can be resolved by creating an overlap at the time when the
shifts start and end. However, when operating with a set number of shifts, the
change of one shift's start time to an hour earlier can have a cascading effect, by
eliminating an overlap that may already exist at the shifts end time. The only
viable solution is to create additional shifts to fill the inefficiency gaps or to accept
that a certain degree of inefficiency is acceptable. Either option has a
consequence in terms of increased cost for additional teams or reduced service
levels.

The process of staggering shifts start and end times to reduce inefficiency
spikes is also problematic unto itself. A one hour overlap between the ending of
one shift and the start of another is not the most desirable option either; the
rationale being that officers are more productive during the middle of their shift
than at the start or end. Another strategy to address this issue includes
staggering shifts at half hour intervals to provide a greater spread in overlap.
While shift staggering issues can rarely be eliminated entirely, steps can be
taken to mitigate the disruption, but with a compromise for any solution adopted.
4. ORGANIZATIONAL AND OPERATIONAL STRUCTURE

The following chapter provides an overview of the Vancouver Police Department organizational and operational structure. This overview is further framed within a discussion of the social, political, economic and cultural environment that it provides services to the community and the particular demands that are placed on the organization. Topics that are analyzed in the Implications Chapter are also contextualized below in terms of how they relate to a police service's ability to manage and assess the effectiveness and efficiency of its operations. Generally, the manner in which a police service addresses crime control issues, such as through the effective deployment of its resources, can be indicative of the organizations' capacity to facilitate change management practices. Before an analysis of patrol deployment efficiency is conducted, particular components of patrol operations are considered within the backdrop of the Vancouver Police deployment model in use between 2000 and 2005. This will help structure the later discussion of key aspects and measurements of patrol deployment efficiency, such as emergency response times and overtime usage. It is also important to consider that patrol operations manage the majority of demands for service placed on a police agency. The manner in which patrol officers are tasked and deployed can be symptomatic of problems with organizational change, resistance to reform and a lack of core capacity to assess...
its effectiveness and efficiency on an ongoing basis. It is from this point of reference that the Vancouver Police Department is examined.

4.1 Vancouver Police Department Overview

The Vancouver Police Department has been in existence since 1886 functioning as a municipal police force for the City of Vancouver (termed COV). The VPD has 1,214 sworn officers to police a jurisdiction of 114 square km, with a city population of approximately 587,000 (BC Stats, 2006; VPD, 2006). In contrast, the surrounding municipalities of Burnaby, Richmond, University of British Columbia Endowment Lands and North Vancouver are policed by the RCMP who are employed on a contract basis to fill a municipal policing role.

Due to a relatively small residential population compared to the combined regional population of approximately 2.15 million, City of Vancouver suffers from what has been termed “core city syndrome” (BC Prov Gov, 2006; GVRD, 2006). “Core city syndrome” refers to a city centre that is surrounded by a suburban area that has a substantial residential population. In terms of City of Vancouver, only 27% of the region’s population lives within the city limits, with a remaining 1.56 million people living in the surrounding 11 municipalities (BC Stats, 2006). However, the metropolitan centre has over 370,000 vehicles enter the city on a daily basis, with an additional 100,000 commuters travelling into the city on transit (COV, 2006; GCRD, 2006). Consequently, crime rates are not representative of the actual population policed and metropolitan police departments typically police a larger non-residential population that includes
elements of the surrounding municipality's residential population. As well, a core city is often a focal point for entertainment, special events, recreation, travel, tourism and commerce. In the City of Vancouver context, the metropolitan centre is also a major port, further adding to the transshipment of commodities, as well as narcotics.

The head of the VPD is a Chief Constable who reports directly to an oversight body termed the Police Board. The Police Board is comprised of six appointed civilian members and the City of Vancouver Mayor, who also chairs the board (VPD, 2004). The creation of police boards stems from the notion of insulating the police from political influence, while still maintaining community representation and input. Historically, political influence was problematic:

America's urban police were heavily "penetrated" by the direct manipulation of local political machines. But the influence of machines waned, as over the next half century, the reform ideal was to seek ways to block such influence or weaken it through various "good government" filters (e.g. a professional appointed city manager) (Mastrofski, 2007, p.17).

Technically, the board controls policy and financial matters in spite of the fact that the City of Vancouver, via the City Council, ultimately controls the budgetary process and the allocation of funds (Malesan, 2004). As such, while the board was established to maintain a separation from political influence, the COV exercises considerable influence on the VPD by determining which programs to endorse via the budgetary process and how many new positions will be funded. The fact that the police department comprises 16% ($165 million dollars) of the
total municipal budget and is the single largest municipal expenditure, ensures its place as a controversial political issue (City of Vancouver, 2005).

Organizationally, the VPD is comprised of four divisions: Operations, Investigations, Operations Support and Support Services, each with a distinct area of responsibility and specialized policing function (VPD, 2004). The Operations Division, otherwise known as Patrol, is the focus of this study and encompasses the largest segment of the police organization, with slightly over 500 sworn officers including supervisors. The majority of positions in this division belong to uniformed patrol teams that are organized around responding to emergency 911 calls and a range of less serious calls for police assistance.

Patrol teams are deployed 24 hours a day, 7 days a week, with rotating shifts designed to ensure sufficient police officers are available to respond to calls for service. In addition to responding to 911 emergency calls, patrol teams provide a visible policing presence in the community and engage in proactive policing activities to prevent and reduce crime. Part of this function involves addressing community concerns before they become problematic, such as engaging in innovative approaches to tackle neighbourhood crime issues. In addition to general response and patrol duties, the Operations Division also includes a multitude of specialty units that support patrol functions, such as general investigations, chronic offender unit, property crime unit, and problem oriented policing to name a few. All total, there are 18 units that perform specialized functions in support of patrol operations (VPD, 2004).
The *Investigations Division* houses the majority of detectives who possess specialized expertise in criminal investigations. They investigate the more serious crimes committed against people, such as homicides, robberies and sexual assaults. Crimes that have been identified by patrol members, but require extensive follow-up and attention, are referred to the Investigation Division. This is premised on the notion that patrol members have insufficient time, expertise and resources to adequately investigate serious crimes.

The *Operations Support Division* provides specialized services to other areas of the Department such as support to criminal investigations and patrol initiatives. The division includes the Criminal Intelligence Section, the Gang and Drugs Section, the Emergency Response Section, and Emergency Operational Planning Section. As the names imply, these units and others within the division possess expertise in a variety of fields that are required for the effective and safe operation of the police department.

The majority of the administrative functions within the organization are housed within the *Support Services Division*. Finance, Facilities, Human Resources, Information Technology and other administrative and technical sections are included within this division. The majority of the civilian staff are employed within this area of the organization, as the duties usually fall outside the traditional areas of policing and are more akin to a corporate structure.

For administrative reasons the 23 unique cultural, ethnic and geographic communities of the city have been divided into four separate policing areas called
patrol districts (VPD, 2004). Each patrol district, designated one through four, are overseen by a district commander who is responsible for ensuring the police under her/his command meets the needs of the communities. In broad terms, District One encompasses the downtown business core, District Two the north-east side of City of Vancouver to Burnaby, District Three includes the south-east segment and District Four the south-west side.

Each district and the corresponding neighbourhoods within them have unique policing issues and concerns that will be addressed in detail in the following section.
4.2 Patrol Districts

4.2.1 District One Environment

District 1 has been noted as the district that has experienced the greatest growth and transition within the past 10 years compared to any other area of the city. For example, District 1 has seen a population increase of 52% from 1993 to 2001 (BC Provincial Government, 2003). Furthermore, from 2000 to 2006 the population continued to grow, recording an increase of 12.9% or approximately 9,670 people (BC Stats, 2006). This population increase becomes significantly more pronounced when contributing factors such as an estimated 125,000 commuters enter the district during the day, according to GVRD estimates (GVRD, 2006). During the summer months, visitors to the city peaks, as do the tourists associated to the cruise ship industry. The city’s over 10,000 first-class hotel accommodation reaches capacity at this time of year and special events such as the *Symphony of Fire* (fireworks display) draws large crowds from neighbouring municipalities (Vancouver Board of Trade, 2005). Regardless of season, it is normal for the downtown core to be bustling with activity throughout the year.

Similarly, licensed premises seating capacity has increased by 20% from 1998 to 2001 within the downtown core (Meeres, 2003). The impact on police resources has been most significant within the Granville Mall area, where late night bar crowds and intoxicated persons have created social disorder problems for police (e.g. assaults, disturbances, noise, intoxicated persons). These changes and other contributing factors resulted in the VPD approving an
additional 33 officers for the district. This benefited the District by increasing patrol team strength to approximately 13 officers, versus a previous team strength of approximately 9 officers, depending on individual teams. However, while these officers were added to the authorized strength on October 4th 2005, their actual deployable strength did not come into effect until late 2006, after a lengthy recruiting and training process.

4.2.2 District Two Environment

District 2 has traditionally been viewed as a district with an intense workload. This is partially attributable to the inclusion of the Downtown Eastside (DTES), which is a significant consumer of police resources. Despite the fact that it only comprises 3% of the city population, the DTES is responsible for nearly 18% of all calls for service compared to the remainder of the City of Vancouver (Dandurand et al., 2004). The DTES has been characterized as the worst open drug market in Canada and home to the most socio-economically disadvantaged residents of the city. The majority of City of Vancouver’s homicides and overdose deaths occur within District 2, and it is generally regarded as having a higher than average crime rate compared to other districts in the city (Dandurand et al., 2004).

In April 2003, the DTES experienced a patrol-based initiative to restore order and assist a community in crisis. The City-wide Enforcement Team (CET) was premised on a highly visible police presence aimed at restoring order to one of the most impoverished and drug filled areas of the city (Dandurand et al.,
2004). This resulted in an additional 56 patrol officers being added to the area. In 2006, CET evolved into the Beat Enforcement Team (BET) and by default, the 56 officers augmented the District 2 authorized strength. In fact, the majority of officers within CET/BET originated from District 2, augmented by officers drawn from throughout the Department.

An important distinction must be made with CET/BET initiative, as these officers are used exclusively for enforcement and proactive initiatives in the Downtown Eastside, and do not take calls elsewhere in the district. Further, CET/BET is a beat enforcement team, meaning they are mainly foot-patrol based, and therefore are not typically used to respond to 911 emergency calls unless the officers are in the immediate area. That does not mean CET/BET officers do not respond to calls in the DTES, but rather that is not the focus of their deployment. The CET/BET is premised on a proactive enforcement strategy and the ability to address on-view incidents, meaning, taking immediate action as situations unfold in plain view of the beat officers. It also involves officers taking proactive measures to address repeat and systemic issues in their area of responsibility.

As is apparent, the inclusion of CET/BET in the analysis for District 2 is a complex undertaking. Where possible, this issue is addressed by both including the data in the analysis and by also excluding the data. This compare and contrast approach serves as a means to illustrate the impact the initiative can have on resource deployment.
District 2 also includes the areas east of Clark Drive to Boundary Road, which encompasses several gentrified neighbourhoods, as well as middle income and lower income areas with diverse policing needs and unique service requirements.

4.2.3 District Three Environment

District 3 encompasses one of the more ethnically diverse and stratified areas of the city. While the majority of the district is primarily single-family residential housing, the highly concentrated businesses along Kingsway and Main Street represent a unique challenge to police, due to a high demand for emergency services. The distinct neighbourhoods and sub-communities that are characterized throughout the policing area compound this challenge. Further, the SkyTrain transportation corridor that cuts through this district also impacts policing issues and the distribution of crime. For example, areas that were previously less accessible, except by vehicle, are now easily targeted by criminals that make use of the transit system to both aid in their movement and to avoid apprehension.

Geographically, District 3 is considerably larger than Districts 1 and 2, which has an impact on response times. Resources available to take calls in District 3 comprise slightly less than 1/3 of all patrol units in the city.

Community changes that impact the current deployment model include an increase in licensed establishments and licensed seating capacity within the district. This has influenced the late night calls for service and created similar
trends to those seen in Districts 1 and 2, which in the past were primarily where drinking establishments were located (Meeres, 2003).

4.2.4 District Four Environment

District 4 is the largest of the patrol districts. Land use in this district is primarily residential, with mixed business use scattered throughout the district, but predominantly located in the north along Broadway, Granville, Cambie, 4th Avenue, in Kitsilano and on Granville Island. The residential areas are in well-established neighbourhoods that are, generally speaking, stable and economically homogeneous compared to the other districts. The district is home to the more affluent and socio-economically advantaged citizens of the city. As was the case in District 3; nightclubs and bars are not the primary destination point within this district, however, there has been a slight increase over the years that has altered the late evening and early morning calls distribution.

Similar to District 3, District 4 response times are adversely impacted by the large geographic size of the policing area. The business corridors to the north consume a disproportionate amount of police resources, with City of Vancouver General Hospital (VGH) requiring special police attention. The higher density housing and business areas to the north also experience more disorder and crime control related calls requiring a greater police presence. In contrast, the residential areas to the south predominantly record property crime offences, but at a far lower rate than the rest of the city. As well, the light industrial use concentrated along the Fraser River primarily experience property related crime.
In terms of current resource deployment, District 4 has 25% of the total available units allocated within the city.

4.2.5 Authorized Strength

Authorized strength refers to the total number of police positions that are officially allocated and funded within each district. Each district has a different authorized strength and the patrol teams within each district, in turn, have a specified authorized strength.

The distribution of police positions to each district is loosely based on a dated analysis of the workload that produced quite rudimentary results. Consequently, subsequent authorized strength allocations were determined through ad hoc estimates, negotiations amongst management and most importantly, on available funding (Malesan, 2004). At a very basic level, prior estimates were premised on an examination of the number of calls for service. This practice helped guide the distribution of police officers, but was not the sole determinant. As a result, the latest evaluation dated back to 1995 and was the last time a review of the distribution of police members was conducted within the Patrol Division.

In general terms, authorized strength has remained constant over time, with a marginal increases noted in District 1. This is important to illustrate, as any changes in the data examined later in this study cannot be attributed to changes in the number of officers available to work. In the event of an increase or decrease in the data, alternative causes must be examined. A possibility is that
while the officers still show on the official authorized strength for the various
districts, they have been deployed to other duties. Likely explanations for this
include patrol-based surveillance teams that are comprised of patrol officers, but
whose task is primarily conducting surveillance on property offenders. In
essence, these officers show on the authorized strength of a team, but their
duties have been altered to meet other identified needs.

Other possible explanations include special initiatives throughout the
various districts. It is not uncommon for a District Commander or Inspector to
create special initiatives whereby patrol officers are assigned to deal with an
issue. While these initiatives are frequently based on problem-solving techniques
and proactive policing, the negative effect they have on patrol deployment cannot
be ignored. If, on the other hand, patrol had additional resources that allowed for
unallocated time to engage in preventive initiatives, then the redirected use of
resources would be a welcome addition to any patrol environment. However,
given the realities of a poorly evaluated environment and undefined priorities
within Patrol, an alternative use of these resources would be to maintain a strictly
911-based response to calls for service. Any proactive initiatives could then be
reviewed with the intent of maximizing officer availability to take 911 calls.

4.3 Patrol Deployment

Patrol deployment refers to the shift scheduling of police officers working
in the Patrol Division. The goal of shift scheduling is to mirror resources to times
of high and low calls for service, while ensuring there are sufficient officers
available to respond to emergency calls. Too many or too few officers working at any one time creates periods of inefficiency, which can create additional problems at other times of the day.

Generally, the VPD patrol deployment model attempts to compensate for periods of high volume of calls with an escalating increase in resources. The only caveat being that there is no mechanism built into the current system to address the gradual build up of demand for services.

The Department has five distinct shifts for each district that are staffed by two teams each, with a total of 40 teams for the entire Patrol Division. For an organization the size of the VPD, with an authorized strength of 1,214 sworn officers, 40 teams is considered quite high (Bellmio, 2004; Broom, 2004). Most other agencies the size of the VPD have on average, 20 to 30 teams (Bellmio, 2004). Of course, the higher the number of teams, and the greater number of shifts equates to a deployment model that is better equipped to schedule resources to mirror demands for service more accurately. But having a large number of shifts does not guarantee the best efficiency, as there are negative costs associated with an overly high number of teams needed to staff these shifts (Bellmio, 2004; Broom, 2004; Sullivan 2001). In the case of the VPD, this provides the opportunity to deploy teams more efficiently than organizations with fewer teams.

Each district's patrol units operate independent of the other districts. Patrol units operating within each district rarely patrol outside their designated district
and calls are rarely dispatched across district boundaries. Depending on the nature of an emergency call, a dispatcher may assign one or multiple units to respond to the scene. Each call typically has a primary responder assigned. If other units are involved in a call, they may assume a backup role or a specialized function. For example, a bank robbery would have a primary response unit, and other available units may be assigned to assist in searching for a suspect in the vicinity of the incident. As well, a police dog unit may be assigned to track the offender. In total, a single 911 call may involve multiple police units and specialized resources. The length of time each unit spends on a call varies and is dependent on issues such as other calls waiting for an emergency response, number of units available, time of day, day of week and the nature of the emergency. Some calls can take hours to conclude and require multiple units to assist in the incident. However, throughout the total length of the call, assisting units may be reassigned to other more exigent calls, depending on demand. As such, the total time spent on a call varies according to when units arrive and leave the incident. For these reasons, figures such as the total number of calls that police respond to, can severely underestimate the actual resources involved and is not considered a good reflection of the total work performed by patrol.

4.4 Overtime Usage

As noted in the Change and Reform in Police Services Chapter, overtime is a critical component to any analysis of organizational reform and serves as indication of a lack of core capacity to measure efficiency. Overtime can be used
to compensate for a poorly designed shift model and inadequately staffed shifts, potentially the product of unfilled vacancies and chronic shortages in patrol. Excessive overtime usage in patrol can be symptomatic of an inability to measure efficiency on an ongoing basis and unchecked specialization (Berkshire, 2004; Jones, 1980; Loveday, 1998). Conversely, a judicious usage of overtime can also act as a highly flexible and efficient way to smooth capacity gaps.

Within the VPD Patrol Division, overtime is used for several purposes. First, it is used for hold-back (extended tour) whereby a patrol team is held back at the end of its shift due to an unusually high workload or series of emergencies that necessitate additional resources to maintain minimum service levels. Second, overtime can be used to maintain minimum staffing levels (callout), which are important, not only to ensure an appropriate number of officers to respond to calls for service, but for the safety of those officers working and the preservation of sufficient backup officers. Callout and extended tour are the main reasons overtime is used in patrol. Prior to 2005, the VPD lacked a core capacity to monitor and measure the organizational use of overtime. However, these circumstances have now changed for the better, with the organization having developed a highly acclaimed internal process that has had a significant impact on reducing overtime usage.
4.5 Response Times

As noted in the Change and Reform in Police Services Chapter, response times, taken in isolation, make a poor performance measure. For example, priority one response times fail to capture non-emergency calls, officer-initiated calls and those calls that require additional investigative follow-up, thereby overlooking some significant demands for resources. Agencies that exclusively use response times data for evaluative purposes typically lack any core capacities to conduct meaningful analysis of their operations. However, response times can also be used as an indicator of whether a police service is meeting one of many stated service objectives to the community. This would require the agency to have predetermined goals and objectives, with clearly defined benchmarks and measurables identified in advance of the analysis. Operating from this framework, an organization could then determine whether it met its stated objectives by constantly evaluating response times against expected response times targets. It is from this point of study that VPD response times are examined.

Response time refers to the time it takes a police unit to arrive at the scene of an emergency. Within the City of Vancouver context, all 911 emergency calls are processed through the regional emergency communications centre called E-Comm. This organization operates as an independent operation providing 911 call-taking and dispatch services to the VPD on a contract basis. When a City of Vancouver resident calls 911, an E-Comm operator receives the call and processes it to a dispatcher. Every call received is prioritized according
to the nature of the emergency. The VPD uses a four-category prioritization schema numbered one through four.

Priority one calls are the most serious emergency calls that the VPD receives and usually involves a life threatening situation. This includes calls such as armed robbery, sexual assault in progress, shots being fired and other life threatening emergencies. This call type invariably requires immediate police response whereby responding police units engage their emergency equipment requiring other motorists to yield the right of way. Depending on the distance to be covered, the use of emergency equipment can reduce response times to a call. Other factors that impact response times is the availability of units to take a call. If every police unit on shift is occupied on an emergency call, then by default there are no units available to respond to new calls. This situation is referred to as call stacking.

Priority two calls are slightly less serious emergency calls than priority one, such as motor vehicle accidents with injuries. Priority three and four calls follow the same continuum of decreasing seriousness and are generally regarded as routine calls.

Taken in isolation, response times to calls for service are not a good performance measure of patrol activity. Beyond responding to emergency calls, other elements of patrol activity are completely negated when response times are used as indicator of patrol workload. The most prominent factors are officer-initiated calls, such as stopping a suspicious vehicle or proactive policing activity
where an officer may attempt to address problem premises or a neighbourhood crime problem. Response time data will not provide any indication as to the type of activity an officer is engaged in other than the time it takes to respond to a 911 call for service.

Conversely, response times, when incorporated into a larger examination and evaluative framework, can provide some indication of times of day and days of the week when there are insufficient units fielded to respond to emergency calls. As well, response times provide an indication as to whether a police agency is meeting its organizational objectives for service to the public. Some agencies have established service target levels for responding to priority one, two and three calls (Bellmio, 2004). By measuring response times, an agency can determine whether it needs to re-evaluate its organizational objectives and benchmarks, or implement changes premised on meeting these goals. Many agencies strive to maintain a 7-minute response time to priority one calls, even though this is a completely arbitrary value with no research supporting a greater likelihood of capturing offenders or preserving life (Harris, 2001; Mastrofski, 2007; Rosenbaum, 2007).

4.6 Need for Change

As illustrated in the literature and review chapter, the problems with police operations in general stem from a lack of sound analysis used to establish business practices and initiatives. In keeping with these observations, in the years prior to 2006, the VPD suffered from the same absence of consistent
evaluations of its business practices and performance models. In order for a police service to reach its full potential and make the best use of its resources, the organization must develop core capacities to not only facilitate change management practices, but also assess the effectiveness and efficiency of its operations on an ongoing basis. In the case of the VPD, this has not occurred on a consistent and regular basis. Without regular measures of efficiency conducted, it further weakens the current deployment and staffing processes, as well as any future deployment analysis.

Because no systematic evaluation has been undertaken to examine the deployment model and staffing practices of the VPD prior to 2006, the state of patrol deployment remained largely undefined. Optimally, a review of patrol staffing levels and shift deployment schedules should be undertaken every two years. This standard helps ensure that current resource allocation still meets demand for services, and two years is also a manageable timeframe for an agency to undertake and provide sufficient time for modified processes to become established (Sullivan, 2001). Most importantly, it helps determine whether environmental changes have altered the efficiency of the deployment model (Bellmio, 2004; Sullivan, 2001). Changes in late night bar closures times, demographics, enforcement and even the price of gas can alter the manner in which police services are in demand at different times of the day and on different days of the week.

The following chapter sets out the methodology used to evaluate the effectiveness and efficiency of the patrol deployment model in use by the VPD.
from 2000 to 2005. The degree of efficiency and the state of VPD patrol
deployment will provide firsthand insight into the manner in which the
organization approaches change and reform. As a core service of a police
agency, the extent to which an organization scrutinizes its patrol operation is a
direct reflection of change management practices and the acceptance of an
organizational learning model. An evaluation of VPD patrol deployment, in terms
of efficiency and effectiveness, provides an illustrative example of the larger
issues in policing related to change and reform. Specifically, perpetuating an
inefficient and ineffective deployment model can be symptomatic of the larger
problems inherent to many police services that suffer from paradigm blindness
and a reluctance to employ evidence-based practices.
5. METHOD

5.1 Overview

The Method Chapter sets out the evaluative structure used to examine the processes and mechanisms that affect organizational change within police services. The analysis component of this research study reviews VPD data to determine whether any of the systemic inefficiencies and organizational impediments identified within the literature review, were observed in the deployment and scheduling of patrol officers. The use of an empirical approach for evaluating patrol deployment provides a means for determining the level of efficiency in the current patrol operations, as well as a method to determine any factors that may be an obstacle to efficient patrol operations. It is through the identification of these issues that will provide insight into the organizational dynamics and evaluative practices of the police service. By highlighting the challenges and drawing a connection to previous literature on the issues, specific policies and practices can be evaluated in terms of how they shape and influence the organization. Further, the issues confronting the VPD can be compared to the findings from previous research studies to determine whether they are reflective of acknowledged barriers and challenges to effecting substantive change.

The first step in this analysis involved determining whether the VPD patrol shift deployment from 2000 to 2005, met the demands of each district, at various times throughout the day and on different days of the week. This is necessary to
evaluate the level of efficiency within patrol operations and to determine whether the VPD has employed evidence-based practices as part of a regular evaluative process. An absence of both would indicate the police service lacks a core capacity to assess its effectiveness and efficiency on an ongoing basis and the organization may suffer from paradigm blindness. More specifically, an absence of clearly defined goals and objectives by which patrol operations are regularly evaluated, can be symptomatic of entrenched inefficiencies and a reluctance to employ empirical-based practices. To evaluate the condition of VPD patrol operations four questions were posed:

- Does VPD patrol staffing meet expected service levels and if not, what resources are needed?
- What structural changes are necessary to improve efficiency of the deployment model?
- What steps are required to improve patrol performance?
- What organizational changes are required to maximize productivity?

Based on a review of research approaches outlined earlier in this report, it was determined that no single tool or performance measure could meet these objectives. Therefore, the evaluative model developed for this study was a melding of the best components of performance measures examined in this research study, drawing from and customizing approaches from the field of operations research, change management, queueing theory, and academic research. This allowed the research model to benefit from and expand on the best practices of police patrol, while minimizing the negative implications. The resulting framework formed the basis to conduct a detailed examination of
quantitative measures, policy decisions and operational influences that shape the overall efficiency and effectiveness of VPD's patrol deployment. By not subscribing to any one dogmatic methodology, the evaluative approach was free to consider a wider range of variables than most commercially available products and past police audits. The most prominent advantage is a greater degree of flexibility and customization according to the unique characteristics and dynamics that comprise the VPD milieu. In fact, the range of variables and breadth of context was far greater than previous patrol deployment reviews noted.

When determining whether there were inefficiencies in patrol shifting and deployment, two variables were first examined: 1) the number of calls for service by day of the week and time of the day; and 2) the time spent on calls for service (defined as unit-minutes). These two variables were then used to study the distribution of patrol workload throughout the Districts and evaluate whether deployment was synchronized with workload. Unlike evaluative methods used elsewhere that typically reviewed one calendar year of data at best, the data analyzed in this study spanned a six-year period. The benefit was a more thorough account of yearly variations in data, as well as an ability to review policy changes over those six years and their cumulative influence on the organization.

A custom data extraction program was created to identify the actual patrol unit-hours deployed by day and by hour in each of the four policing districts. This model was necessary to perform calculations, such as: patrol utilization based on available unit-hours, number of calls for service, and time spent on calls for
service. The model calculated what percent of available patrol time was consumed by calls for service and what the peak times were by hour and day.

As well, overtime and response time data was included as part of the analysis model. Overtime data was necessary to identify systemic issues, such as organizational attempts at compensating for problems with the current shift model and resource deficiencies.

Police response times to emergency calls were also evaluated as part of the overall patrol model. This data was used to examine patrol performance and patrol service levels, in the context of meeting organizational benchmarks and achieving minimum service-level expectations of the public.

5.2 Patrol Evaluation

The empirical component of this study examined six years of data spanning January 1st 2000 to December 31st 2005 inclusive. Two areas of police patrol were evaluated. The first examined whether there were sufficient resources to respond to calls for service, including the number of resources necessary in order to meet certain thresholds of effectiveness. The second looked at potential changes to the existing deployment model to achieve optimal efficiency from existing resources. While each topic requires a review of different components of patrol, the two are interrelated. An organization that is efficiently deployed will make the best use of the finite resources it has at its disposal. This involves reviewing shift scheduling and deployment to eliminate times of inefficiency and ensuring deployment corresponds with the predicted call-load.
according to the time of day and day of the week. These factors have a profound impact on when and how many officers should be deployed to respond to emergency calls.

The study also analyzed district overtime usage, examining the extent, types and frequency of overtime. This level of detail made it possible to also analyse overtime usage by day of week and time of day, as well as identify distinct differences that exist between the patrol districts of the city. Callouts to maintain staffing minimums and extended tours of duty (otherwise known as holding back officers at the end of a shift to deal with arrests and unanticipated emergencies) are the two main types of overtime used in patrol. The analysis delved into these types of overtime usage in detail.

Further, police response times to 911 calls were analyzed according to priority, day of the week, time of day and district variations. This was deemed important to analyze, as a lack of resources, poor shift-scheduling and a deficient business process, can have a profound effect on the time it takes police officers to arrive at emergency calls. Data was collected for the entire response process, from the time a 911 call is received to the time when police arrive on the scene.

5.3 Data Collection Framework

5.3.1 Introduction

In the last ten years, the VPD has utilized three different computer dispatch systems. The advent of three CAD systems within a relative short time span, had a marked impact on the ability of the organization to develop a core
capacity to assess it effectiveness and efficiency. As was illustrated in the Change and Reform in Police Services Chapter, police agencies encounter difficulty when it comes to using technology and developing interoperability between computer systems. Police agencies generally lack the technical abilities to use systems in the manner in which they were designed and therefore make the best use of evolving technology (Mastrofski, 2007; Rosenbaum, 2007). In the case-study of the VPD, each system brought with it a new vendor, as well as the introduction of unique features and functions pertaining specifically to that system. Some of these specific features included additional data fields and different methods for data collection and storage. These different CAD systems are summarized in figure 5-1.

Figure 5-1 Evolution of VPD CAD Systems

![VPD CAD Systems Diagram]

- Police
- Altaris
- Macro

1988 Apr. 03  2002 Dec. 1  2005 May 08
5.3.2 VPD Process Changes

The adoption of the three different systems created a need for changes in operational practice. Some of these changes were driven by internal operational decisions and others by the requirements of external agencies (i.e. Justice System, PRIME Corp.). An example of an internal change that impacted operational practice is the transition of the Call Centre from the VPD to E-Comm, while an example of an external change implemented by E-Comm is the change in priority of the call type "Motor Vehicle Accident with Injury (MVI)" from a priority one to a priority two call for service. Taken together, these frequent and recurring technology and process driven changes to operational practices likely contributed to an inability of the VPD to build an evaluative core capacity.

5.3.3 Impact on Research

Similar to the manner in which the VPD was negatively influenced by the evolution of three distinct computer dispatch systems, the research methods of the study were also impacted in several profound ways. Primarily, there was an impact on the technical specifics of threading data from multiple systems into one consolidated database. Prior to performing the amalgamation, it was necessary to research and document how the data differed in collection, structure and storage on each system, to ensure cross-compatibility between data-sets from each extract. Any discrepancies between each system needed to be accounted for, including changes to the operational practices used under each system. Once these factors were accounted for, and processes were put in place to mitigate variation between systems, it was then possible to build a database of
aggregate values spanning the entire six years of the population survey. In the end, a consistent set of data collection rules were applied throughout the six years of the study for each year in question and for each CAD system. See Appendix “A” for a detailed account of these calculations, exclusions and assumptions.

5.4 Data Usage and Interpretation

The methodology employed to determine whether there were inefficiencies in patrol looked at a range of predetermined variables and attributes. The variables and attributes that provide insight into patrol include: shift scheduling efficiency, deployment model composition, resource requirements, policy decisions, supportive organizational processes, predetermined goals and objectives, and the existence of progressive deployment strategies. The aggregate analysis of these patrol dependent features and organizational dynamics provide a comprehensive representation of the underlying characteristics of a police service. While many of the performance measures outlined within the methodology chapter focus on patrol operations, it is important to reiterate the intention of this study is to evaluate organizational change and those factors that influence a reform agenda in police. However, there is no universally accepted technique for evaluating the presence of transformation change and organizational learning practices in police services. As illustrated in the organizational change literature, many police services are ill-equipped to evaluate their own operations and fail to comprehend even the basic
requirements necessary provide an evaluative framework. As such, approaches that rely on police services reporting on their own progress towards reform are woefully flawed and suffer from paradigm blindness. Given these inherent weakness, an empirical-based assessment, premised on measuring indicators of change and reform, offer the best potential for insight into how police services respond to change.

Further, by examining and measuring predetermined indicators of reform, as part of the case-study of the VPD, provides firsthand insight that is representative of many police services. The first series of variables that are examined includes consumed unit-minutes, available unit minutes and unit utilization. These three variables comprise a significant segment of the variable-set required to answer two of the four questions posed at the beginning of the Method Chapter. Particularly, does the current VPD patrol staffing meet expected service levels, and what structural changes are necessary to improve efficiency of the deployment model? Once these empirically-based questions are answered, attention will then turn to issues concerning organizational capacity for reform and supportive organizational processes.

5.4.1 Data Application and Analysis Process

Specifics of the database used to collect and analyze the empirical data are detailed below. With respect to consumed unit-minutes, the database considered the fact that several units might attend a call, in addition to the dispatched primary unit. Given that one or more units can attend a call, and that
units arrive and leave the scene at different times, the program allocated the time spent by each unit on a given call to the 24-hour time-blocks that make up a day. Recognizing that calls have different durations, each call was broken into the time consumed by hour of the day and on the appropriate day of the week. For example, a call that began at 11:45 p.m. on Saturday and concluded at 12:30 a.m. Sunday was broken into the 15 minutes consumed in the 11 p.m. to 12-midnight block on Saturday, and 30 minutes in the midnight to 1 a.m. block on Sunday.

Only those calls that were actually attended by patrol officers, as opposed to calls where a police officer was not dispatched, were captured. As a result, based on disposition information, a number of incidents were excluded. In all, 17 disposition types disqualified CAD calls from the data collection. These dispositions included cancelled calls, general broadcast calls, and reports to follow from the communication centre that indicated no police unit was dispatched.

The available unit-minute tables and the consumed unit-minute tables were then used to calculate an additional table that shows, by hour and day, what percent of the available time is consumed by calls for service (unit utilization table). This table was used to determine how well the current use of time matches that desired by management. Specifically, using target percent time allocations (i.e. ratio of time consumed by calls for service); matrices were then used to assess how time is currently being used and how close current usage matches the target allocation percentages. Using this patrol modelling schema, it
was then determined whether more or less officers were needed to reach the
target percent time allocations. Each district was individually evaluated using the
patrol modelling technique to determine the number of officers required to meet
target rates.

An additional modelling matrix was produced incorporating the total
*consumed unit-minutes* by factored *available unit-minutes*, expressed as a ratio.
The average time consumed by calls for service was calculated for each day of
the week. *Unit utilization* by hour and day was then graphically charted to assist
in the analysis.

The number of units available to take calls was compared to the total
number of calls for service on an hourly basis, according to each day of the
week. This relationship was charted for analysis purposes to determine weekly
and hourly trends and to assess whether there were times and days that were
under or over resourced for the call demand.

Similarly, a city-wide comparison matrix was produced, which incorporated
the average *unit utilization* for each one hour block within a twenty-four hour
period for each district. The results of this matrix were graphically charted to aid
in district comparisons and identify call-load patterns.

The statistical package SPSS version 15.0 (SPSS Inc.) was also used to
assist in the data analysis, such as to help identify relationships and patterns
within the various data-sets and to perform time-series predictions.
5.4.2 Assumptions

To more closely mimic the realities of patrol deployment and to improve the accuracy of the subsequent calculations, several assumptions were universally applied to the available unit-minute data tables. These assumptions and the rationale are detailed below.

Even though patrol officers work 11-hour shifts, they do not actually spend their entire shift attending calls. Available unit-hours were adjusted to account for the various tasks occurring during a shift that render a unit unavailable to attend calls. These tasks include meetings, squad briefings, meal breaks, vehicle servicing and other administrative functions. Previous studies used percentages ranging between 20% and 25% (Holland, 1999; Flemming & Rossmo, 1995). For this study, a 13.6% factor was used, which means that nine hours and thirty minutes out of an 11-hour shift were available for deployment. In practical terms, this accounts for the one hour, plus two 15-minute coffee breaks, that are mandated by the collective agreement.

To facilitate analysis, an extraction table was built to illustrate the staffing data with no built-in assumptions (i.e. 100% of patrol time is available to take calls), as well as tables that include the 13.6% assumption. Administrative tasks were considered to be accounted for by the CAD data, given the fact that the

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2 Calculated using an 11-hour shift equal to 660 minutes (11x60) and nine hours and thirty minutes as 570 minutes, taking into account meal breaks. Formula: $1 - (570/660) = 13.6\%$
CAD system accurately records only those times when officers are logged into the system and able to respond to emergency calls. Officers can still be deployed to a call, even when on a meal break if the situation warrants it. While the system does not record a unit as taking calls when on a meal break, as a dispatcher will try to use the other available units if possible, it still records the officers as available. In essence, a dispatcher will try to accommodate meal breaks as best as possible, but at times of high volumes of calls, meal breaks are sometimes overlooked or interrupted. Therefore, the 13.6% unavailability factor is a conservative estimate.

5.4.3 Data Definitions

To assist in the later discussion and analysis of patrol deployment, the variable-sets have been divided into four main categories. The following terms and definitions are used throughout the empirical analysis of the VPD data when referring to these groupings of data. For ease of reference these terms are detailed below:

- *Consumed patrol unit-minutes* are defined as the total number of minutes in the period from when the unit is dispatched to a call until the unit is cleared and available to take another call. This is a precise method of measuring call-load in terms of patrol resources devoted to responding to calls within each hour block.

- *Available patrol unit-minutes* are defined as the total number of minutes that a patrol officer is available for work. This is a key indicator of patrol resources available to respond to calls within each hour interval.
• *Unit utilization* refers to the percent of the available time consumed by calls for service (calculated as: consumed patrol unit-minutes/available patrol unit-minutes).

• *Unavailability factor* accounts for the Collective Agreement – *Schedule G No.4 – Rest and Meal Breaks* – that accounts for one 60 minute meal break and two 15 minute rest breaks during an 11 hour shift that render a unit unavailable to attend calls. A 13.6% unavailability factor was applied to the data, and the data was also run with no factor applied, i.e. assuming that patrol officers are devoting 100% of their time attending calls for service.

### 5.4.4 Consumed Patrol Unit-Minutes Special Consideration

*Consumed unit minutes* form part of the basis by which the analysis of the patrol deployment model is conducted. However, this category of data can be significantly influenced by organizational practices and ad hoc reactions to periods of intense workload. The examination of this variable not only forms part of the understanding of patrol deployment efficiency, but it helps identify some of the informal practices that are symptomatic of larger problems in a police service.

When examining calls attended, *consumed unit-minutes* are impacted by the availability of police resources. Priority three calls are the most likely to be impacted by the number of police officers available to attend calls and address the call-load. These two variables directly impact the total time available for units to attend calls. In other words, *consumed unit-minutes* are dependent on whether supply (officers) can keep pace with demand (calls for service).
Given a situation of scarce resources available to attend calls, the Operations Division could find itself vetting calls and limiting the time spent on calls in order to meet demands. Therefore, limited resources only permit patrol to spend a finite number of minutes attending calls before a district vetting process is implemented and lesser priority calls are not responded to. In situations such as this, a patrol sergeant calls complainants and cancels calls or places calls in a holding queue for the next day. This sometimes causes citizens to wait over 24-hours until a police officer attends their lower priority call. This has the effect of capping the total number of consumed unit-minutes according to the number of units available and the level of the resource burden. Simply, a heavily taxed patrol district can only consume so many unit-minutes per hour, given the maximum number of unit-minutes that can be consumed. In practice, patrol officers who are constantly attending queued calls would only have the ability to attend as many calls as time permits. Unattended calls remain in the queue until they are cancelled or dealt with through other means.

Considering the internal vetting process, in circumstances where demand exceeds the resources available, consumed unit-minutes may not accurately reflect the actual unit-utilization, which at times would be represented as over 100%.

The use of consumed unit-minutes for part of the analysis is considered a superior measure of workload, especially when compared to simple reporting of dispatched calls for service. While many police audits and efficiency studies have been based on dispatched calls for service, the use of consumed unit minutes is
a better overall indicator of actual patrol workload (Bellmio, 2004; Mazerolle, 2002; Sullivan, 2001). Unlike aggregate calls for service data, consumed unit-minutes take into account the total time spent on a call. Additional units, such as cover units, containment units, and additional resources required for major incidents, are all captured in consumed unit-minute data.

As well, the difference in call-types are accounted for using consumed unit-minutes, as it records the total officer time spent on a call. For example, a break and enter call typically requires additional investigative follow up that is recorded by the CAD system and used to calculate consumed unit-minutes. Conversely, a simple fight call can usually be resolved quite quickly, which is also reflected in the data. Variations in call types distributed by district and at different times of the day are then reflected by the total amount of time it takes officers to deal with each call recorded. The total number of dispatched calls in a given hour would only provide a partial picture of actual workload performed. As well, district variations and changes in call types by time of day are not accounted for with calls for service data. For these reasons, consumed unit-minutes, and the subsequent unit-utilization ratios that are partially based on this data, are considered a valid indicator for evaluating police deployment, efficiency and patrol effectiveness.

5.5 Patrol Utilization

The following section contextualizes and provides meaning to the patrol utilization methodology used to collect data and perform calculations. By
providing a point of reference to illustrate the significance of the results, especially when examining unit utilization ratios, the broader implications of a range of results can be realized.

This component of the methodology is designed to generate data that can be used to assess whether the current deployment model accurately mirrors demands for service and, if not, which time blocks, days and districts are in need of modified scheduling to improve efficiency. This is an important first step in the larger analysis of resource efficiency and organizational dynamics. The results of this analysis will form the basis by which the level of efficiency is illustrative of either innovative management practices or a diminished capacity to systematically evaluate processes. By applying this evaluative approach to a case-study of the VPD, the issues identified and practices encountered will either refute or confirm previous organizational change research.

By calculating unit-utilization (time consumed / available minutes) with an unavailability factor of 13.6% to account for unavailability during meal breaks, the deployment model can be compared to the demand for service and changes that have occurred over the six years. Through this analysis, a better appreciation of the nature of the call-load and police resource availability can be made.

A unit utilization ratio of 70% or higher was used as a benchmark to indicate a workload that has reached a level where it has a limiting effect on the ability for police to respond to additional demands for service or respond in a proactive manner. Police that are deployed in a reactive model, going from call
to call, cannot be expected to produce or respond to calls beyond their means. The 70% cut-off was used, as this equates to 10 minutes or less of unallocated time within each hour block.

The calculation is based on 9.5 hours available to take calls using the unavailability factor of 13.6% after meal breaks have been deducted from each 11 hour shift. Further, the 10 minutes that is unallocated within each hour block may be further broken down into small time-block segments, such as five minutes or less, which is virtually unusable in terms of proactive policing (Bellmio, 2004; Sullivan, 2001). In reality, 10 minutes or less within an hour time-block would allow for little more than finishing up report entry and preparing for the next call. At this heightened level of call-load, officers are simply responding to dispatched calls that are queued in a priority sequence.

In practical terms, officers who spend 70% of their time responding to calls for service are considered extremely high within the policing community. For example, the International City/County Management Association has stated:

Generally when a department operates at optimum efficiency, patrol officers will spend approximately 30 to 35 percent of their time committed to calls for service. Spending 45 to 50 percent of patrol time on calls leads to call stacking, citizen dissatisfaction, neglect of crime prevention, and officer stress. This also means that there may not be enough time to conduct proper investigations (ICMA, 1997).

While adverse affects have been noted in police departments whose patrol officers spend over 45% of their time responding to calls, at levels above 70% the degradation of service is so severe that patrol officers are stretched
beyond their ability to effectively respond to emergency calls (Bellmio, 2004; Mazerolle, 2002; Sullivan, 2001). Under these conditions, emergency calls become backlogged and are transferred to a queue for the next available unit. Any form of proactive policing is virtually non-existent, including core functions such as traffic enforcement (Bellmio, 2004; Mazerolle, 2002; Sullivan, 2001). Special notations are made throughout the report identifying those days and times when unit utilization surpassed the 70% mark. When reviewing the findings outlined in the subsequent section, consider the implications each percentage value represents in terms of time spent responding to calls and what effect that has on the ability to provide an emergency service to the public.

5.6 Response Times

Response times can be used as an indicator of whether a police service is meeting one of many stated service objectives to the community. This requires the agency to have predetermined goals and objectives, with clearly defined benchmarks and measurables identified in advance of the analysis. In the absence of clearly stated service delivery goals, response times can still be analyzed retroactively against industry standards and established benchmarks. Under these conditions, response times are used as an indicator of core service capacities, the existence of organizational learning practices and whether deployment planning is applied to patrol operations. In the case-study of the VPD, the latter applies.
As previously mentioned, response time refers to the time it takes for a police unit to arrive at a call for service. However, the data collection and analysis methodology is far more complex than it would initially appear. This is based on the series of steps and processes that take place from the time of call inception to call completion. Specifically, this includes the time from when a call was received at the 911 emergency call centre, the time it took to dispatch a police unit to take the call and the travel-time to the call until a police unit arrived on the scene. The process starts with a 911 operator receiving the call and identifying the nature of the emergency. Once the call is identified as requiring a police response, the call is transferred to a police call-taker. The call-taker then records the pertinent details of the emergency and transfers those details to a police dispatcher. The police dispatcher prioritizes the calls requiring police attention, and depending on the nature of the call, identifies an available police unit to take the call. The time between when a dispatcher identifies a need for police attendance and the time it takes before an available unit can respond to the call is termed queueing delay. Once an available police unit is identified, it is then dispatched to the call. The unit must then navigate through traffic and depending on the location, this can add to the length of time it takes to arrive at the scene of the emergency.

For this study, response time was calculated from the time a 911 call was received to the time it took for a police unit to arrive on the scene. The elements of this calculation include the total of queueing delay, unit travel-time and arrival-time on scene.
As well, priority one and two calls received the most attention in this study. This decision was based on the quality of the data examined for the various priority types. It was noted that beyond priority two calls, the reliability of the data diminished considerably. There were a multitude of reasons for the reduced quality of the data as the priority number increased, but for the most part, officer error and data inconsistency were the main contributing factors. Beyond priority two calls, police officers were inconsistent in identifying their arrival on the scene of a call. Because priority one and two calls receive intense attention and scrutiny, officers were more likely to identify when they arrived on the scene of a call. Routine calls did not receive the same level of attention and consequently the quality of the data suffered. While lower priority calls were reviewed as part of the study, these data-sets required more extensive cleansing, resulting in larger segments being excluded from the analysis. As such, the reliability of the data was impacted by these procedures.

As well, several filters were applied to the data, as were data cleansing procedures for blank values. A complete list of procedures, calculations and filters are contained in Appendix A of this study.

5.7 Overtime

The case-study component of this study includes an examination of the extent of overtime usage within VPD patrol. This variable provides a unique appreciation of how police services cope and compensate for a poorly designed shift model, inadequately staffed shifts and resource shortages. An extensive use
of overtime can maintain minimum service levels, while avoiding the unpleasant
task of addressing resource issues and taking steps to develop core capacities to
measure efficiency. More telling, excessive overtime usage in patrol can be
symptomatic of unchecked specialization and the lack of organizational practices
that support reform policies. The evaluation of overtime usage is a crucial
element to understanding resource demands and the manner in which a police
service responds to the necessity for reform. Details on how the overtime data
was collected, collated and structured to meet these analysis requirements are
detailed below.

5.7.1 Data Collection

A year's worth of data from the Overtime Database was extracted to
examine the cost-efficiency with which the VPD currently deploys its patrol
officers and to quantify the primary influences of overtime use in the organization.
Ideally, the overtime data used by patrol officers in the most recent calendar year
(2006) would have been compiled. Unfortunately, this could not be
accomplished. While the Overtime Database has been established for over a
year, this period actually straddles two calendar years (the years of 2005 and
2006). As a result, it was only possible to extract annual overtime data for patrol
officers for the period from June 1st, 2005 to May 31st, 2006.

5.7.2 Overtime Methodology

The Overtime Database is robust, in that it records both the number of
hours earned by the individual, as well as the time-period during which the
overtime occurred. Thus, either the actual number of hours worked or the number of hours earned by the officer can be obtained. As a result, hourly figures represent the number of actual hours worked by the individual (e.g. if an officer worked a callout that lasted eleven hours, this will be recorded as eleven hours, not the 22 hours that the officer receives in compensation for this overtime tour).

The Overtime Database records information on all overtime worked by employees of the VPD, both sworn and civilian. As a result, the first step in this compilation involved isolating operational overtime worked by sworn patrol officers. In order to achieve this goal, the data was sorted by division. Only overtime which occurred in the Operations Division was considered. Because only data for frontline patrol sergeants and constables was desired, it was necessary to remove overtime claims submitted by managers and overtime worked by support units in the Operations Division, such as the district surveillance teams and units in the Patrol Support Section. Next, data that was worked by patrol officers, but was billed to other sections of the VPD or other police agencies was removed from the data; this was achieved by examining each cost centre and/or determining if the overtime had been funded by another agency.

While it was clear that the above items should be removed from the overtime data that was collected, overtime used to fund Liquor Squads (special patrol squads that inspect licensed premises - commonly referred to as Lima callouts), was also excluded from the main data-set used for patrol analysis.
Arguably, this overtime should not be included because it is not used to deploy patrol officers in a traditional sense (the primary focus of this overtime is not 911 response, but the creation of order and the preservation of peace in the entertainment district). However, it can be argued that these squads provide additional resources, which are required to meet the excess demand for police services in District One (if these squads were not deployed, this work would fall to the on-duty District One patrol teams). Because there was no clear answer, it was decided that two separate data-sets should be compiled for the subsequent analysis, one set with the Liquor Squad callouts included and the other with this overtime removed; in effect, creating two data-sets.

Once the entries for patrol officers were isolated, the data was then sorted by district, day of the week, and type of overtime. This process allowed for the computation of aggregate levels of overtime usage for each district according to the day of the week.

It was also necessary for cross comparison analysis with utilization data that the overtime data illustrate the times when demand for overtime began. The data also needed to account for the number of officers working at any given time. This was accomplished by first breaking the day into 15-minute intervals. Next, an automated program of binary data switches was incorporated to record the period over which the overtime occurred. As a result, the computer would turn on all the data switches for the intervals that covered the period over which the overtime occurred, while leaving all the other data switches for the rest of the day turned off (a switch that was turned on was recorded as a one, while a switch
that was turned off was represented by a zero). This analysis allowed for the preparation of graphs that depict the timing, length, type, and frequency of overtime usage.

The analysis that was performed allowed for a comprehensive examination of the data contained in the VPD Overtime Database. Rather than simply examining overtime start times or total expenditures billed to a given cost centre, this methodology permitted a detailed analysis regarding the frequency of overtime, the specific time over which it occurred, and the underlying reason why this work was required.

5.8 Shift Deployment Methodology

The following section will detail the process used for developing an optimized deployment model that corrects for any efficiency issues identified in the analysis of the VPD. The optimized model is premised on illustrating the techniques and innovative approaches identified in the research literature that when applied to a deployment model wrought with issues, substantial gains can still be achieved. Further, by addressing issues within the largest concentration of resources within a police service, specifically patrol, it demonstrates how a change management approach could be applied organization-wide. The optimized model is also intended to validate how the adoption of organizational learning practices and a management style that employs systematic evaluative processes, can positively influence a police service. By applying reform-based practices to a case-study of the VPD, and by modelling these practices to a real-
world example, it validates how the systemic issues identified in the research literature are representative of a typical police service. Analogously, the lack of change and reform identified in the VPD between 2000 and 2005, is symptomatic of the types of problems identified in the research literature that many police service are encountering. The body of literature documenting these issues also provides perceptive approaches for addressing these shortcomings and as illustrated in optimized deployment model, are generally effective. The methodology used to create an optimized deployment model is detailed in the following discussion.

A computational matrix built on modelling shift deployment was developed to ascertain *unit-utilization ratios* as resources are adjusted to target levels. Specifically, using staffing data (*available minutes*) and workload data (*consumed minutes*) to calculate the percentage of available time consumed by calls for service, equally weighted by time and day, an adapted version of the *unit utilization* matrix was produced. The matrix was designed to allow for the modification of *available unit-minutes* by adjusting the percentage of resources allocated to each district.

*Available unit-minutes* were manipulated by adjusting the percentage of resources assigned to each time-block and to each day of the week. By adjusting the *available unit-minutes* in a systematic manner, the target utilization ratio could be attained. For example, in order to attain an average *unit-utilization ratio* for each district, at each time and day of the week within a 24 hour period, incorporating a full seven day period at a 50% level, each district *available unit-
minutes was increased by the percentage necessary to meet this target. This percentage increase was then translated from the target available unit-minutes into the number of officers required to reach this level of utilization. Once this figure was calculated, it was then a matter of determining how many officers were required to distribute equally to each team within the districts and to adjust the figure to compensate for the deployment of one and two officer units and specific nuances of a proposed shift model. The Department policy of a 60/40 ratio between one to two officer-units was used.

For each district, a figure was obtained that captured the true number of officers that respond to calls for service as a normal function of their position. Each district's authorized strength was then calculated using the same exclusions that were used in the units considered section of this study. In particular, the following units and individuals were not included as deployable patrol officers that respond to 911 emergency service calls: patrol team supervisors, Mounted Squad, Waterfront Unit, Marine Squad, Youth Squad, Community Policing Officers, School Liaison Officers, and Car 86 and Car 87. As well, District 1 surveillance team was excluded, as was CET/BET; as their primary function is proactive policing activities, versus exclusively responding to 911 calls. Given these exclusions, the adjusted figure more accurately reflects the number of officers within the Patrol Division that are tasked with responding to dispatched calls. This figure may differ slightly from the official authorized strength figures for each district.
6. FINDINGS

This chapter provides a summary description of the range of variables examined as part of the case-study of the VPD. This chapter is not intended to provide a detailed analysis, but rather to outline the dynamics and prepare the reader for an in-depth analysis conducted in the following Implications Chapter.

To start, the Findings Chapter summarizes patrol utilization characteristics for Districts 1 through 4 inclusive. The summary encompasses six years of data (2000 to 2005) for each district, identifying notable trends and patterns. Following this, the chapter also examines response times and overtime usage, looking specifically at data-trends and common characteristics. The summarized components for each data element are then represented in the deployment model section, which provides the number of officers required to staff patrol at a 50% and 40% utilization ratio respectively.

6.1 District 1 Utilization

District 1 unit utilization, which is the percentage of time consumed relative to available time, fluctuates significantly by day of the week and the hour of the day. As well, there are slight variations from year to year that will be examined separately when there is a deviation from the established trend. Using 2000 data, starting at 7:00 am, unit utilization progressively builds for every day of the week from the 15% to 25% range until reaching a plateau at noon that slightly
drops off until 2:00 pm. In contrast, the same trend is followed by 2005 data, with the exception that the utilization rate has increased by an average of 13.8%. For example, in 2000 at 7:00 am Tuesday, which is the lowest point of utilization for every time and day of the week, the utilization is 16.3% compared to the same time and day in 2005, which is 45.7%. Another example is Wednesday evening at 6:00 pm in 2000, which recorded a utilization ratio of 74.4% compared to the same day and time in 2005, which increased to a utilization ratio of 84.8%.

For every year studied, a consistent trend was identified whereby after 5:00 pm unit utilization increases sharply for each day of the week until reaching a peak at 6:00 pm. For 2005, Saturday had the highest utilization with an average high of 89.4%. At this level of unit utilization, only 6 minutes are unaccounted for within the hour block. The remaining days were within the 73% to 90% range of utilization, which is a remarkable increase within a very compressed time. Continuing to look at 2005 data, after 6:00 pm, unit utilization once again dropped sharply to the 50% to 56% range, with a slight increase noted between 8:00 pm and 9:00 pm and then continuing to drop again. Interestingly, Friday and Saturday unit utilization increased slightly above the norm to midnight, for the years 2000 to 2002. From 2003 onward, every day followed the same pattern outlined above, which was a gradual decrease until a 3:00 am spike.
Saturday and Sunday early morning utilization did not spike until 4:00 am, likely attributed to a modified weekend shift extended to 4:00 am. Wednesday, Thursday and Friday early morning experienced a substantial spike (up to 85% in 2005) occurring at 3:00 am. After 3:00 am, mid-week utilization, which includes Thursday and Friday mornings, dropped significantly to a 40% to 51% range in 2005, while Saturday and Sunday morning remained elevated in the 67% to 68% range. In 2000, for the same time and day, utilization ranged from 52% to 53%.

For the six years studied, utilization spiked everyday of the week at 6:00 am, with the highest levels displayed for Saturday and Sunday in the 82% to 76% range.
range in 2005, versus midweek, which was significantly lower in the 50% to 68% range (2005). Friday morning was the midweek day with the closest level to weekend rates, at 68% in 2005, with the second highest day being Tuesday at 61%. Again looking at 2005, between 6:00 am and 7:00 am, unit utilization dropped to the lowest levels in a 24 hour period, with midweek at 40% to 50% and Saturday and Sunday levels at 55% to 48% respectively.

District 1 reaches its weekend early morning peak of consumed minutes between 2:00 am and 3:00 am. This is a significant change from the past, where the same District hit its weekend early morning peak between 1:00 am and 2:00 am.

Interestingly, District 1 peak consumed minutes was higher in 2000 and 2001 compared to 2004 and 2005. However, the overall level of consumed minutes was higher for 2004 and 2005 compared to other years. In other words, the volume of consumed minutes was consistently higher on average than in the past, but extremes were higher in the past compared to more recent years. Possible explanations point to recent police intervention tactics having had a preventative effect on calls for service and consumed minutes. While the volume of calls has not abated, the extreme peaks have been mediated through a strong enforcement presence on weekends. While not exactly equal to mid-week consumed minutes for the evening, there is a closer mirroring for 2005 than the extremes observed in 2000.
6.2 District 2 Utilization

Using 2005 data as an illustration, District 2's *unit utilization* ratio corresponds to extremes that range from 44% to 80% depending, on day and time. Using 7:00 am as a point of departure, as this time consistently has the lowest values, utilization increased incrementally every hour until reaching a high at 1:00 pm. The 1:00 pm peak ranged from 62% to 74% (2005). This increase is evident for every day of the week, with Saturday and Sunday representing markedly higher ratios than the midweek increases. From 1:00 pm to 2:00 pm, *unit utilization* dropped significantly to the 56% to 63% range. Everyday of the week experienced a significant upward spike at 6:00 pm. After 6:00 pm, *unit utilization* dropped for each day at 7:00 pm and then gradually climbed to 9:00 pm. After 9:00 pm, Friday continued to climb and the remaining days gradually decreased until midnight.
Figure 6-2  District 2 Utilization Year Total 2000 to 2005

From midnight onward, unit utilization increased rapidly, reaching a peak at 1:00 am. Midweek levels were within the 60% to 63% range, and weekends 77% to 68% range. Utilization levels dropped at 2:00 am for 2005 and the remaining years were split between decreasing at either 1:00 am or 2:00 am. In 2005, levels sharply increased again at 3:00 am, reaching 74% to 60% utilization before dropping to the 46% to 64% range at 5:00 am. Weekend unit utilization closely mirrored midweek trends, with the exception of the 3:00 am peak occurring one hour later. After dropping at 2:00 am, weekend levels rose sharply at 4:00 am. From 4:00 am onward, weekend levels dropped until 5:00 am. From 5:00 am, unit utilization increased rapidly to 6:00 am for each day, including
weekends, and then dropped again at 7:00 am. Throughout these fluctuations, Friday and Sunday morning utilization levels were appreciably higher than during midweek days.

6.3 District 3 Utilization

District 3 experienced a similar pattern of unit utilization to that of District 2, albeit at an elevated level. The ebb and flow of the unit utilization closely mirrored District 2, with weekend peak utilization matching and at times surpassing those seen in District 1.

Specifically, District 3 unit utilization was quite low at 7:00 am, with a range of 43% to 64% in 2005. From 7:00 am to 1:00 pm, the unit utilization ratio increased progressively until reaching a high point at 65% to 76% (2005), depending on the day of the week. Saturday and Sunday were the two days with the highest utilization ratio at 1:00 pm in the afternoon. Between 1:00 pm and 2:00 pm, utilization plummeted, before increasing slightly at 3:00 pm and then dropping slightly at 4:00 pm. More importantly, unit utilization increased from the range of 70% to 75% at 5:00 pm to 89% to 89% at 6:00 pm in 2005. Immediately after 6:00 pm, unit utilization dropped sharply at 7:00 pm to levels similar to those seen at 5:00 pm before increasing again at 9:00 pm. From 9:00 pm to midnight, unit utilization dropped slightly, with only minor fluctuations noted.

From midnight to 7:00 am, unit utilization data demonstrated wide variation. Starting at midnight, unit utilization increased gradually to 1:00 am, with weekends peaking at 72% and 73% for Saturday and Sunday respectively. In
fact, weekend levels remain elevated above those recorded for midweek for the entire early morning timeframe.

Figure 6-3 District 3 Utilization Year Total 2000 to 2005

From 1:00 am to 3:00 am, the most significant utilization ratio increases were recorded compared to any other time-block. Weekend levels peaked at 96% and 85% for Saturday and Sunday, respectively in 2005. Midweek levels also increased substantially, with highs in the 70% to 75% level for Thursday and Friday morning. From 3:00 am to 5:00 am, unit utilization recorded its most
significant drop. For example, on Saturday, utilization changed from 96% to 73% in only two hours (2005).

Similar trends were observed for the other days of the week, with Monday and Tuesday recording the lowest utilization ratio compared to the other days. From 5:00 am to 6:00 am, there was a substantial spike in utilization, with Saturday and Sunday reaching highs ranging from 91% to 86% respectively. Surprisingly, Friday did not follow the same trend, but rather more closely mirrored midweek levels in the 65% range.

From 6:00 am to 7:00 am, utilization levels dropped to all-time lows, with Monday, Tuesday and Wednesday grouped closely at the 45% level (2005). Saturday and Sunday were more elevated, in the 60% range (2005). Friday morning utilization was between these two ranges at 51% (2005).

6.4 District 4 Utilization

Unit utilization fluctuated throughout the twenty-four hour period for each day of the week, with weekend levels consistently recording higher values than midweek. Beginning at 7:00 am, District 4 unit utilization was at its lowest point for the twenty-four hour period. Midweek levels were in the 44% range and weekend levels were slightly elevated in the 47% range (2005). From 7:00 am, unit utilization increased until reaching a high at noon. At noon, the utilization ratio was approximately 71% for Saturday and Sunday, and midweek was within a range of 64% to 70% (2005).
From noon to 2:00 pm, utilization decreased sharply, to the 54% to 60% range for both weekdays and weekends (2005). From 2:00 pm, utilization increased until reaching a peak at 6:00 pm. However, at 3:00 pm, utilization spiked slightly, with Friday reacting in a more pronounced manner. Neither of these spikes were at levels close to the 6:00 pm peak, which for Friday was 89% and for Thursday 81% in 2005. Immediately after 6:00 pm, utilization levels dropped sharply at 7:00 pm and then increased again at 9:00 pm before slowly decreasing to midnight. Looking back to 2000 data, Friday and Saturday evening deviated from the other years by increasing from 9:00 pm to midnight, with Friday evening reaching a utilization ratio of 71% at 11:00 pm.
From midnight to early morning, unit utilization continued sporadic shifts between extremes, with weekend levels reaching highs in the 84% range. For midweek, utilization increased from midnight to 1:00 am reaching levels that ranged from 59% (Tuesday) to 68% (Friday). In comparison, Saturday and Sunday noted increases that were substantially more pronounced at 75% and 73% respectively.

From 1:00 am to 3:00 am, midweek levels spiked to a range of 65% (Tuesday) to 84% (Friday) in 2005. For the same time, weekend levels increased sharply. Midweek levels then dropped drastically at 5:00 am to a range of 42%
to 40% for Monday to Thursday and 48% for Friday (2005). Weekend levels also reacted similarly, by decreasing to 61%. From 5:00 am to 6:00 am, weekday utilization levels increased to a range of 50% to 66% (2005). In the same pattern, weekend levels also increased, but to a higher point at 67% to 77% (2005). From 6:00 am to 7:00 am, utilization dropped again, but in this instance to the lowest point in the twenty-four hour period at an average of 45%.

6.5 Response Times

6.5.1 City-wide

Looking at priority one city-wide response times by each day of the week, they are lowest on Sundays with a sharp build-up to Tuesday. Beginning from Tuesday, there is a gradual increase to Friday, where it peaks and then drops sharply on Saturday. On a yearly basis, 2005 had the highest response times, both by day of week and for time of day. From 2000 onward, every successive year saw marginal increases in priority one response times, starting at a low of 8.3 minutes and escalating to 11.7 minutes in 2005.

In detail, it took the longest to respond to priority one calls between 8:00 am and 6:00 pm, but dropped sharply before and after these times. Peak response times were observed at 3:00 pm. Looking at city-wide totals for 2005, the range between the highest and lowest response times was 6.2 minutes. The slowest average response time was 15.5 minutes at 3:00 pm and the quickest average response time was 9.14 minutes at 4:00 am.
6.5.2 District Comparison

When examining Districts 1 through 4, the change in priority one response times from 2000 to 2005 increased by 29.5%, 40%, 43% and 44% respectively. This resulted in it taking on average, 9.3 minutes in District 1, 11 minutes in District 2, 13.2 minutes in District 3, and 13.2 minutes in District 4 to respond to priority one calls.

However, district averages (mean) do not always tell the full story of response times. This measure tends to have a mediating affect over extremes, even when those extremes are experienced on a consistent basis. As the most common measure of central tendency, the use of arithmetic mean can prove misleading at times, as it can distort the complete picture of the data. By limiting measures to only the arithmetic mean, the representation of extreme values and the complete spread of the data (dispersion) are lost (Palys, 2003). Rather than using other statistical measures to compensate, such as mean absolute deviation or standard deviation to represent the dispersion of the data, other alternatives were chosen. The justifications are that while measures of dispersion are helpful, they still do not capture extreme values. When examining response times, it is important to appreciate the realities of how long it could possibly take police to arrive on the scene of an emergency.

To provide a more complete picture of actual response times experienced by the general public at various times of the day and in each district, a comparison between highs and lows is also provided. When examining 2005 high and low response times by district for priority one calls, District 1 took the
longest to respond to calls at 3:00 pm with a 13.4 minute response. Conversely, at 2:00 am it only took 6.3 minutes to respond to calls. District 2 followed a similar pattern with a high 13.8 minute response at 2:00 pm compared to a 8.4 minute response at 2:00 am. District 3 experienced significantly higher average response times, with an average high of 18.3 minutes at 1:00 pm and a low of 9.4 minutes at 5:00 am. District 4 took the longest to respond to priority one calls at 2:00 pm, with an average 19 minutes and the quickest response took place at 4:00 am at 8.1 minutes.

Table 6.1  Response Times by District and City-wide Total

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>7.22</td>
<td>7.91</td>
<td>9.21</td>
<td>9.18</td>
<td>8.38</td>
</tr>
<tr>
<td>2001</td>
<td>8.03</td>
<td>8.63</td>
<td>10.18</td>
<td>9.82</td>
<td>9.17</td>
</tr>
<tr>
<td>2002</td>
<td>8.40</td>
<td>8.76</td>
<td>10.18</td>
<td>10.43</td>
<td>9.44</td>
</tr>
<tr>
<td>2003</td>
<td>9.89</td>
<td>10.58</td>
<td>11.72</td>
<td>11.52</td>
<td>10.93</td>
</tr>
<tr>
<td>2004</td>
<td>10.26</td>
<td>9.71</td>
<td>11.65</td>
<td>11.24</td>
<td>10.72</td>
</tr>
<tr>
<td>2005</td>
<td>9.35</td>
<td>11.08</td>
<td>13.21</td>
<td>13.21</td>
<td>11.71</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td>11.34</td>
<td>12.21</td>
<td>14.43</td>
<td>14.23</td>
</tr>
</tbody>
</table>

Average Response Time 00 to 05

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Change 00 to 05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast % Change 05 to 07</td>
<td>21.3%</td>
<td>10.2%</td>
<td>9.2%</td>
<td>7.8%</td>
<td>11.8%</td>
</tr>
</tbody>
</table>

6.6 Overtime Usage

When examining overtime usage in patrol, it is evident that its use is limited for most days of the week with the exception of Thursday, Friday and Saturday where it is more prevalent. Callouts (to maintain minimum staffing) are
used most extensively on Thursday to Saturday, compared to extended tours, which are more gradual and an incremental increase throughout the week from Sunday to Saturday. Further, extended tour overtime was used 67% more than callouts to maintain minimums. This use of extended tour overtime is consistently higher than callouts by 66% for each district, regardless of day or time in question. As well, each district follows a similar and consistent pattern, but with District 3 experiencing the greatest increase near the end of the week compared to the other districts.

Figure 6-5  District 3 OT by Day of Week

In terms of hour of the day and day of the week, where extended tour overtime was used more extensively, Friday early morning between the hours of 3:45 am and 4:30 am and between 6:00 am and 6:45 am recorded the highest
usage. A similar practice is repeated on Thursday and Saturday at the same times, but with slightly lower usage.

Figure 6-6  All Districts Extended Tour OT Total by Day and Time

When examining district discrepancies, District 1 is unique, in that Thursday evening for the same times listed above recorded the highest use of overtime, followed closely by Friday and Saturday. For District 3, Saturday is disproportionately higher than any other day of the week for the same times listed above, followed by Friday and Thursday. District 2 and 4 are consistent for Friday and Saturday morning, at the same times listed above, as having the highest use of overtime.
6.7 Shift Deployment Model

The following section details the exact number of officers necessary for each district, in order to meet a target of a 50% utilization ratio. Subsequent to this section will be detailed results of the number of officers needed to meet a 40% utilization ratio target, using the same methodology and benchmarks.

6.7.1 Modelling Deployment with 50% Utilization

In order for VPD Patrol to reach a 50% utilization ratio, an additional 82 constables are required. The addition of 82 constables will provide sufficient resources to meet a benchmark that an average of 50% of officer’s time will be consumed responding to calls for service. This standard is applied equally to each district, with staffing adjusted to provide a consistent level of policing, proportional to workload variations within the city.

The figures in the following table do not include supervisory positions, which would vary according to the modified shift model adopted by the Department. Typically, each additional team requires one supervisory sergeant. In situations where new positions are integrated into existing teams, an additional sergeant is only required when the span of control exceeds 14 constables (Bellmio, 2004; Broom 2004; Sullivan, 2001). In situations of split teams, where the team composition is particularly low, such as below six constables, it is possible to share sergeants amongst two split teams. Each proposed shift model will provide details regarding supervisory span of control and the required sergeant positions.
Table 6.2 Adjusted Patrol Authorized Strength

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Patrol Team Staffing</td>
<td>89</td>
<td>98</td>
<td>119</td>
<td>103</td>
<td>409</td>
</tr>
<tr>
<td>Authorized Strength % Adjustment</td>
<td>27%</td>
<td>22%</td>
<td>30%</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>Evaluated Resource Total</td>
<td>113</td>
<td>120</td>
<td>155</td>
<td>128</td>
<td>515</td>
</tr>
<tr>
<td>District Increase</td>
<td>24.0</td>
<td>21.6</td>
<td>35.7</td>
<td>24.7</td>
<td>106</td>
</tr>
<tr>
<td>Factored Team Increase</td>
<td>-33</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Adjusted District Increase</td>
<td>0</td>
<td>22</td>
<td>36</td>
<td>24</td>
<td>82</td>
</tr>
<tr>
<td>Percentage Proactive Time</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Percentage Allocated Time</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>New Patrol Team Staffing</td>
<td>122</td>
<td>120</td>
<td>155</td>
<td>127</td>
<td>524</td>
</tr>
</tbody>
</table>

Note:
1. Based on obtaining unit utilization percentage range below 50% weighted by day and time for each district
2. Figure based on the calculation (Patrol Team x Percent Adjustment).
3. An adjusted figure that takes into account an even distribution of officers for each patrol team within the district. All districts have ten teams that respond to calls for service. Furthermore, the staff increase for each team is adjusted to compensate for one and two officer units in order to impact unit utilization to the level stated.
4. The actual number of officers required per district in order to effect change in the unit utilization ratio to the level stated.
5. Based on District 2 authorized strength, but excluding CET/BET staffing. See analysis section for complete explanation of FTE figures.
6. Excludes recent addition of 33 officers to District 1 that only became deployable in late 2005 through mid 2006.
7. On October 4th 2005 the VPD increased the number of officers in District 1 by 33. This resulted in patrol teams increasing from a norm of 9 to a new norm of 13 person teams. The authorized strength for PCs in District 1 is currently at 122 officers.
8. Figures do not include sergeants (supervisors).

Looking only at those patrol teams that exclusively respond to calls for service, the current aggregate total is 409 constables distributed among the four districts. By adopting the recommended staff increase to attain optimal efficiency, the total number of constables responding to calls for emergency service would increase to 524.

Specifically, in order for District 1 to obtain its target utilization, whereby patrol officers spend 50% or less of their time responding to calls for service, the
district will need to increase the number of emergency response staff by 27%. Therefore, District 1 will need to bolster its strength from its complement of 89 constables to a minimum of 113 constables.

However, a District 1 recommended staffing increase is not included in the proposed patrol deployment model. The reason for this exclusion is due to a previous staffing request in 2005 that resulted in an additional 33 officers being assigned to this district by 2006. While the additional officers were added to the authorized strength in mid 2005, the recruiting and training process is quite lengthy and it takes approximately 9 months of Academy and Field Training before a new recruit is considered a deployable resource.

For these reasons, and the fact that the current study examined the period from 2000 to 2005 inclusive, the new positions were not incorporated into the evaluation. As well, the 33 new constable positions that were added to District 1 exceed the current district evaluation by nine positions. The full impact of these 33 constables has not been evaluated, given that they only became fully operational in the summer of 2006. A follow-up evaluation will need to be conducted to examine the net benefit from these positions over a one-year period.

The projected staff requirements for District 1 are then included in this report for comparison purposes only, as the 2005 staffing allocation to the VPD has already addressed this need. Further, the proposed shift modifications require an equal allocation of resources amongst the four districts, which is
relevant to follow-up discussions and explanatory sections below. Therefore, it is necessary to look at the resources required across every district to fully evaluate the various shift-models put forward below.

As previously stated, District 2 had the lowest utilization ratio in the Patrol Division. In order to meet target efficiency, this district will require the lowest contingent of constables compared to the other districts. Currently, there are 98 constables that respond to calls for service. The district requires an additional 22 constables to reduce the percentage of time, consumed by responding to immediate calls for service, to 50%.

District 3 requires the largest increase in patrol team staffing in order to meet minimum target efficiencies. At present, the district has 119 constables distributed amongst ten teams that respond to dispatched calls. The proposed efficiency level for District 3 requires patrol strength to increase by 30% to reach a unit utilization ratio of 50%. This would require 36 constables distributed amongst the teams. With four additional constables allocated per team, the total deployable strength will increase to 155 constables, bearing in mind that this figure only refers to those officers who respond to calls as a regular function of their position.

Table 6.3 50% Utilization Ratio
Adjusted Resource Distribution by District

<table>
<thead>
<tr>
<th>District</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumed Patrol Unit Minutes</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
</tr>
<tr>
<td>Percent of Total Consumed Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>25%</td>
</tr>
</tbody>
</table>
### Available Unit Minutes

<table>
<thead>
<tr>
<th></th>
<th>5,856,514</th>
<th>5,581,633</th>
<th>6,297,145</th>
<th>5,732,283</th>
<th>23,467,575</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Total</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>24%</td>
<td>100%</td>
</tr>
</tbody>
</table>

| Number of Calls  | 32,749    | 49,606    | 35,117    | 38,981    | 156,453    |
| Percent of Total | 21%       | 32%       | 22%       | 25%       | 100%       |

| Unit Utilization | 50%       | 50%       | 50%       | 50%       | 100%       |

Note:
1. The 50% utilization factor considered a 13.6% unavailability factor as part of the available unit minutes to address Collective Agreement meal breaks.

District 4 requires the second lowest number of additional officers in order to meet the objective of 50% of officer time spent responding to service calls. Given the current deployable strength of 103 constables, District 4 requires an additional 24% to meet this goal. In real terms, this translates into 25 additional officers allocated amongst the ten teams. The total number of district patrol officers would then increase from 103 to 128.

### 6.7.2 Modelling Deployment with 40% Utilization

Following from the 50% utilization section, the total officers required within the Patrol Division to meet a 40% utilization ratio is 611. This is based on an existing city-wide authorized strength of 409 and an additional 202 officers distributed throughout the four districts. As was the situation with the 50% utilization results, District 1 staffing is modified to incorporate the 33 officers the district received as part of the 2005 staffing request. Therefore, any projected staffing increases for District 1 factor in the existing 33 new officers.
Table 6.4 Adjusted Patrol Authorized Strength

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Patrol Team Staffing</td>
<td>89</td>
<td>98</td>
<td>119</td>
<td>103</td>
<td>409</td>
</tr>
<tr>
<td>Authorized Strength % Adjustment</td>
<td>58%</td>
<td>52%</td>
<td>62%</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>Evaluated Resource Total</td>
<td>141</td>
<td>149</td>
<td>193</td>
<td>160</td>
<td>642</td>
</tr>
<tr>
<td>District Increase</td>
<td>52</td>
<td>51</td>
<td>74</td>
<td>57</td>
<td>233</td>
</tr>
<tr>
<td>Factored Team Increase</td>
<td>-19</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Adjusted District Increase</td>
<td>20</td>
<td>50</td>
<td>74</td>
<td>58</td>
<td>202</td>
</tr>
<tr>
<td>Percentage Proactive Time</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>Percentage Allocated Time</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

New Patrol Team Staffing | 109 | 148 | 193 | 161 | 611

Note:
1. Based on obtaining unit utilization percentage range below 40% weighted by time and day for each district
2. Figure based on the calculation (Patrol Team x Percent Adjustment).
3. An adjusted figure that takes into account an even distribution of officers for each patrol team within the district. All districts have ten teams that respond to calls for service. Furthermore, the staff increase for each team is adjusted to compensate for one and two officer units in order to impact unit utilization to the level stated.
4. The actual number of officers required per district in order to effect change in the unit utilization ratio to the level stated.
5. Based on District 2 authorized strength, but excluding CET/BET staffing. See analysis section for complete explanation of FTE figures.
6. Excludes recent addition of 31 officers to District 1 that only became deployable in late 2005 through mid 2006.
7. On October 4th 2005 the VPD increased the number of officers in District 1 by 33. This resulted in patrol teams increasing from a norm of 9 to a new norm of 13 person teams. The authorized strength for PCs in District 1 is now at 122 officers.
8. Figures do not include sergeants (supervisors)

In particular, District 1 requires 20 additional officers over the 33 it has already received, to achieved a 40% utilization. This would result in a total district authorized strength of 141 officers compared to the current 122 officers, including the 33 recently deployed and the acquisition of an additional 9 officers that are addressed in detail within the Implications Chapter. Specifically, this staff redeployment is explained in detail within each of the proposed shift-models outlined in the subsequent chapter.
District 2 requires the second lowest number of officers compared to the other districts to reach an optimal utilization ratio. Based on a current staffing of 98 officers, District 2 staffing would need to increase by 51 additional officers to reach a 40% utilization. The district authorized strength would then move to 148 total officers.

District 3 currently has an authorized strength of 119 constables. At 40% utilization this would increase by 74 officers to a total of 193 constables, the largest district increase in patrol. District 4 follows closely behind with the second largest increase in patrol. An additional 57 officers need to be added to its existing strength of 103, for a total of 161 officers.
7. IMPLICATIONS

The Implications Chapter provides a detailed analysis of each variable examined in this study and then connects these findings within the larger discussion of organizational dynamics and transformational change. The intent is to contextualize the data results in terms of the VPD environment and provide an informative discussion as to the significance of the results. The chapter starts with a discussion of *resource distribution, consumed minutes, available minutes* and then moves to *utilization* for each district. As with the Findings Chapter, response times and overtime usage are examined next, and are specifically analyzed in terms of organizational practices.

This discussion then leads to an examination of those organizational practices and operational policies that influence the development of an optimized deployment model. In presenting the optimized deployment model, to correct for the inefficiencies in the current system, the issues with organizational practices that propagated these long-standing issues emerge. The discussion then incorporates these systemic limitations within the larger context of police organizational impediments to meaningful change and the lack of evidence-based decision-making. As was illustrated in the literature review, these are not isolated issues, but are representative of many of the problems with police efficiency in general. The optimized model further demonstrates how the adoption of *organizational learning practices* can constructively influence a police
service. The use of reform-based practices to manage the issues facing VPD illustrates how the systemic problems identified in the research literature are representative of a typical police service. In other words, the lack of change and reform in the VPD is symptomatic of the types of problems that many police service are encountering. Specifically, within the VPD, reform programs have historically been initiated, and then abandoned, such as a review of their shifting model in 1995 by Flemming and Rossmo. This initiative was short-lived and nearly 11 years passed before attention again turned to deployment, and only after the situation degraded to a state of crisis. The optimized deployment model applies some of the solutions identified in the literature review that were found to be effective in transforming police services.

7.1 Performance Measures

7.1.1 Resource Distribution

This study included a complete and detailed data-set of consumed unit-minutes, total calls for service and available unit-minutes ordered by district. This data allowed for an analysis of the distribution of resources throughout the patrol districts and provided a means to determine the relative efficiency of each district's deployment. This analysis also provided an opportunity to evaluate which districts would benefit from additional resources or in some circumstances, a redistribution of existing patrol officers when it was determined that pre-existing organizational practices were adversely affecting patrol efficiency.
Compared to the other districts, District 1 had the second highest percentage of total available minutes, with 25% of the patrol total in 2005. In 2005, this roughly equated to 89 officers allocated to teams that respond to calls for service. In other words, District 1 officers comprised 22% of the total officers available in patrol.

Despite having the lowest authorized strength of the four districts, District 1 maintained a percentage of available unit-minutes of 25% compared to the other districts. The percentage of consumed unit-minutes was also 25% of the city total, which equated to an average 65% utilization ratio for the entire district in 2005.

Table 7.1 Resource Distribution by District

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumed Patrol Unit Minutes</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
<tr>
<td>Percent of Total Consumed Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Available Unit Minutes</td>
<td>7,286,057</td>
<td>6,954,166</td>
<td>7,847,211</td>
<td>7,165,353</td>
<td>29,252,787</td>
</tr>
<tr>
<td>Percent of Total Available Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>24%</td>
<td>100%</td>
</tr>
<tr>
<td>Number of Calls</td>
<td>32,749</td>
<td>49,606</td>
<td>35,117</td>
<td>38,981</td>
<td>156,453</td>
</tr>
<tr>
<td>Percent of Total Calls</td>
<td>21%</td>
<td>32%</td>
<td>22%</td>
<td>25%</td>
<td>100%</td>
</tr>
</tbody>
</table>

District 2 has the second smallest complement compared to the other districts, with 98 officers available to respond to calls. This translated into 24% of the total patrol strength. In terms of available unit-minutes, District 2 had 24% of the city total. Consumed patrol unit-minutes for District 2 was also 24% of the city total (2005).
District 2 had an average unit utilization level of 62% in 2005. Interestingly, the number of calls for service ratio was higher than any other district, with 32% of the total calls responded to by the VPD. This indicates that the calls were of the type that required less time to complete and conduct investigative follow-up.

District 3 available unit-minutes was the highest in the city at 27%. This matched consumed unit minutes, which was also 27% for the district in 2005. District unit utilization was on average 67% in 2005, which was the highest in the city.

While District 4 has the largest geographic area to police in the city, the resources allocated to this district are the second lowest after District 2. In 2005, District 4 had 103 officers, 25% of the total patrol strength in the city. In terms of calls for service, District 4 had the second highest level after District 2, with 25% of the city total. Despite having a relatively high number of calls for service, consumed unit-minutes were lower than would be expected at 25% of the city total. In a reversal of the phenomenon seen in District 3, the matching of consumed unit-minutes with calls for service indicate many of the calls were dealt with much more quickly, and were of the type that did not require as much investigative follow-up. This could be explained by more minor and nuisance type calls.

On average, District 4 had the second lowest utilization rate compared to the other patrol districts at 64% in 2005. This indicates District 4 available unit-minutes were the second closest paired to the consumed unit-minutes relative to
the other districts. However, as will be examined in the recommendation section, this does not indicate that the resources allocated were sufficient to deal with the call-load and maintain an acceptable level of service.

7.1.2 Consumed Minutes

*Consumed minutes* provide the best indicator of actual hours worked by patrol officers over the six-year period. Over the course of six years, the total city *consumed minutes* has been in transition, with several factors influencing the interpretation of the data results.

City-wide, from 2000 to 2005, a 7.2% drop in *consumed minutes* was recorded, with District 2 recording the largest reduction of 28% for the same period. However, this figure is somewhat misleading, as the City-wide Enforcement Team (CET) was created in the spring of 2003, whereby 56 beat officers were deployed in a ten block radius of the Downtown Eastside (DTES). This had a profound impact on patrol resources in District 2, as the influx of officers to the area assumed the majority of calls and took ownership over problems that influenced crime in the area. While the DTES only composes a small geographic portion of District 2, it accounts for the majority of calls for that district. A review of calls for service for the DTES for a five year period prior to CET’s inception, indicates a range of between 40% and 55% of the calls within District 2 were located within the DTES. Similarly, for the period between 2000 and 2005, the total consumed officer minutes were calculated for both District 2 and the DTES. This comparison revealed a range of between 52% to 58% of the
District’s total officer consumed minutes were within the DTES. Given the fact that the majority of calls for service and consumed officer time for District 2 is focused in the DTES, it stands to reason that eliminating this area of responsibility from District 2 call-load would have a significant impact on resource and workload levels. Therefore, the 28% reduction in consumed officer time for the district can be attributed to the creation of the CET.

When consumed minutes are re-examined and CET, now called BET (Beat Enforcement Team), data is added to the District 2 calculation, there is a 0.4% increase recorded for 2000 to 2005. For the same period, the population of District 2 only increased slightly by 1.7% (Dandurand, 2004). The addition of the CET/BET data to the analysis also impacted the city-wide total consumed minutes. The addition of CET/BET data altered the total consumed minutes for the city with a marginal increase of 1.6% recorded. This is a significant difference from the 7.2% drop recorded with the CET/BET data removed. Clearly, the size and complexity of District 2 workload has an impact on both the district itself and city-wide analysis. For this reason, the analysis will present both CET/BET and District 2 data when its inclusion or exclusion influences the results.
### Table 7.2 Consumed Minutes by District and City-wide Total

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,329,221</td>
<td>3,372,083</td>
<td>2,814,838</td>
<td>2,479,887</td>
<td>10,996,029</td>
</tr>
<tr>
<td>2001</td>
<td>2,537,700</td>
<td>3,275,824</td>
<td>3,020,435</td>
<td>2,562,828</td>
<td>11,396,787</td>
</tr>
<tr>
<td>2002</td>
<td>2,409,315</td>
<td>3,099,586</td>
<td>2,847,764</td>
<td>2,259,754</td>
<td>10,616,419</td>
</tr>
<tr>
<td>2003</td>
<td>2,480,150</td>
<td>2,798,128</td>
<td>2,753,936</td>
<td>2,418,421</td>
<td>10,450,635</td>
</tr>
<tr>
<td>2004</td>
<td>2,659,288</td>
<td>2,553,117</td>
<td>2,917,958</td>
<td>2,613,298</td>
<td>10,743,660</td>
</tr>
<tr>
<td>2005</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th></th>
<th>14,955,363</th>
<th>17,522,880</th>
<th>17,098,227</th>
<th>14,835,186</th>
<th>64,411,656</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 Predicted</td>
<td>2,723,452</td>
<td>2,001,184</td>
<td>2,792,011</td>
<td>2,581,130</td>
<td>10,097,777</td>
</tr>
</tbody>
</table>

**Consumed Minutes 00 to 05**

<table>
<thead>
<tr>
<th></th>
<th>2,492,560.6</th>
<th>2,920,480.0</th>
<th>2,849,704.5</th>
<th>2,472,531.0</th>
<th>10,735,276.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Change 00 to 05</td>
<td>9.0%</td>
<td>-28.1%</td>
<td>-2.5%</td>
<td>0.9%</td>
<td>-7.2%</td>
</tr>
<tr>
<td>Forecast % Change 05 to 07</td>
<td>7.2%</td>
<td>-17.4%</td>
<td>1.8%</td>
<td>3.2%</td>
<td>-1.1%</td>
</tr>
</tbody>
</table>

*Note: Excludes CET/BET Data*

Continuing at the district level, District 1 experienced the greatest increase in workload in relation to the other districts. District 1 encompasses the downtown business core, and has seen its population increase by approximately 9,600 from 2000 to 2005 (BC Stats, 2006). With a population increase of 12.9% from 2000 to 2005, it is not surprising that consumed officer minutes have also increased in the District for the same period by 9%. Conversely, District 3 saw a 2.5% drop in consumed minutes and District 4 had a marginal increase of 0.9% from 2000 to 2005. Interestingly, both District 3 and 4 experienced a 2% and 2.5% population increase respectively for the same period (BC Stats, 2006).

### 7.1.3 Available Minutes

*Available unit minutes* provide the best indicator of the actual officer deployment level at any given hour or day of the week. This is important for further calculations and comparison with *consumed unit minutes*, but it also
provides insight into Department deployment practices within patrol. When examined in relation to authorized strength changes, it provides some understanding of whether patrol is being used as effectively as possible and whether there is a deviation from the Operations Division goals and objectives.

Patrol authorized strength has not increased in any sizable manner in the past six years, with two exceptions. District 1 changed from 98 patrol officers to 131 on October 4th 2005. This addition was in direct response to uncurbed street disorder issues in the downtown core and the substantial increase in the downtown population (see District 1 Organizational and Operational Structure section for details), which created a significant need for additional officers, more than any other area of the city.

Since CET/BET has been in existence from April 2003 onward, there has been a reduction in the total available officer minutes for District 2, not including the DTES. This has tended to skew the District 2 data, requiring special attention when examining the analysis findings.

<table>
<thead>
<tr>
<th>Current Patrol Team Staffing</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>131</td>
<td>136</td>
<td>119</td>
<td>103</td>
<td>489</td>
<td></td>
</tr>
</tbody>
</table>

There are two major issues to consider when reviewing these results. First, the primary role of CET/BET is not to respond to 911 calls for service outside of the DTES. This is an important consideration when examining patrol scheduling and efficiency in terms of emergency response to 911 calls. Second,
when CET/BET *available minutes* are added to the district totals, it creates a very different picture of available resources. While CET/BET does not focus on responding to 911 calls in District 2, by default of patrolling the DTES area, they assume responsibility for many calls that normally would fall to the District 2 teams. Therefore, when comparing *available unit minutes*, it is reasonable to include both CET/BET within the total *available minutes* for the district. *Consumed unit minutes* are a completely different issue, with separate considerations and are addressed in that section of the analysis.

City-wide, the percentage of *available minutes* increased marginally from 2000 to 2005 by 0.4%. This figure includes CET/BET staffing for District 2, which has an upward driving affect on the overall city *available minutes*. When CET/BET data is excluded from the analysis, there is a significantly different result of a 10.3% reduction in *available unit-minutes*. A district analysis provides further insight into patrol deployment practices. In District 1, there was a net reduction in total available minutes of 4.2% from 2000 to 2005. In contrast, District 2 saw a net gain of 15.5% available minutes from 2000 to 2005 when CET/BET data is included in the analysis. However, for the reasons stipulated above, when the CET/BET data is removed from the calculations, there is a drop in *available unit minutes* for District 2 by 22.4%. This stands to reason, given the majority of the CET staff originated from District 2, resulting in a reduction in the total *available minutes* for the district. District 3 mirrored District 1 closely, with a 2.3% reduction in *available minutes* from 2000 to 2005. For the same period,
District 4 witnessed the greatest decrease in *available minutes*, with an 8.9% decrease recorded.

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>4,814,835</td>
<td>5,892,017</td>
<td>5,018,285</td>
<td>5,074,320</td>
<td>20,799,456</td>
</tr>
<tr>
<td>2001</td>
<td>4,875,026</td>
<td>5,855,666</td>
<td>5,125,018</td>
<td>5,074,140</td>
<td>20,929,851</td>
</tr>
<tr>
<td>2002</td>
<td>4,645,632</td>
<td>5,393,413</td>
<td>4,764,732</td>
<td>4,299,356</td>
<td>19,103,133</td>
</tr>
<tr>
<td>2003</td>
<td>4,340,923</td>
<td>5,130,425</td>
<td>4,865,334</td>
<td>4,432,502</td>
<td>18,769,185</td>
</tr>
<tr>
<td>2004</td>
<td>4,595,536</td>
<td>4,972,037</td>
<td>4,926,902</td>
<td>4,729,123</td>
<td>19,223,599</td>
</tr>
<tr>
<td>2005</td>
<td>4,611,428</td>
<td>4,575,109</td>
<td>4,843,957</td>
<td>4,622,809</td>
<td>18,653,304</td>
</tr>
</tbody>
</table>

**Table 7.4 Available Minutes by District & City-wide Total**

<table>
<thead>
<tr>
<th></th>
<th>Dist 1</th>
<th>Dist 2</th>
<th>Dist 3</th>
<th>Dist 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>27,883,381</td>
<td>31,818,667</td>
<td>29,544,228</td>
<td>28,232,250</td>
<td>117,478,527</td>
</tr>
<tr>
<td>2007 Predicted</td>
<td>4,485,674</td>
<td>4,212,344</td>
<td>4,732,020</td>
<td>4,382,262</td>
<td>18,320,113</td>
</tr>
</tbody>
</table>

| Available Minutes | 4,647,230.2 | 5,303,111.2 | 4,924,038.0 | 4,705,375.0 | 19,579,754.4 |
| % Change 00 to 05 | -4.2%       | -22.4%      | -3.5%       | -8.9%       | -10.3%      |
| Forecast %       | -2.7%       | -7.9%       | -2.3%       | -5.2%       | -1.8%       |
| Change 05 to 07  | -2.3%       | -2.3%       | -5.2%       | -1.8%       | -1.8%       |

*Note: Excludes CET/BET Data*

Based on a regression curve estimate using a growth model with *available minutes* as the dependant variable and *time* as the independent variable, a line of best-fit was developed. Predictions were run for 2006 and 2007. If current trends continue, it is predicted that District 1 will experience a further 2.7% decrease in *available minutes* from 2005 to 2007. District 2, depending on whether CET/BET data is included, will experience either a 22.3% increase or a 22.4% decrease. District 3 is predicted to have a further 2.3% decrease in *available minutes* from 2005 to 2007 and District 4 will likely see a 5.2% decrease for the same period.
7.1.4 District 1 Utilization

As previously noted, District 1 was allocated an additional 33 officers to its authorized strength in 2005, a result of a successful staffing request to City Council. While recorded as part of the official authorized strength in 2005, these resources were not effectively deployable until mid-2006.

Given these circumstances, it was impossible to weigh their impact on the district's available minutes and utilization ratio. However, the fact that additional resources were simply added to the existing deployment structure, it is safe to assume that the same pattern in utilization was maintained, although at a reduced level.

Extrapolating from 2000 to 2005 data should not be problematic in terms of assessing inefficiency peaks and issues with deployment. Regardless of the additional officers added to District 1, the same times and days that create scheduling issues will continue in 2006, independent of the 33 officers added to the existing shift model. However, it would stand to reason that utilization ratio will be considerably lower with the added resources. Following this reasoning, the 2000 to 2005 data was still analyzed with the intent to assess shift deployment issues that could be improved upon and possibly modified to provide a better use of resources. This is premised on the analysis still carrying through to the current District 1 staffing composition and informing possible deployment changes.
With this in mind, the number of available patrol units within District 1 comprises 23% of the total patrol units within the city. With slightly less than one quarter of the Operations Division’s patrol units, District 1 attends 21% of the total calls for service within the city.

As to be expected, District 1 unit utilization was greatest during weekends, with early mornings recording the highest elevated rates that deviated from midweek levels. On closer examination, the primary factor for the elevated unit utilization during these weekend times was an elevated call-load that resulted in a substantial increase in consumed patrol unit-minutes. Despite the fact that available unit-minutes were also higher on weekend evenings and early mornings, this was not adequate to cope with the spike in consumed unit-minutes. In other words, while District 1 did attempt to compensate for the increase in consumed unit-minutes during weekend evenings and early mornings by increasing available units through modified shifts, deployment was still below the level required to prevent extreme spikes in unit utilization levels.

Spikes noted at 3:00 am and 4:00 am were also compounded by the fact that available units decreased at these two crucial times because of shifts ending, despite the elevated call-load. The substantial call-load volume during weekend bar hours, coupled with shift changes that do not align well with the current call-load pattern, resulted in several spikes in unit utilization.

Early morning midweek unit utilization also followed a similar pattern, albeit at a less magnified level. As was the case on the weekend, midweek
experienced a spike in *unit utilization* at 3:00 am. While not as significant as the weekend, it clearly demonstrates that similar issues are at play during the early morning. As was the case with the weekend, *consumed unit-minutes* was quite elevated at 3:00 am in District 1, but resource levels drop off sharply as a result of shifts concluding. Following a comparable trend to the weekend, but one hour earlier, midweek *unit utilization* climbed significantly at 3:00 am. This was a result of an elevated call-load consuming available unit-minutes, but also a consequence of a late afternoon shift ending at 3:00 am on Monday to Thursday, compared to ending at 4:00 am on Saturday and Sunday. In essence, the weekend *unit utilization* spike is offset by one hour due to a modification in shift scheduling.

As mentioned previously, each day recorded a significant rise in *unit utilization* at 6:00 pm. While the call-load gradually increased from 6:00 am onward for every day of the week, the sharp increase in *unit utilization* was a direct result of resource scheduling. At 6:00 pm, day shift ended (Bravo shift) and there was an hour lag before the next significant shift became available, namely the 7:00 pm Echo shift. This resulted in a yo-yo effect in the *unit utilization*, as remaining shifts scrambled to deal with the number of calls until the next shift became available. *Unit utilization* then dropped sharply once more units were available, but only temporarily.

Call-load (consumed minutes) continued to build and place increasing demand on available shifts until 9:00 pm when it hit a plateau and then continued to slowly drop off until 6:00 am the next morning. Friday and Saturday evening
and the following early morning were the exception to this midweek trend, as the call-load decreased slightly until 2:00 am, then increased slightly before continuing on a downward trend to 6:00 am. This pattern was most prevalent in 2005.

In terms of adequately resourced days, Monday and Tuesday appear to have the best ratio of unit-minutes to call-load compared to other days of the week. This translates into the greatest number of available units at most hours of the day. However, calls for service were consistently low on Tuesday and Wednesday, which together impacted the low unit utilization percentage for these two days.

It should be recognized that the workload and utilization data for District 1 has been underestimated due to the Liquor Squads (Lima units) and the Firearms Interdiction Team (FIT). These units were deployed on weekends to deal with street disorder in the Entertainment District, and the gang and gun violence that has become commonplace in District 1. In fact, more than nine officers are regularly deployed to Lima and FIT respectively, to deal with the unique problems that have developed over time in District 1. By deploying these additional squads in District 1, it is reasonable to assume that these units accepted responsibility for a significant portion of workload that would have normally been dealt with by regular patrol units.

This situation also highlights the organizational practice of specialization within the patrol operations. By creating specialty units tasked with addressing
firearms and street disorder issues, regular patrol teams may assume that other units are exclusively dealing with these types of issues. Patrol officers may perceive that gangs, guns and street disorder are not part of their duties. As identified in the preceding literature review, a growth in the compartmentalization of problems that only specialized units can address, can lead to regular patrol duties becoming marginalized and devalued (Bellmio, 2004; Berkshire, 2004; NWUCPS, 2004). Further, it can lead to regular patrol duties being regarded as mundane and rudimentary labour, such going from call-to-call, but with no meaningful resolution or ability to affect change (Jones, 1980). In some instance it can lead to a general attitude in patrol that anything that falls outside of simply responding to an emergency call is ‘not my job’ and falls to some other area of the organization to assume ownership over the problem (Berkshire, 2004; Jones, 1980). However, given the plethora of diverse call-types, it is unlikely that a specialized unit will exist for every issue encountered, regardless of the degree of specialization. The consequence is that many solvable issues are simply not addressed and continue to generate repeated emergency service calls, further adding to the mounting workload.

This is particularly troublesome, when considering the issues of gang violence and the proliferation of handguns. Few would argue against the notion that general patrol members are best positioned to gather intelligence and act as the eyes and ears of the organization. Patrol members are particularly well situated to gather gang intelligence, and interdict gang violence as part of the normal course of their duties. However, by limiting patrol member’s capacity and
responsibility to conduct proactive actions, such as gather intelligence, a valuable opportunity is circumvented.

Equally as important, is the role that these specialty units fulfil, and the overall goals and objectives these specialty units are expected to meet. As was previously noted, this requires an organization to establish a clear mandate, in measurable terms, to ensure regular evaluations of performance goals can be obtained. Reviewed from a more global perspective, the ability to evaluate the conduct of these units requires accountability flowing from management to ensure the wide-ranging goals and objectives of the organization are being met (Skolnick, 1986). Yet, the overall effectiveness of specialty units rarely come into question, and the same problems that plague the evaluation of patrol deployment are equally fitting for specialty units (Broom, 2004; Sullivan, 2001). As will be demonstrated later in this study, Lima and FIT teams are not the only examples of specialization and a general absence of evidence-based practices. A series of specialty patrol units are identified that fail to conduct regular evaluations based on empirical research. Further, there are no provisions for a comprehensive evaluative framework to assess whether they are meeting their intended goals and objectives. Wide-ranging questions are raised, such as: are these units part of a clearly articulated, long-term planning strategy and if so, are the actions of these initiatives supporting the achievement these objectives?
7.1.5 District 2 Utilization

District 2 data recorded five significant increases in unit utilization that are examined in detail. The first section will deal with late morning and early evening periods of fluctuation and the second section will deal with late evening and early morning shift variances. The relationship between consumed minutes and available minutes is also summarized to contextualize the utilization findings.

Call-load (consumed minutes), gradually increased throughout the day, starting from a low at 6:00 am and generally building to a high at 9:00 pm. Consumed minutes increased more aggressively from 7:00 am to 11:00 am, then generally levelled until 2:00 pm, at which time it escalated more abruptly until 4:00 pm. From 4:00 pm to 6:00 pm, call-load remained relatively level before increasing again from 6:00 pm to 8:00 pm. After 8:00 pm the call-load plateaued before dropping slightly until midnight. Weekends presented some variations in the call-load trend by increasing more rapidly in the evening, and continuing to increase after 8:00 pm, but generally followed the same pattern of build up.

In contrast, available unit-minutes, which are dependent on the number of units available, followed a more abrupt pattern of increases and reductions throughout the same time period. Considering the extreme fluctuations in unit utilization, it appears that the deployment model failed to keep pace with the gradual increase in calls for service. Calls for service and the associated consumed unit-minutes are predictable over time. Therefore, the most efficient use of patrol resources would mirror call-load with the appropriate units required to field calls.
Notably, the number of available units increased significantly at 7:00 am as Bravo (day shift) started. From 7:00 am to 9:00 am the available unit-minutes kept pace with consumed unit-minutes. However, as the call-load continued to climb and the number of units remains constant, unit utilization levels peaked at well over 73% (2005) at 1:00 pm. As was mentioned previously, a high unit utilization ratio is indicative of overworked patrol officers that are unable to engage in proactive policing.

At 2:00 pm, Charlie shift started, which increased the available unit-minutes in a significant step that reduced the unit utilization ratio to a more manageable level, within the 56% to 63% range in 2005. However, the compensating effect of Charlie shift is negated by the 5:00 pm reduction in available unit-minutes on Friday and Saturday and the 6:00 pm ending of Bravo shift, which isn’t replaced until 7:00 pm by Echo shift. The ending of Bravo shift created a jump to the 74% to 78% range for one hour in 2005.

Late evening and early morning variations in unit utilization were observed at 1:00 am, as available unit-minutes dropped off significantly because of Charlie shift ending. This resulted in a significant spike in unit utilization, as the remaining units were left to manage a call-load that was significantly elevated compared to day shift. Weekends were the most appreciably impacted, as Saturday unit utilization, on average, reached 77% (2005).

The situation is further compounded at 3:00 am when Delta shift ends. This substantially reduces the number of units available to field calls, resulting in
a unit utilization that is in the 60% to 75% range (2005), depending on the day of the week. In 2005, weekends are impacted by the adjustment of Delta shift, which ends at 4:00 am. The modified Friday and Saturday shift repositions the weekend unit utilization spike to 4:00 am. Regardless of the one-hour variation between times when unit utilization surges, it is quite evident that resources are considerably over extended, both on weekdays and on weekends.

At 5:00 am Alpha shift starts, creating a temporary reduction in unit utilization; however, at 6:00 am, Echo shift ends creating another surge. While not as pronounced as earlier utilization increases, due to a decrease in call-load, the surge still represents an inefficiency that requires other patrol teams that are only just starting, to attempt to compensate for the spike.

While an overlap of shift end-times would help alleviate the drastic surges in unit utilization at 1:00 am, 3:00 am, 4:00 am (weekends) and 6:00 am, the elevated call-load and rapid reduction in available units would still result in a high unit utilization ratio. A comprehensive strategy will need to incorporate an increase in available resources for the late evening/early morning call-load, extended shifts to provide longer coverage at peak times, and an overlap of shifts to reduce unnecessary utilization surges. This topic will be discussed in detail within the deployment model section.

7.1.6 District 3 Utilization

From 2000 to 2005, District 3 resource deployment was an exception to the other districts in that it did not have a modified weekend Charlie or Delta shift.
Throughout this period in District 3, both midweek and weekend shift patterns were exactly the same. This practice was despite substantial variations in call-load, especially on Friday and Saturday evenings, as well as Saturday and Sunday early mornings. The following analysis will identify the times and days that are influenced by resource availability and calls for service fluctuations.

Unit utilization levels were at their lowest point at 7:00 am for every day of the week. While call load was lowest at 6:00 am, the start of Bravo shift at 7:00 am resulted in an elevated but steady overall unit usage, despite a notable increase in the call-load. From 7:00 am to 1:00 pm, the unit utilization ratio increased substantially, a direct product of the rise in consumed unit-minutes. In other words, the total number of minutes spent attending calls increased throughout the late morning until reaching a peak at 1:00 pm in the 65% to 76% range (2005).

At 2:00 pm, Charlie shift started, which caused a drop in the unit utilization ratio despite a continued increase in the call-load. The extra patrol resources temporarily reduced the utilization ratio to approximately 62%, but the level of consumed unit-minutes continued to rise, creating a slight upsurge at 3:00 pm before levelling off again at 4:00 pm when Delta shift started, providing much needed units to cope with the mounting calls for service. This levelling continued until 6:00 pm when unit utilization increased rapidly. For example, Wednesday and Monday recorded ratios of 85% and 88% respectively (2005). The ending of Bravo shift created a temporary gap in resources until 7:00 pm when Echo shift became available to take calls. Consequently, unit utilization dropped again at 164
7:00 pm, although still maintaining a higher level than at 5:00 pm, a result of a continued increase in the call-load.

From 8:00 pm to 9:00 pm, unit utilization increased slightly while patrol resources remained stable. From 10:00 pm to midnight, there was a gradual decrease recorded in the utilization ratio.

From midnight to 1:00 am, unit utilization climbed for every day of the week with variations on Saturday and Sunday, that were notably higher with levels at 72% and 73% compared to 60% and 66% for Monday and Friday. While in the early morning, call-load decreased for every day, the ending of Charlie shift at 1:00 am was substantial enough to create a resource dependant spike.

At 3:00 am, Delta shift ended, creating a sizeable increase in unit utilization. In fact, utilization levels were at their highest level at 3:00 am, with Saturday and Sunday leading at 96% and 85% respectively. However, Wednesday, Thursday and Friday were still quite high, recording utilization ratios of 75%, 69% and 77% respectively. As is evident from the data, Echo shift was left to respond to the bulk of the calls for service within the district until 5:00 am. From 3:00 am to 5:00 am consumed unit-minutes continued to drop, which impacted the unit utilization ratio causing it to fall. The rapid drop after the 3:00 am spike was further fuelled by the additional resources of Alpha shift, which came available at 5:00 am. However, the low utilization ratio was soon reversed by a spike at 6:00 am when Echo shift ended. The one hour that Alpha shift was left without other resources created a spike such that Saturday and Sunday
morning levels were in the 91% to 86% range. The remaining days were considerably lower at the 65% level. From 6:00 am to 7:00 am \textit{unit utilization} dropped to its lowest level, as Bravo shift started, resulting in a substantial influx of available patrol units when the call-load was still quite low and only starting to build.

7.1.7 District 4 Utilization

From 7:00 am, \textit{unit utilization} climbed sharply to 8:00 am. This increase was a result of a substantial rise in the number of calls and a static number of units available after day shift (Bravo) started at 7:00 am. From 7:00 am, the number of available unit-minutes remains constant until 1:00 pm. In other words, no other shifts began until 2:00 pm, despite the fact that call-load builds throughout the day. This resulted in an increased \textit{unit utilization} that eventually peaked at 1:00 pm. The utilization ratio dropped significantly at 2:00 pm, as a direct result of Charlie shift starting and a relative levelling in the call-load. The extra resources assisted with the elevated afternoon call-load.

From 2:00 pm to 4:00 pm, call-load continued to climb, while available unit-minutes remained constant. At 4:00 pm, early day shift (Alpha) ended and Monday to Thursday Delta shift started. This had little effect on \textit{unit utilization}; bearing in mind the call-load is stable for this part of the day. In contrast, for the same time, Friday and Saturday recorded a spike in \textit{unit utilization}. This spike was a direct result of the one-hour interval between Alpha shift ending and the 5:00 pm start time for Delta shift on Friday and Saturday. The Friday and
Saturday delay in the Delta shift start-time also created a drop in unit utilization at 5:00 pm, as extra police resources became available to deal with the previous hour’s spike in call-load.

At 6:00 pm, Bravo shifted ended, which adversely impacted unit utilization, creating an increase that was recorded for each day of the week. Friday was most significantly impacted with a utilization ratio reaching 89%. For one hour, available unit-minutes remained low until Echo shift started at 7:00 pm, generating a pool of police resources that increased the unit-minutes available to deal with calls. The availability of Echo shift also mitigated the impact of the call-load spike at 7:00 pm resulting in a net decrease in unit utilization for this time.

However, the call-load (consumed unit-minutes) continued to increase from 7:00 pm to 9:00 pm resulting in an eventual jump in utilization. From 9:00 pm to midnight, utilization remained stable with a slight decrease noted.

From midnight to 1:00 am, unit utilization spiked sharply. Weekend utilization was the most severely impacted, with Saturday hitting a high of 75% and Sunday at 73%. At 1:00 am Charlie shift ended, resulting in a resource generated utilization spike. This substantial increase in utilization occurred despite a slight drop in consumed unit-minutes. However, weekend levels were already at an excessive level for this time of the morning and any slight decrease had little effect on overall unit utilization. Similarly, midweek days were impacted by the ending of Charlie shift at 1:00 am, but not to the same extent as weekends. The utilization spike was not as pronounced considering the reduced call-load during midweek early mornings.
From 1:00 am to 3:00 am, *available unit-minutes* remained constant compared to *consumed unit-minutes* that decreased substantially within the 2 hours. From 1:00 am to 3:00 am, this trend reversed, as Delta shift ended at 3:00 am. The ending of this shift resulted in a substantial reduction in the total available minutes. Consequently, *unit utilization* surged to new highs. For example, Monday and Friday utilization levels were at 65% and 84%, respectively, which is the second highest level either day attained within the twenty-four hour period (2005). Weekend utilization reacted slightly differently, pushing the utilization spike to 4:00 am on Saturday and Sunday morning. From 1:00 am to 4:00 am, utilization increased significantly, such that Saturday went to 81% (2005) at 4:00 am. This was due to an adjusted end-time for weekend Delta shift.

5:00 am recorded a substantial decline in utilization, both weekend and midweek alike. The predominant cause was a rapid decrease in call-load paired with the start of the early morning Alpha shift at 5:00 am.

From 5:00 am to 6:00 am, both midweek and weekend utilization spiked upwards when night shift (Echo) ended, but dropped again at 7:00 am when Bravo shift started. While the range between *unit utilization* was not as pronounced as that recorded during early morning, it nonetheless represented a period of fluctuation and resource inefficiency with Saturday hitting a high of 77% utilization at 6:00 am.
7.1.8 City Comparison of Utilization

When examining 2005 district utilization rates, in rank order, District 3 had the highest average unit utilization at 67%, followed by District 1 at 65%, District 2 at 62% and District 4 at 64%.

Still using 2005 data, when weekends (Saturday and Sunday early mornings) were examined independent of the other days of the week, District 3 consistently had a higher utilization ratio than any other district. For example, at 1:00 am and 4:00 am, the average weekend utilization ratio was 73% and 70% respectively. Similarly, Monday to Thursday data also recorded District 3 peaking higher than the other districts between 1:00 am and 3:00 am and at 6:00 am.

The fact that District 3 did not adjust its Charlie and Delta shifts from 2000 to 2005 is quite apparent when the utilization percentages are compared across districts. While more pronounced on weekends, the 3:00 am spike in unit utilization for District 3 is considerably higher than even District 2. This abnormally high level in unit utilization, compared to the other districts, is caused by Delta shift ending when the call-load is still quite high for only one shift to deal with. The deployment of a single shift, namely Echo, is inadequate to deal with the call-load at 3:00 am. The lack of available resources creates utilization levels that are consistently in the high 80% range during peak times (2005).
In contrast, District 1 had several times when utilization was elevated, especially on weekends, but the extent of the increase was still well below levels seen during District 3 high points. District 1 utilization patterns were extensively detailed within the analysis section; however, it is important to note that despite fluctuations, the levels recorded were substantially higher than in the other districts. District 1 utilization was second highest for 2005, compared to the other districts from midnight to 6:00 am. After 6:00 am, utilization dropped significantly, save from 6:00 pm to 7:00 pm where it was the second highest and only slightly below District 3 at a high of 89%. The discussion will now move to organizational practices and resource dynamics that can equally influence patrol deployment effectiveness and efficiency.
7.1.9 Response Times

A regression curve estimation was computed for priority one response times for each district using a growth model for forecasting. As well, the curve estimation procedure produced 95% confidence bands for the predictions to help evaluate the forecasts. Other FIT (SPSS model fit and accuracy procedure) error statistics were produced to assess the model errors and performance.

A two-year prediction was incorporated into the analysis. Given the nature of the data, the reliability of predictions beyond one year diminishes, as the results tend to move towards the average.

Given these caveats, if no steps are taken to alter the response times for priority one calls, it is predicted that by 2007, all things being equal, it will take 11.3 minutes for District 1, 12.2 minutes for District 2, 14.4 minutes for District 3 and 14.2 minutes for District 4 to respond to these types of calls. This will reflect an increase in response times of 21.3%, 10.2%, 9.2% and 7.8% for District 1 through 4 respectively from 2005 to 2007. The predicted time it will take to respond to priority one calls, on an average city-wide basis, is 13.1 minutes.

A review of the data identified that the VPD experienced a significant time lag between when a call is received at the 911 Call Centre (E-Comm) and the time it takes for the call to be dispatched to a unit. On average, looking at city-wide data, queueing delay accounts for 30% of the total response time, with travel time accounting for the remaining 70%. In terms of total minutes, this equates to a little less than eight minutes of travel time and a little over three
minutes of time spent in a queue for priority one calls. City-wide response time data for 2005 indicates an average of eleven minute and forty seconds (11 min, 40 sec) response time for priority one calls.

The relationship between response times and number of calls from 2000 to 2005 indicates that as response times increase every year, the number of calls decrease for the same period. This inverse relationship is contradictory to what would be expected under the circumstances. An expected relationship would be for response times to decrease in relation to a drop in the number of calls for service. The rationale is that a reduction in the number of calls for service would result in an increased availability of officers to respond more quickly to calls. Given indications from the data, it cannot be said that such a relationship exists and other factors are likely driving response times higher.

Possible explanations include that there are fewer officers available to take calls than in the past. A reduction in the total available minutes per hour reflects this possibility. The total time spent on calls has increased, as is reflected in the consumed unit-minutes data, thereby further reducing the number of officers available at any give time to respond to calls in an expedited manner.
For priority two calls, the second tier of emergency calls requiring police response, the relationship between time spent en route to a call and the time a calls waits in a queue, is almost the exact opposite to that seen for priority one calls. Approximately 30% of the total response time is consumed travelling to a call and the remaining 70% is spent waiting in a queue at E-Comm. In terms of actual time, this translates into approximately 13.5 minutes of travel time and 31 minutes waiting in a queue, for a total 45-minute response time for city-wide data.

The results of the analysis determined that the nature of the lengthy call queueing times was a result of a low number of police units available to take the incoming calls. Due to police units being unavailable to respond to emergency
calls, incoming calls were subsequently stacked or put on hold until a unit was available. As is evident, this process is less than ideal. Extreme emergency calls are simply not responded to immediately, due to lack of police resources. This situation must be kept in mind when reviewing unit utilization ratios. Unit utilization ratios, taken in isolation, do not tell the whole story of police resource issues. Generally speaking, whenever high utilization ratios are observed, there is a very good chance that call stacking is also taking place. Simply, whenever police units are proceeding from call to call, typically a utilization ratio above 55%, call stacking is also occurring because there are only a finite number of units available to take incoming calls. Furthermore, when a substantial number of units are occupied with existing calls, it stands to reason that there are fewer units available to field new calls for service.

7.1.10 Overtime

Interestingly, callout overtime used to maintain minimum staffing was not used as extensively as first thought and extended-tour overtime was used far more than anticipated, indicating a possible issue with shift deployment at the times of high overtime usage. As detailed in the utilization analysis section, weekends (Thursday to Sunday morning) have long been problematic for patrol, regardless of district. The times between 3:00 am and 4:30 am and between 6:00 am to 6:30 am, consistently have high peak utilization, indicating inefficiency with the current deployment model. This is a mirror overlap of the extended-tour overtime peak usage as well. Interestingly, both times of high inefficiency and
highest use of overtime are one in the same. It appears that extended tour
overtime is being used as an ad hoc way to compensate for shift resource
issues. Albeit, not the most cost-effective manner to correct deployment model
shortcomings, the regular and extensive use of extended callouts can have a
mediating effect on times of peak inefficiency without adding an entirely new shift
to compensate.

This is an important distinction to make, as the use of extended tour
overtime is limited to individual officers who are engaged in a serious call and
cannot be released or officers that have a suspect in custody that require
documentation that cannot wait until another shift. One of the main reasons for
the concentration of extended tour overtime at the two times listed above, as
opposed to other times of the day, is that in the early morning there are fewer
shifts available to handover serious calls to. Typically, during the afternoon, a
dispatcher will assign calls that have a substantial investigative component to
oncoming shifts rather than to a unit that is about to go off shift. This reduces the
need to use extended tour overtime, as the fresh unit has the entire shift to wrap
up the call. However, this situation does not exist during the early morning
between 3:00 am and 5:00 am, as there is only a Delta shift (Delta ends at 4:00
am) and then only an Echo shift available to field calls (Echo ends at 6:00 am).
The next shift does not start until 5:00 am. This limits the ability to transfer
serious calls that occur between 3:00 am and 4:30 am to an oncoming team that
will have 11 hours to deal with the situation. The two available teams are left to
deal with the situation, regardless if it happens very close to the end of their shift.
The alternative is to create a transition shift to bridge the gap between the end of Echo and the start of Alpha shift. However, certain realities must be considered. Throughout the city the call-load is very low between 4:00 am and 7:00 am, with 6:30 am having the lowest call-load in any given 24-hour period, regardless of day of the week. Therefore, the cost implications of creating an entire team to exclusively address these early morning times of peak utilization is far greater than the overtime generated by individual officers on-a-need basis. An entire shift devoted to solving the overtime issue would be a very poor use of resources given the extremely low call-load at this time. While some modifications can be made to help address the use of extended tour overtime in the early morning, the complete elimination of all overtime cannot be accomplished in a cost effective manner. A detailed examination of proposed shift modifications that will help address some of these issues is contained in the deployment model section.
Given these findings, there is some evidence to support an argument that extended tour overtime is being used to compensate for inadequate weekend resources and poor shift scheduling at times when arrests are occurring as shifts are endings.

Looking at additional organizational practices that influence overtime usage, the deployment of Lima and FIT teams also brings into question the regular use of call-out overtime to staff these specialty unit positions. An important characteristic on the use of call-out overtime is important to contextualize the analysis. When Lima and FIT teams are removed from the data-set, call-out overtime is used very sparingly throughout the patrol districts. However, when Lima and FIT data is included it portrays a very different picture.
Consequently, an examination of call-out overtime with Lima included in the data-set, identified that there was approximately a 68% to 74% increase in overtime costs for those days that deploy Lima teams, typically Friday night and Saturday night, compared to mid-week call-out overtime levels. In effect, these units are being staffed exclusively through the use of call-out overtime for both Friday and Saturday evenings to perform a very specialized and limited function.

The merits of the function and role of these units aside, Jones noted the practice of staffing positions through overtime was a strong indicator of chronic shortages in patrol and an attempt to compensate through ad hoc solutions that created more problems than they solved, such as unchecked specialization (1998). The performance measures analysis section identified peak call-load inefficiencies on Friday and Saturday evening, as well as a poor pairing of patrol officers to call-load, which corroborates the need for some form of additional resources on these days and times. Assuming there is a demonstrated need for these additional resources to be deployed on Friday and Saturday evening, a more suitable solution would be to modify the existing shift deployment to eliminate times of peak inefficiency. This approach would also require the deployment of addition officers to the modified deployment structure to provide the commensurate resources needed to address these problems from within the patrol teams. The result is an elimination of unnecessary specialized units and a transfer of these duties and responsibilities back to properly staffed patrol operations that are empowered to perform these functions and have the sufficient unallocated time to engage in these types of proactive endeavours. A detailed
implementation and deployment plan that can realistically accomplish these objectives is outlined in the following shift modelling section.

7.2 Shift Modelling

7.2.1 Model Objectives

As part of the analysis of VPD patrol deployment, there was also the intent to develop an alternative, optimized model in order to highlight the merits of building organizational capacities to conduct efficiency reviews and the potential gains that can result from embracing a change management approach. As observed in the literature, adopting a comprehensive evaluative framework, whether limited to patrol deployment or a more inclusive strategy aimed at transforming an entire agency, requires a profound shift in the mindset and attitude of an organization’s members (Malesan, 2004). This process must flow from management and the policies it establishes, but equally important, it must permeate into every aspect of an organization. The principles of organizational learning and the adoption of an evaluative framework must become the norm by which decisions at any level are based (Broom, 2004; Tan, 2001). By adopting organizational learning practices and a management style that employs systematic evaluative processes, every policing initiative and resource decision must be constantly measured against the expected goals and objective they were intended to meet (Bratton, 1995; Broom, 2004; Tan, 2001). This is no small undertaking, but is necessary if a police agency is to break a cycle of ill-defined
and ambiguous goals and impracticable objectives - on those rare occasions when objectives are predefined (Gaunt, 2007; Jacobs et al., 2006).

Within the VPD context, certain realities must be considered when developing a more efficient patrol model. One such consideration is a determination of the efficiency of the existing model, including how adjustments could improve overall performance. The previous analysis of performance measures and organizational practices provided the necessary background and framework for the creation of a more efficient model. During the data-analysis, certain inefficiencies were observed in each district, as well as highlighting both distinct and consistent patterns. In general, each district had, on average, three periods of inefficiency. These periods were either times of high demand for resources that were poorly compensated for by shift scheduling, or conversely, times of low demand for resources that were poorly compensated for by shift scheduling. Furthermore, inadequate resources were identified at a systemic level, based on obtaining established thresholds in utilization of either 50% or 40%.

Based on these findings an improved deployment model was developed that addressed these issues and introduced more streamlined and efficient shift scheduling with the necessary resources accounted for within the model. The recommended shift model advances a range of efficiencies that varies in degree and outcome. Each has its own strengths and shortcomings, depending on the measurements being used to evaluate it against. With this in mind, there are no perfect solutions to any staffing situation. Each solution is fraught with positive
gains mixed with some degree of negative consequences. For these reasons, management decision-making should be premised on reaching a balanced and realistic approach to patrol deployment. Any decision on the best course of action should then be weighed against the intended goals and objectives of the organization, cost effectiveness, the degree of efficiency to be obtained, and the proposed service levels to the public. The deployment model will then depend partly on the level of importance placed on each influencing variable, as established by the organization.

From an efficiency perspective, the oscillation in *unit utilization*, or the fluctuating level in which patrol units are engaged in taking calls, creates numerous issues for patrol officers. Under these circumstances, officers are constantly shifting from periods that are extremely demanding to periods of relative normality in a very short time. Ultimately, the impact of an escalating workload is degraded service, significantly increased response times for emergency incidents and an increased risk to police due to unfilled shifts (Bellmio, 2004; Sullivan, 2001). The use of excessive overtime is not an efficient strategy and, in the long-term, the costs are greater than the solutions.

Eventually, these circumstances create stress and reduce the quality of life for officers, as well as negatively impacting the level of policing within the community (Broom, 2004; Sullivan, 2001). Not only is this an inefficient use of police resources, but also the scheduling system artificially creates unnecessary periods of stress and fatigue.
7.2.2 Model Development

Generally, call-load is quite predictable over time, with only occasional variations due to special events, holidays and seasonal changes. Given this situation, it is possible to match resources to call-load with a reasonable degree of certainty. Therefore, more efficient models, such as the optimized model presented in the deployment models section, incorporate a best-fit between the matching of police officers to the call-load and a gradual layering of available officers as the call-load changes.

As previously stated, the optimum level for patrol utilization, based on the industry workload standard is in the 40% to 50% range (Bellimio, 2004; Broom, 2002; Berkshire, 2004; Green, 1989; Moonen, 2004; NWUCPS, 2004; ICMA, 1997; Sullivan, 2001). As is evident from the preceding analysis, the Patrol Division currently operates at a level considerably higher than that. In some instances, unit utilization reaches levels that are consistently over 70%. Under these circumstances, patrol units are simply responding to emergency 911 calls in priority sequence while lower priority calls are stacked waiting for available resources. In some situations, calls are simply not responded to due to a lack of available units. Team supervisors are then left to contact the complainants to inform them no unit will be attending their call. The limitations on officer availability also has serious implications, as there have been situations where there were insufficient officers available to respond to emergency calls. Part of the problem rests with the Department operating with too few officers to ensure there is a contingent of units unassigned to calls and available for emergencies.
The solution to the fluctuations and lack of resources, due to peak utilization, is the addition of more shifts staggered over time to coincide with the gradual increase and decrease of the call-load. The best way to accomplish this depends not only on the level of service sought, but also on the intended effectiveness of the deployed resources. Essentially, two things must happen concurrently. First, additional resources must be added or transferred from specialty units to address the elevated utilization ratio that is negatively impacting the police department's ability to adequately respond to calls for service. Second, modifications need to be made to the existing shift deployment model to make better use of existing resources in a more efficient manner. Simply doing one or the other independently will not have the desired effect of improving the ability of patrol to respond to calls for service.

For example, adopting only one option of redesigning the shift model to maximize efficiency will result in some efficiency gains throughout the patrol squads, but it will be insufficient to address the issue of a consistently high utilization ratio. While some inefficiency peaks may be reduced with such an approach, the fact remains that the utilization ratio for each district is consistently above 60% the majority of the time. No degree of efficiency gains will compensate for a continually elevated utilization ratio that only drops below a 60% utilization ratio 15% of the time. The best that efficiency gains could hope to accomplish would be to even out times of extremely high and low utilization, where available officers do not match the call-load as efficiently as possible.
However, for the remaining times, where efficiency is optimized, the only method to reduce utilization is through the addition of more resources. This would result in an increase in the number of available minutes to better match consumed minutes, thereby reducing the utilization ratio to a more manageable level. It is also important to keep in mind that the existing patrol deployment model has some elements of efficiency. Generally speaking, it gradually increases the number of officers on shifts as the call-load increases throughout the day. When discussing inefficiencies in patrol, there are approximately three significant times throughout a 24-hour period when the utilization ratio indicates a period of ill-matched resources to call-load. However, with shift scheduling adjustments and transformations of some poorly defined and impractical business practices, these issues can be resolved satisfactorily.

### 7.3 Deployment Models

The deployment model section brings together the results and findings of the entire research study in the form of a proposed shift deployment model. The proposed deployment model addresses the identified concerns with inefficient shift scheduling, poor deployment planning, understaffed patrol operations and detrimental organizational practices that have contributed to the current circumstances facing the VPD patrol. The section also incorporates an ongoing discussion of the specific issues with efficiency and recommended changes to the VPD patrol operations that could equally apply to other metropolitan police departments facing many of the same challenges. Rather than examining the
state of VPD patrol operations in isolation, the approach used to correct these shortcomings are reflective of problems inherent to police organizations in general.

**7.3.1 Overview**

To tackle systemic inefficiencies with the current shift deployment model, an optimized deployment model has been designed that will address these problems with significant improvements and efficiency gains. When examining the proposed deployment model, it is important to note that no single deployment model can create a perfectly efficient system. While one model may create a statistically ideal and efficient deployment in terms of patrol utilization, it may also introduce new issues that affect efficiency and cost effectiveness. Optimizing efficiency goes beyond maximizing the amount of officer time available to respond to emergency calls and includes striking a balance between response times, effective policing strategies and resource management considerations. Therefore, a more holistic approach is necessary that weighs the merits of deployment efficiency, quality of life for police officers, infrastructure support, span of control for supervisors, and most importantly a range of organizational practices that promote an evaluative framework.

The proposed deployment model (termed *Option A*) offers the best balance between the above noted considerations. As well, it offers the greatest efficiency gains with the lowest number of officers needed to support the model and with only marginal increases in infrastructure support. Other important
factors relate to change management and implementation within patrol operations. Those models that can integrate easily with the existing system and cause the least disruption in services will ultimately make a more seamless transition. A consideration over ease in transition does not, however, negate the requirement to examine systemic inefficiencies and non-evidence based practices. While not directly related to model development, these issues are still important concerns when making changes in any organization.

7.3.2 Option “A”

Deployment Model Option “A” introduces two additional shifts in order to maximize efficiency over a 24-hour period and to adjust for service demands over a seven-day period. This approach attempts to correct for the two major issues with the current deployment structure. First, a failure to adequately account for hourly fluctuations within a twenty-four hour period. Second, a lack of shift adjustments that mirror the gradual increase in demands for service that start building on Monday and eventually peaks on Sunday early morning (late Saturday night). Therefore, any efficiency changes will, at a minimum, need to correct these shortcomings.

Other inefficiencies that are introduced by the current deployment model concentrate around shift start and end times that do not adequately overlap at times of high demand for service. This has a magnifying effect, in that a one-hour period of ill-matched shift changes creates a backlog of calls and contributes to call stacking. Depending on the call-load, it can then take hours for the
oncoming shifts to recover from the backlog, while still responding to new 911 calls.

*Option “A”* is considered an optimized shift deployment model, as it incorporates the best use of existing resources while still addressing shift inefficiencies with the least number of additional officers. As well, it accomplishes this objective by creating the fewest number of new shifts, thereby reducing the total number of additional supervisors required to support this model. In total, six new teams are created with *Option “A”*, with one team created using existing resources in District 1 and the remaining teams formed from new resources that are required to staff the proposed model.

**Figure 7-4  Proposed Shift Deployment Model All Districts “Option A”**
Deployment Model Option “A” creates an additional shift that closely mirrors the existing Delta shift (4:00 pm to 4:00 am), but with significant differences. The new modified Delta shift will start at 6:00 pm and end at 4:00 am. It will be a fixed shift that works 10 hours on a four ‘on’ and three ‘off’ rotation. In other words, the shift will cycle four days working and three days off, over a seven-day period. The fixed shift refers to the shift not cycling through other start and end times. Rather, the modified Delta fixed shift maintains a Wednesday to Saturday schedule on an indefinite basis. This is an important difference compared to the existing shift deployment model that cycles through five different shifts, with four days working and four days off. Under the existing model, the shift deployment does not mirror a seven-day cycle, resulting in a different start day at the end of an eight-day rotation of working and days off. Normally this would not be an issue; however, there is a need to match resources to a call-load that increases throughout the week. For example, generally, there is a 10% increase in the call-load from Monday to Saturday, resulting in a greater requirement for resources near the end of the week than at the start of the week. The fixed shift modified Delta shift addresses this shortcoming in each district. Given the greater capacity to mirror call-load, the number of constables required for each district’s new modified Delta shift will be kept to a minimum. Four teams of approximately nine to 12 constables, depending on the district, will be required for a Department-wide rollout.

In addition to the creation of a new fixed shift for each district, there is an added requirement for resources to address demands for service throughout the
entire week and to compensate for ill-matched shift changes primarily seen in the afternoon and evening. While Monday typically has approximately a 10% drop in demand for service, there are still peak times of inefficiency created by the current shift model. To compensate for these peaks in resource utilization, a second fixed shift is required. As a result of the net gains in efficiency from the modified Delta shift, a reduced number of officers are required for the second fixed shift. Therefore, a new shift deployed as a city-wide resource will meet the remaining service demands and compensate for shift overlap. The new shift, a ‘fixed’ modified Charlie, will work a four ‘on’ and four ‘off’ rotation requiring a total of two squads to staff. Each team will work an 11-hour shift with a staff of 14 constables each.

This city-wide resource, otherwise known as a roving patrol team or metro patrol team, will provide the flexibility to deploy officers throughout the city wherever the demand is greatest and will respond to daily fluctuations. As well, the team can be split and sent to any district to help reduce stacked calls or other unanticipated developments. The new modified Charlie shift will have a ‘fixed’ start and end time of 3:00 pm to 2:00 am (everyday). The combination of the new modified fixed Delta and metro patrol fixed Charlie shift will address the inefficiencies seen in the current deployment model, while requiring the fewest officers to accomplish the greatest gains. A total of six new squads will be required to staff this model, with four teams for the new modified fixed Delta shift and two for the modified fixed Charlie roving shift.
Other benefits of this model include the ability to phase in components over a gradual time frame. For example, the roving patrol teams can be created with only 28 patrol officers and two supervisors. This option will still have a marked impact on patrol efficiency, with no modifications required of the existing shift deployment model. This strategy could be implemented until such time as the fixed Delta resources are available for district-wide augmentation.

The officer staffing for this model, whether at a 50% or a 40% utilization, is detailed in the tables that follow. Each district’s specific needs are taken into account with this staffing estimate, including internal staffing redeployments that advance internal efficiency and help address patrol resource issues in the most cost-effective manner. As well, supervisory positions are added to the staffing table according to the needs of each option. While supervisory positions were not included as part of the calculation, the general rule is that each team requires one sergeant and any team over 14 constables requires additional supervision due to the larger span of control (Bellmio, 2004; Broom, 2004; Sullivan, 2001). These general rules were applied in the allocation of supervisory positions in each model.

7.3.3 Organizational Dynamics

In addition to the creation of a fixed 4 ‘on’ and 3 ‘off’ Delta shift and a roving patrol team under Option “A”, several internal efficiency modifications are also required to field as many patrol officers as possible. Particularly, it was noted that every district maintains its own district surveillance team. The staffing
for these surveillance teams are *skimmed* from teams 3 through 10 in each district, creating a seven constable and one sergeant special project / surveillance team.

This is problematic for a multitude of reasons. First, the authorized strength for each district does not accurately reflect the true staffing deployment within each district. With the exception of District 1, which has its surveillance team counted as part of its actual authorized strength, namely team 11, the remaining districts simply loan (skim) the officers, in an ad hoc manner from each team. The authorized strength, which represents an official record of the deployment of patrol members, does not in anyway reflect the organizational practice of *skimming*.

Second, by loaning up to seven constables and one sergeant from each district to an ad hoc surveillance team, on an indefinite basis, and in some cases several years, the remaining officers are left to compensate for the reduced staffing levels. This creates further problems for maintaining minimum staffing on busy weekends and for the individual officers themselves, who find it difficult to book leave with an understaffed team. Additionally, by reducing each team’s strength by one person, there are fewer officers available to take calls in each district, thereby leading to a higher utilization ratio and call stacking. While the reduction of one person per team is not a significant driver in elevating the utilization ratio, at times when the call-load is already elevated, any reduction in *available minutes* will likely compound the problem.
Furthermore, the practice of \textit{skimming} illustrates several issues identified in the research literature. Namely, Jones observed that it was common practice for patrol constables to be deployed in a role that did not include patrol related duties, despite authorized strength records indicating differently (1998). The creation and deployment of unofficial specialty units, such as the VPD district surveillance teams, is a prime example of organizational practices contributing to the problem. The organization may even be aware that at some level, these practices contribute to the current resource crisis. Yet, the organization may chose to ignore the inconvenient truth of the matter, as Loveday noted in his research of police organizational practices (1998). The fact that the district surveillance teams are not reflected in the official authorized strength of the VPD and were created through \textit{skimming} from other patrol teams, reinforces the perception that these units did not submit to a rigorous justification and evaluation process. A reasonable assumption can be made that these units were not created as a result of a defendable business case, premised on sound evaluative methodology and empirical evidence, but were likely created in an ad hoc manner, with little thought given to follow-up evaluative practices. As Bellmio noted, many metropolitan police departments base their decision-making on anecdotal evidence and fail to supply empirical documentation outlining whether an initiative is meeting even rudimentary criterion for existence (2004). The existence of the district surveillance teams illustrate that in this occurrence, these specialty units were created in a haphazard manner, and without consideration
as to whether their formation and deployment was in furtherance of departmental priorities and the overall strategic goals of the organization (Tan, 2001).

Given these conditions, an evaluation as to whether these units are meeting expected goals and performance benchmarks is not possible. Therefore, certain assumptions must be made in order to facilitate further analysis of patrol efficiency and deployment models. As a point of departure, an underlying assumption is required that these units perform some necessary function. From this supposition, a more efficient alignment of resources can be developed that minimizes some of the negative effects these ad hoc units generate from using *skimmed* resources.

To address the perceived need for these specialty units, two patrol-based surveillance teams could be created using resources drawn from each of the four districts. The various shift-model options outlined below provide a template for the best use of these officers in addressing the current problem with resource inefficiency, while still maintaining a surveillance capability spread between the North district (Districts 1 & 2) and South districts (District 3 & 4). As part of the realignment of patrol officers and the creation of two legitimate surveillance teams, there is also a requirement to develop a business case that establishes clear and measurable outcomes, empirical-based performance measures and a mechanism for constantly evaluating these units against expected goals and objectives (Broom, 2004). Therefore, in the evident that these surveillance teams are not producing desired outcomes, based on the findings of the evaluative
process, a determination can be made whether to terminate the initiative or pursue other approaches (Bellmio, 2004).

The option of creating two properly equipped and staffed surveillance teams will free up approximately 10 constables for redeployment back into squads that actively respond to calls for service. As well, the creation of the two new surveillance teams effectively stops the current practice of loaning out officers to special projects and units without adequate adjustments in the district resources to compensate. In practical terms, a newly created Patrol North Surveillance Team will be shared between District 1 and 2, and a new Patrol South Surveillance Team will be shared between District 3 and 4. The Patrol North Surveillance Team is a progressive step towards eliminating individual district surveillance teams and amalgamating resources between two consolidated surveillance teams.

To achieve this efficiency gain and a reversal of poor organizational practices, the District 1 Team 11 Surveillance Team, District 2 Rapid Action Team (RAT), the District 3 Street Crime Enforcement Unit (SCEU), and District 4 Property Crime Reduction Unit (PCRU) will need to be disbanded and the officers currently staffing these adjunct units return to regular patrol duties. Some of these officers will be used to create a Patrol North Surveillance Team and a Patrol South Surveillance Team.

While the disbandment of the existing ad hoc surveillance teams would be a progressive step forward for the organization, there are other issues to
consider. The fact that these units were allowed to exist, despite the lack of empirical support and evaluative processes in place, further illustrates the need for well-defined organizational goals and objectives. Organizational goals and objectives are essential to instil a shared vision from within the organization that are reflected in organizational practices and supported by management through policy and direction. In order to prevent a repeating cycle of anecdotal decision-making and ill-conceived initiatives, the VPD patrol operations must have established policy directives that prevents future adjunct specialty squads from being created. This includes a cessation of the practice of loaning officers out of patrol without receiving a replacement (skimming) if the agency is to embrace evidence-based decision-making and the principles of organizational learning.

7.3.4 Option “A” Implementation

To adequately staff patrol to meet the projected utilization ratio of 50%, an additional 82 officers are required. In addition, several modifications to the current deployment model must take place to facilitate this transition. At a 50% utilization ratio, the creation of the District 1, 4 days ‘on’ and 3 days ‘off’ (termed 4/3) fixed Delta team requires a redistribution of existing district resources to accomplish the creation of a new team. This is based on the fact that 33 new constables were added to District 1 in 2005 and no other new resources will be transferred to this district. Any further additions to the authorized strength will be distributed to Districts 2 through 4 according to the implementation plan outlined below.
The current District 1 team composition of 13 constables will need to be dropped to 12 constables, with the 8 constables coming from teams 3 to 10 and the remaining 3 coming from the redeployed District 1 Team 11 surveillance team. In detail, the 9 constables from the District 1 surveillance team are divided between the creation of an 11 constable fixed 4/3 Delta team and a newly created Patrol North Surveillance Team. Three constables from team 11 are to be used for the 4/3 Delta team and the remaining six constables form part of the district contribution to the amalgamated *Patrol North Surveillance Team.*

District 2 is projected to receive 22 additional constables to reach a 50% utilization in this district. As well, the disbandment of the *RAT* will provide an additional seven constables for redeployment. Six of those officers from District 2, plus three constables and a sergeant from Team 11 in District 1 will form the new Patrol North Surveillance Team. The remaining staff are distributed amongst the new fixed 4/3 Delta shift (9), the *roving patrol team* contribution (7) and the district patrol teams (6).

District 3 requires an additional 36 new constables to achieve optimized utilization ratio. The creation of the amalgamated district *Patrol South Surveillance Team* sees five officers contributed to that undertaking, with the remaining three (2 constables and 1 sergeant) redistributed back to the district. From the 36 new constables, 12 form the new fixed 4/3 Delta and 13 go to the *roving patrol team* and 11 are distributed amongst the 10 teams.
For District 4, four officers from the PCRU help form the *Patrol South* Surveillance Team, and three are redeployed back into patrol. From the 24 new constables, nine create the 4/3 fixed Delta shift, eight contribute to the Metro roving team and seven augment the existing patrol teams.

The distribution of resources and breakdown of staffing for both a 50% and 40% utilization is detailed in the following tables:
Table 7.5  Option “A” 50% Utilization Staffing Projections

<table>
<thead>
<tr>
<th>Team</th>
<th>Redeployed to Patrol Increase</th>
<th>Combined Tm Increase</th>
<th>Delta (4/3)</th>
<th>Roving</th>
<th>Total</th>
<th>New FTE</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Officers</td>
<td></td>
<td>4 Teams</td>
<td>2 Teams</td>
<td>6 Teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District 1</td>
<td>-8</td>
<td>3</td>
<td>0</td>
<td>11 (8 + 3)</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>District 2</td>
<td>6</td>
<td>4</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>District 3</td>
<td>11</td>
<td>3</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>District 4</td>
<td>7</td>
<td>3</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>17</td>
<td>24</td>
</tr>
<tr>
<td>Team Supervisor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Surveillance</td>
<td>9 ([D1] 6 + [D2] 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Surveillance</td>
<td>9 ([D3] 5 + [D4] 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Only Total</td>
<td></td>
<td></td>
<td>41</td>
<td>28</td>
<td>69</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>35</td>
<td>34</td>
<td>45</td>
<td>30</td>
<td>75</td>
<td>86</td>
</tr>
</tbody>
</table>

Note: 2% efficiency gain over Option B  
1. District 1 - Team 3 to 10 reduces in size from 13 to 12 constables.

Table 7.6  Option “A” 40% Utilization Staffing Projections

<table>
<thead>
<tr>
<th>Team</th>
<th>Redeployed to Patrol Increase</th>
<th>Combined Tm Increase</th>
<th>Delta (4/3)</th>
<th>Roving</th>
<th>Total</th>
<th>New FTE</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Officers</td>
<td></td>
<td>4 Teams</td>
<td>2 Teams</td>
<td>6 Teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District 1</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>District 2</td>
<td>34</td>
<td>4</td>
<td>38</td>
<td>9</td>
<td>7</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>District 3</td>
<td>54</td>
<td>3</td>
<td>57</td>
<td>12</td>
<td>8</td>
<td>20</td>
<td>74</td>
</tr>
<tr>
<td>District 4</td>
<td>42</td>
<td>3</td>
<td>45</td>
<td>9</td>
<td>7</td>
<td>16</td>
<td>58</td>
</tr>
<tr>
<td>Team Supervisor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Surveillance</td>
<td>9 ([D1] 6 + [D2] 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Surveillance</td>
<td>9 ([D3] 5 + [D4] 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Only Total</td>
<td></td>
<td></td>
<td>52</td>
<td>28</td>
<td>69</td>
<td>202</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>35</td>
<td>146</td>
<td>56</td>
<td>30</td>
<td>75</td>
<td>206</td>
</tr>
</tbody>
</table>

Note: 2% efficiency gain over Option B

7.3.5  Perpetuating Inefficiency

A common alternative to engaging in efficiency and effectiveness evaluations, and one that is frequently observed in policing, involves maintaining an existing deployment model and the redistribution of any new resources within that inefficient system (Bellmio, 2004; Broom, 2004; Greene, 1986; Tan, 2001). Unfortunately, this popular approach simply reinforces the existing deployment
structure and perpetuates an inefficient system of managing resources. This results in a cycle of continually deploying more resources into a system that can never achieve the desired outcome; namely, efficient resource management and the attainment of crime-control goals and objectives. Police services that lack the core capacity to assess the effectiveness and efficiency of their current practices and exhibit a reluctance to embrace change, will often default to perpetuating their flawed processes. While it is not suggested that the VPD embraces this approach to modelling deployment, the following example will assist in illustrating the consequences and implications of failing to conduct ongoing reviews of police resource usage. The intent is to validate the merits of adopting organizational learning practices by way of using a case study of a police service that could either support systemic evaluative processes (Option “A”) or conversely, maintain the status quo and recoil from the challenge (termed Option “C”). Furthermore, by precisely demonstrating how the continuance of an inefficient model fails to address even basic service demands, even when substantial resources are deployed within the existing model, may help explain some of the symptomatic problems of police services that avoid change and reform.

Following the findings of the optimized deployment model (Option “A”) that estimated 82 new patrol constables were needed to meet organizational demands for service, the same number of officers will also be applied to the current shift model and the results modelled. By applying an equal number of new resources to the existing deployment model will identify how well the existing model responds and addresses issues of efficiency and effectiveness. As was
identified in the literature and review chapter, police agencies are prone to demanding more officers as a panacea solution to an inability to address demands for services and for a failure to curb crime-control issues. Despite a lack of meaningful measures and an absence of an evaluative framework that supports the need for additional resources, many police services simply demand additional officers as a reactionary response and then deploy them within existing organizational structures (Broom, 2004; Greene, 1986; Sullivan, 2001). Given these circumstances, the following case example is in keeping with the common practices of a number of police services.

Under the Option "G" modelled approach, District 1 would not receive any new patrol constables (based on receiving previous resource allocations), and the 82 new constables would only be distributed amongst the remaining three districts. The distribution of constables would be in relation to district size, call-load and the utilization ratio. Specifically, District 2 would receive 22, District 3 would receive 36, and District 4 would receive 24 patrol constables. As well, patrol efficiencies discussed in detail in the preceding sections would also be incorporated into the redistribution. In other words, District 2 would regain much of its authorized strength by the elimination of the district surveillance team and the creation of a shared Patrol North Surveillance Team. The same would apply to Districts 3 and 4, and the creation of the Patrol South Surveillance Team. Further, the elimination of the current practice of using Charlie and Delta teams for special projects would apply to this model, thereby maximizing the utilization of existing resources. The existing Delta shift would continue to extend from 4:00
pm to 4:00 am (12 hours) throughout the districts and minimum staffing levels would be properly adjusted to match call-load. While there is no guarantee that a police service that is lacking the core capacities to assess patrol efficiency would re-distribute resources from ad hoc surveillance teams back to patrol duties, it is equally unlikely that a municipal government would fund 82 new officer positions without some organizational concessions made. The reintegration of the ad hoc surveillance teams into patrol teams and the creation of *Patrol North & South Surveillance Teams* are a reasonable compromise.

**Figure 7-5  Current Shift Deployment Model**

*All Districts 2006/02/06 to Current*

By adhering to the above criteria, and with the addition of 82 new constables to patrol, an average utilization of close to 50% is still obtainable with
this model. However, this figure does not fully account for district inefficiencies and the objective of making the best use of resources. As detailed throughout this research, one of the major shortcomings of the existing patrol deployment model are periods of both high and low utilization. This is typically a result of poor deployment scheduling that fails to adequately match resources to call-load. The subsequent peaks and lows indicate periods of extreme activity or inactivity. In either case, there is an abundance of resources disproportionate to the demand, or an inadequate allocation of resources to meet demand. Regardless, each type of variability are indicators of periods of inefficiency. Other areas of concern rest in the rapid fluctuation between the two extremes. This situation creates further problems for officers and exemplifies a shift deployment model that artificially generates heightened periods of stress and anxiety.

An examination of these factors provides some insight into the situation. This is done using a predictive model, based on the redistribution of resources according to the proposed deployment Option “C”, covering a 24-hour period of deployment. To start, additional constables distributed throughout the districts have a positive affect on the available minutes compared to previous years. For example, the chart below illustrates a gain in resources available to take calls in District 3 compared to previous years without the additional constables or internal efficiency gains. Clearly, the additional officers deployed in the existing model demonstrate an improvement over past years.
While the additional officers illustrate a net gain in the total available minutes over a 24-hour period, this does not provide a complete representation of the situation. A district-by-district examination of the predicted utilization ratio will help explain some of the issues related to this option.

While District 2 has an average utilization ratio of close to 50%, there are 14 times through the 24-hour period where the ratio peaks over 50% and there are nine (9) times throughout the same time frame where utilization drops below 50%. Looking specifically at the extremes, utilization reaches a high of 62% and a low of 43%, each illustrating periods of substantial inefficiency.

A special notation on measurements of central tendency may help explain this effect. When measuring central tendency such as the mean (average), the
purpose is to summarize, in a single value, the typical point or central location of a set of values. As previously noted, the most familiar measure of central tendency is the mean. However, some data-sets have a skewed distribution when the values are much larger or smaller than the typical values found in the data-set. Because the mean is affected by all the values of the variable-set, it can lose its representative quality in badly skewed data-sets. When this occurs, it is important to account for dispersion or variability in the data. By measuring the spread in a data-set, it is then possible to compare distributions with the same mean (average), but different dispersion. The simplest way to represent dispersion is by providing the range, which are the highest and lowest values recorded. For example, as indicated above, District 2 has a range of 43% to 62%. An efficient deployment model is premised on reducing dispersion from the mean and maintaining a concentration around the central tendency. It was partly for this reason that additional shifts were created in the proposed model detailed in Option “A”.
As was the case with the existing shift deployment model, there are still periods of peak inefficiency in District 2 that are not addressed by simply adding more constables to a poorly structured deployment model. Similar to the previous six years, 6:00 pm is problematic, as it reached peak utilization well above 60%. As well, between the times of 1:00 am and 4:00 am, the current shift deployment model fails to account for an elevated call-load and reduced resources; this combination results in an elevated utilization ratio.

District 3 experienced much of the same issues as District 2, in terms of periods of peak inefficiency, but with the added factor of greater fluctuations and
extremes. For example, in terms of range, the uppermost utilization ratio was 66% and the lowest was 40%, indicating periods of significant inefficiency and dispersion. In other words, 66% and 40% measure how far away the peak and low utilization-ratios are from the average of 50%. This is further reflected in the spread in the data, where nine times in a twenty-four hour period the utilization ratio was above 52% and four times, it was below 48%. One of the goals of a shift deployment model is to reduce this amount of spread or scatter and to implement corrective measures that result in the values more tightly clustered about their mean.
As was the case with District 2, the additional constables in District 3 did little to address periods of systemic inefficiency seen over the past six years, but it did significantly reduce baseline utilization to within the 50% limit. Previous years illustrate how the utilization ratio was consistently above the 50% threshold, in fact rarely dropping below it. After the deployment of 36 additional constables within the district, it was only during periods of peak utilization, which was quite frequently observed in the chart above, that the ratio crossed the 50% mark. A more efficient deployment model, such as Option "A", would address
times of peak inefficiency and correct the highs and lows observed with this model.

District 4 witnessed three distinct times where there were substantial peaks in utilization spread throughout the day. Mirroring much of the patterns seen in other districts, this indicates a shift model that generates deficiency in deployment; District 4 reached its highest point at 6:00 pm. Between the times of 6:00 pm and 7:00 pm was problematic for every district. This was due to Bravo shift ending at 5:00 pm and the next shift, Echo, not starting until 7:00 pm. The ending of Bravo occurs during a time of high demand for service, reflected in the elevated call-load. Yet, this is the exact time when a crucial shift ends, generating a peak inefficiency. This one-hour period of operating with a reduced number of officers creates a series of issues that takes hours to recover from. Whenever utilization peaks over 60%, it can take the oncoming shift hours to adequately deal with the backlog of calls that have been placed in a priority queue. Therefore, even with the additional 24 constables added to the deployment model, the range for District 4 was 36% to 64%.
At 8:00 pm the utilization rate has still not completely recovered, hovering at 53%. However, this is still an improvement over 2004 when at the same time the utilization levelled at 67% after a sharp drop from a high of 78%.

A cautionary note is warranted with this deployment model. The Option “C” model was presented for comparison purposes only and was not intended to be used as an alternative to the existing VPD patrol model. The illustrative example was templated on the existing VPD patrol model and therefore shares many of the problems of the existing VPD model. As such, it fails to address even basic issues of inefficiency and the lack of shift-overlap during times of
peak call-load. However, it does provide an important lesson and illustrates potential pitfalls that many organizations suffer from when caught in a cycle of maintaining existing structures and processes without engaging in objective evaluations and empirical analysis. By not reviewing and scrutinizing the efficiency of police activities, many organizations continue to supplement entrenched practices and reinforce poorly conceived arrangements (Gaunt, 2007; Mastrofski, 2007; Tan, 2001). The existing deployment model with 82 new officers demonstrates the consequences of routine-based approaches to resource decisions. The lack of consideration for organizational learning and by not qualifying resource decisions on clearly defined benchmarks and measurables, predetermines an organization to perpetuating the same mistakes over time.

7.4 Summary

By assessing how the VPD deploys and manages its patrol resources, this thesis examined not only the degree of efficiency in its patrol operations, but also delved into more complex issues surrounding organizational dynamics and the capacity to evaluate police practices. With a point of departure grounded in past research, a multitude of factors ranging from policy decisions, previous practices that illustrated a traditional resistance to adopt and implement meaningful change, and resource limitations to name a few, contributed to the overall manner in which these issues were examined. Although one may expect shift modelling to explain most aspects of patrol efficiency, research on the subject
demonstrates that this is just one consideration of a very complex problem. The case-study of the VPD illustrated how a police service must overcome many obstacles on the road to embracing transformational practices and the adoption of an organizational learning model. Of those factors that were preventing the VPD from attaining an efficient operation, the most apparent were an absence of clear objectives and strategies that chart a course for meeting these goals. This in turn influenced organizational practices and a general acceptance of the situation. To initiate substantive change the VPD embarked on a process whereby patrol was deemed to require immediate action to correct for inefficient practices. In order to correct for these past inefficiencies, the VPD adopted evidence-based practices that empirically evaluated and continually reassessed the business decisions they adopted. The evaluated patrol deployment model provided an opportunity to implement such change and engage in progressive management practices.

The research study determined that the shift model in use from 2000 to 2005 had a marked impact on the overall efficiency of the patrol operations. This was evident in district comparisons and at a city-wide level. The oscillation in unit utilization, or the fluctuating level in which patrol units are engaged in taking calls, created numerous issues for patrol officers. Officers were constantly faced with extremely demanding work and remained in a state of heightened response for prolonged periods of time. Not only was this an inefficient use of police resources, but also the scheduling system artificially created unnecessary periods of stress and fatigue.
Shifts were left to deal with an extremely busy call-load with limited resources. In some instances, shifts were temporarily left to deal with a period of frenzied response until another shift became available to render assistance. A more efficient model, such as the proposed patrol deployment model, incorporates a more gradual decrease in police officers paired to the call-load and a more gradual phasing in of officers as the call-load builds. The shift pattern of five distinct shifts could be replaced with a more efficient model. The recommended model addressed shift inefficiency resulting in a more efficient deployment model than the previous model provided. The matching of resources to call-load, utilizing the proposed deployment model will result in a very efficient model that has the potential to increase productivity, as well as maximize the performance of patrol teams.

In terms of the systemic problems with elevated levels of unit utilization, a threshold should be set at which unit utilization should not exceed a certain level in order to maintain an acceptable level of policing service. The situation with the 2000 to 2005 model, where unit utilization levels frequently exceeding 70%, is not in accordance with best practices and a more appropriate target would be in the 40% to 50% range. This would allow patrol officers the available time to engage in proactive policing in support of the VPD’s strategic objectives, specifically “improving community safety” (VPD, 2004).

While an initial conclusion could be drawn that adopting the proposed shift model will resolve workload issues and periods of over utilization, this is not entirely accurate. Although a reduction of extreme peaks and fluctuations will
certainly make utilization levels more consistent, the fact remains that patrol is substantially under staffed given their workload. When staff are continually taxed beyond their ability to meet call-load demands, service to the public suffers. The only tangible solution is to increase the authorized strength in order to meet the target utilization rate of 40% to 50%. Without these additional officers, patrol will continue to operate at elevated utilization levels and be severely limited in its ability to engage in any form of proactive policing.

Beyond shift deployment, other influencing factors had a significant impact on patrol efficiency. For example, the ongoing costs associated with overtime and holding back teams at the end of their shift, in order to deal in an ad hoc manner with unit utilization levels, are creating more issues than they resolve. Under the current system, both the financial and human costs are substantial and must be considered when weighing the option of maintaining the status quo or facing the challenge of adopting innovative strategies and solutions.

Other organizational practices, such as a trend towards specialization, also influenced patrol operations. For example, the existence of specialty surveillance units in patrol had a detrimental effect on the ability to deploy fully staffed patrol teams on a daily basis. This was compounded by the fact officers were still recorded on patrol-team authorized strength, but were deployed elsewhere. Therefore, official numbers did not fully capture the actual depletion of resources that was occurring, further hindering any reform and efficiency goals.
The practicality of having predetermined goals and objectives with clearly defined benchmarks and measurables, is that it can positively influence organizational procedures that if left unchecked, can lead to undesirable practices like excessive specialization. Looking at the VPD experience, it is apparent that specialization within patrol led to undesirable outcomes. Having experienced the consequences of this approach, the organization can learn from this and take steps to implement reform policies that embrace more innovative strategies for patrol deployment. In fact, at the time of writing, the VPD was actively pursuing these alternatives and progressive approaches. However, the development of clear goals and objectives requires an organization and management in particular, to make difficult decisions concerning the future direction of patrol operations.

Mastrofski identified the resource challenges facing police organizations that extend from a growth in 911 emergency calls to the demands of community policing (2007). Attempts at meeting these competing agendas and goals have contributed to much of the resource crisis observed in police organizations, including the VPD. The easy response to this predicament is that there are no solutions to the resource problem and that police agencies have always suffered from understaffing and over-deployment. Needless to say, this is a very short-sighted response that ignores much of the research literature that demonstrates effective strategies that have transformed organizations suffering from these very same difficulties (Bellmio, 2004; Berkshire, 2004; Broom, 2001; Jacobs, 2006; Mazerolle, 2002; Sullivan, 2001).
In responding to resource challenges, first and foremost management must make difficult decisions as to what is realistic for an organization to accomplish with existing resources and what is optional. By focusing the goals and objectives of an organization to something that is realistic and obtainable, the agency will then be in a better position to conduct these activities in a proficient manner. Following from this process, once clear direction and departmental priorities are established, the next stage is to put in place the tools and mechanisms discussed above to evaluate the effectiveness and efficiency of those initiatives on a reoccurring basis. By adopting organizational learning and processes that support an evaluative framework, a police department can then determine whether it is meeting the goals and objectives it established, and what areas require further attention. These same processes apply equally to patrol operations as they do to department-wide transformational change, with the only impediment being the organization itself.
8. CONCLUSION

8.1 Research Considerations

This thesis examined the dynamics and processes that influence the acceptance of transformational change and reform in policing. The presence of these organizational attributes were directly related to the core capacity of a police service to facilitate change management and an ability to assess effectiveness and efficiency on an ongoing basis. In particular, empirical-based analysis of patrol deployment, using clearly defined benchmarks and measurables, was a revealing indication of these progressive traits. The research literature revealed how police agencies have generally failed to embrace and adopt positive change, and when change was attempted, it was not based on empirical evidence, but rather on ad hoc justifications and undefined objectives.

The research examined the deployment of patrol resources within the Vancouver Police Department during the years 2000 to 2005, as well as the issues of change management, organizational practices and the application of evidence-based decision making. More specifically, within this framework, a case-study was conducted of the Vancouver Police Department to evaluate how efficiently the VPD responded to the changing demands made on the Department by the community during a six-year period of time. The analysis was guided by the theories and best practices from the field of operations research, statistics,
change management, police efficiency research and prior audits conducted on police organizations.

The case study was based on an assessment of the Vancouver Police Department’s patrol deployment and a determination of any a priori conditions that may influence efficiency. The research focused on two diverse approaches, but nonetheless interconnected outcomes for examining efficiency. The first studied methods of attaining efficient patrol operations through a modified shift model, such as the realignment of shifts to more closely match resources to demands for service. Included in this approach was a determination of whether core-staffing levels were adequate for demands. The second extrapolated from this research by examining the way the Vancouver Police Department approached patrol operations and defined its business practices. In light of previous research on how organizational practices can alter established structures, and result in unintended consequences, it was important to consider larger systemic issues. This approach was also necessary to ascertain whether organizational policies and modus operandi had an effect on the overall efficiency of patrol operations.

The final stage involved synthesizing the results of both approaches into a consolidated analysis. This provided a specific case example of the ad hoc nature in which many police organizations deploy their resources and illustrated some of the challenges police face when it comes to evaluating their own operations. Considering the Vancouver Police Department patrol operations were deployed in a mostly inefficient manner during these years, and suffered from
many of the reoccurring themes identified in police research literature, such as depleting patrol staffing for other duties, there is much that can be learned from this undertaking. The impact of this research touches on the organizational dynamics and practices that influence whether an agency will embrace innovative strategies or remain trapped in a cycle of ad hoc decision making and ill conceived initiatives. Further, the case study of the Vancouver Police Department patrol operations offers firsthand insight into the barriers, challenges and reform that can effect transformation change in a large metropolitan police department. In the case of the VPD, while the police service may have historically suffered from a lack of regularly scheduled evaluations and decisions informed from empirical data, many of the current practices are considered groundbreaking within the policing community. The most recent participation in an independent review by the University College of the Fraser Valley and a Patrol focused Operations Review conducted jointly by the City of Vancouver and the VPD, with the assistance of an outside consultant, illustrates the potential for creating core capacities to improve the effectiveness and efficiency of patrol deployment. This exercise has also demonstrated that it is possible for police services to address, and overcome the obstacles that have traditionally mitigated the effective and efficient deployment of patrol resources.

8.2 Policy Implications

It is widely recognized that police resource efficiency is a topic of keen interest to elected officials and to some degree the electorate themselves. City
councils are continually preoccupied with balancing budgets and minimizing tax increases. As a result, the manner in which police organizations deploy and respond to calls for service are increasingly under scrutiny and review by external examiners and municipal auditors. In many metropolitan centres, police budgets consume the greatest portion of a municipal budget, thereby garnering the greatest scrutiny.

Given these realities, and based on my research findings, it is advantageous for police organizations to seek out methods to review and examine their operations. Rather than wince at the prospects of external review, a truly progressive organization would initiate regularly scheduled audits of its operations in order to improve efficiency and ensure that current practices still reflect best practices. A proactive approach that extends beyond the confines of ad hoc enforcement initiatives and touches on organizational change and progressive management, is in the best interests of the police service. Keeping in mind most police organizations have conducted very little internal reviews of their operations, there is much to be gained, both monetarily and efficiency-wise from adopting a culture of self-review and analysis.

At a practical level, the case-study of the VPD and the subsequent optimized deployment model that was produced, illustrates very tangible incentives to adopting organizational learning practices and developing core capacities to evaluate police operations based on empirical evidence. In fact, by applying a similar methodology to that used in the case-study of the VPD, any
metropolitan police service could undertake the first step in developing a core capacity to assess the effectiveness and efficiency of their operations.

8.3 Limitations

In terms of the methodology employed as part of the case-study, there are several limitations to consider. As with any quantitative approach that relies on statistics and policy documents to determine research findings, there is a strong possibility that other mitigating factors, such as undefined human elements, could play a key role in determining efficiency and shaping police response to call-load. The risk is that by adopting a research approach heavily weighted in police generated dispatch data, the results could ultimately be skewed. The assumption that CAD data is a true reflection of workload limits the operationalization of the variables and creates the very real possibility of mono-operational bias. As well, given that interviews or self-reporting of time spent during a patrol shift were not utilized, there is also a problem of mono-method bias (Palys, 2003; p.129). Expanding the research project to include multiple operationalization of the research question and by adopting additional research methods would alleviate these concerns.

A second limitation is that the research focuses only on those years 2000 to 2005 inclusive. In an ideal situation, it would have been beneficial to examine the effectiveness and efficiency of patrol deployment following the implementation of a number of initiatives that flowed out of the VPD Operations Review.
8.4 Future Research

To address some of the limitations identified in this study, future research should include qualitative elements in combination with quantitative research grounded in measurable outcomes. Onsite interviews with practitioners, supervisors and managers would provide further insight and details as to possible methods to improve patrol deployment and shift scheduling. As well, a survey of police and civilian staff opinions on a range of issues facing patrol may provide innovative solutions and alternatives to traditional scheduling changes.

Assistance from the public, in terms of establishing expectations of police patrol, a willingness to fund police hiring initiatives and input on organizational goals and objectives may also prove beneficial. This could be accomplished through surveys and/or the use of focus groups of a large enough sample size for the results to be representative of the city population.

A number of private companies have capitalized on the lack of consistency and standards by which police organizations review their patrol deployment. A range of vendors offering scheduling software based on simplistic and outmoded methods for evaluation continue to flourish in the unregulated market. An in-depth evaluation of the various products offered by vendors would serve to establish some standardization and best practices. Consequently, police services intent on evaluating their patrol operations would have a benchmark in which to base their decisions.
8.5 Moving Forward

This thesis included a literature review that examined many of the challenges facing police efficiency and the organizational dynamics that affect how change is implemented. Building on these identified issues, an analysis was conducted on the VPD patrol deployment model. The analysis revealed that the current VPD deployment model is largely inefficient and requires substantive modifications to improve its effectiveness. Through the process of conducting this research study, certain organizational characteristics were identified that were similarly iterated in the literature review. Issues with unchecked specialization and a resistance to adopting evidence-based evaluative practices were shown to hinder the development of improved strategies aimed at maximizing patrol effectiveness. Furthermore, it was established that the VPD, similar to other metropolitan police departments, engaged in decision-make based on anecdotal information that lacked any evaluative framework to empirically support their decisions. Based on the research findings, the significant impediments to affecting real and substantive organizational change were highlighted and assessed. Moreover, the study identified challenges to implementing an organizational learning approach and the many competing goals and agendas that are fragmenting police resources. Issues with over-extended resources and difficulties in defining organizational goals and objectives that are both realistic and obtainable are not isolated to the VPD. As such, the case-study of the VPD offers firsthand insight into the barriers and challenges of any police service attempting to effect change.
8.6 Epilogue

The data and policy documents that formed the case-study component of this research spanned January 2000 to December 2005 inclusive. Consequently, the analysis of the VPD, including the efficiency calculations and the description of its organizational practices, are only current as of December 2005. As a result, the most recent participation in independent audits and reviews by academic consultants are not reflected in this thesis.

However, it is worth noting that in an extremely short time-frame, specifically less than three years, the VPD has made tremendous advances as a leader in policing. Many of the negative practices identified in this thesis have either been addressed since 2005 or are in the accelerated process of being reviewed and corrective action taken. For example, the main crux of this thesis focused on the inefficiency of Patrol and the question of whether there had been management policies that led to unit over-specialization, or an imbalance between the number of officers assigned to Patrol as compared to specialized units.

Yet, in the time since the data for this report was extracted and analyzed, the VPD has developed innovative technology to analyze its operations and develop a core capacity to conduct regularly scheduled performance reviews. The development of a core capacity for measuring efficiency and effectiveness has further enhanced the services strides in effecting change and reform. Moreover, the VPD has gone to great lengths to eliminate ad hoc surveillance units, and transfer a significant number of constables back to patrol from non-
essential specialty units. The VPD has adopted organizational learning practices by deciding to implement and test the effectiveness of Roving Metro Units and fixed Delta shifts that mirror weekly utilization increases. The creation of organizational and unit specific benchmarks and clearly articulated and measurable mandates, as part of an organizational strategic plan, illustrate meaningful reform and positive change.

Further, several steps taken toward tighter fiscal responsibility and budget accountability at the manager level, as well as greater responsibility placed on patrol managers for the crime control performance of their units, are yet other examples of innovative management practices.

While the exact degree of improvement is beyond the scope of this thesis and would require further analysis and review to ascertain the capacities that have since developed, it is fair to say that many police services are now turning to the VPD for best practice advice on which to model their own practices. In a sense, the turn-around in the business practices of the VPD and the transformational change the organization has experienced throws into question the contention of an *Unbending Blue Line*. 
9. REFERENCE LIST


Broom, Cheryle (2004). *Performance Audit of the King County Sheriff's Office*. Seattle, WA: Metropolitan King County.


10. APPENDICES

The following section contains tables and charts that illustrate many of the concepts identified in the body of the report. While the tables and charts are explanatory in nature, they were not critical to the analysis. Only those tables and charts that helped to identify key findings and trends were incorporated into the main body of the report.
Appendix A  Data Conversion and Extraction Techniques

Evolution of CAD systems comprises of three CAD data sets. The database application used to build the databases was MS Access 97. The final aggregate tables were converted to MS Excel format:

1. Police (PC) CAD
2. Altaris CAD
3. Macro CAD

Police CAD (May 08th, 2005 - December 31st 2005) This data set is comprised of twenty data tables, with over 600,000 transaction records. For the purpose of this study, three tables were used and two tables were created with additional information:

- dc_data
- cc_data
- unit_mileage
- Translation_Code_Table_PC_CAD
- tbl_shift

Altaris CAD (December, 10th, 2002 - May 8th, 2005) This data set is comprised of seven data tables with over 700,000 transaction records spanning over three years including part of 2005:

- mis_rpt_evh_stl
- mis_rpt_evh
- uhist_primary
- Translation_Code_Table_PC_CAD
- tbl_shift

Macro CAD (April 03rd, 1988 - December, 10th, 2002) The data set tables for the Macro CAD are very similar to Altaris CAD; the same processes and analysis were applied to Macro CAD as to Altaris:

- chist_primary
- uhist_primary
- Translation_Code_Table_Macro_CAD
- tbl_shift

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Extraction calculations performed. Three main calculations were performed on the data during the extraction process.

1. Response Times - total time it takes a patrol unit to respond to a call for service ("at_scene" – ‘time-received”).
2. Consumed Minutes - total minutes in a time period when a patrol unit is dispatched ("cleared_time" – “time_dispatched”)
3. Available Minutes - total minutes a patrol unit is available for work (“time_logoff” – “time_logon”)

General assumptions made with the data extract. For maximum efficiency and accuracy between databases the technique of “Aliasing” was used. Aliasing is used to specify a custom name for a source table or query when the same table or query is used more than once. This facilitated using the same queries for all three CAD databases with minimal adjustments.

The following patrol units were extracted from the three CAD systems’:
1. Uniform Patrol Units (i.e. VA1A11)
2. Plainclothes Patrol Units (i.e. VA1D21)
3. Patrol Beat (Foot) Units (i.e. VA1B77)
4. Beach Patrol Units (i.e. VA4H11)
5. Bicycle Squad (i.e. VA4C44)
6. CITU/SOCO (VA5S20)
7. Telephone Response Team (TRT) (VA5B52)

With the joining of multiple data tables duplicate records do occur, and they must be filtered out. Using MS Access to filter out the records, a nine step elimination process, available in the Help Index under “Automatically delete duplicate records from a table”, was used.

Where District identifiers were not present within the record, the District was identified by the district identifier within the Unit call sign (i.e. unit_id - VA2G18, first numeric value indicates the district. This numeric value was appended to the record entry. In some cases a unit in District 02 VA2xx will assist in District 03, the time will be credited to District 02 not District 03.
Response time assumptions included a criteria for excluding records that could not be analyzed, such as blank records or records that were clearly system generated errors.

1. All records where the “time_received” or “at_scene_time” was null
2. All records where the Unit call sign was a Wagon (VAxxx62) or NCO (VAxxx51)
3. On View calls – “how_received” = ‘s/v’
4. Priority 1 (P1) calls less than 1 minute or greater than 2 hours in duration
5. Priority 2 (P2) calls less than 1 minute or greater than 12 hours in duration
6. Priority 3 (P3) calls less than 1 minute or greater than 24 hours in duration
7. Priority 4 (P4) calls less than 1 minute or greater than 24 hours in duration

Consumed minutes assumptions for excluded records.

- All records where the “time_dispatched” or “clear_time” was not null
- Records excluded:
  - All records where the “clear_time” – “time_dispatched” is greater than 11 hours.
  - Any dispatch record that shows a unit particular unit dispatched more than once to the same call
  - Any record where the Unit dispatched is an NCO (VAxxx51)

For available unit minutes it was assumed that all units log on immediately when on shift and log off thirty minutes before the end the shift. i.e. (BRAVO SHIFT 0700 hrs – 1800 hrs. Adjusted Time 0700 hrs – 1730 hrs. Available unit minute assumptions for excluding records where the logoff times were not available.

- All records where the “clear_time” – “time_dispatched” is greater than 11 hours.
- Any dispatch record that shows a particular unit dispatched more than once to the same call
- Any record where the Unit dispatched is an NCO (VAxxx51)
Response time was calculated by finding the difference between the
at_scene_time and time_received. The results were then converted to minutes
i.e. (24*60).

\[
\text{Response Time} = (24\times 60 \times (\text{at\_scene\_time} - \text{time\_received}))
\]

24 hours a per day
60 minutes in a hour
This function calculates the number of minutes.

- Hour of the Day = Hour ([time_received]) (hour)
- Day of the Week = Day ([time_received]) (day of the week)
- Week Day = Weekday ([time_received]) (week day)

<table>
<thead>
<tr>
<th>response_time</th>
<th>hour_day</th>
<th>day_week</th>
<th>week_day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.03333333339077</td>
<td>18</td>
<td>1</td>
<td>Sunday</td>
</tr>
</tbody>
</table>

Consumed minutes were calculated by finding the difference between the
clear_time and dispatch_time. This time difference is stored in a field named
Service Time

- In-service or (time the call was cleared)

\[
\text{Dispatched Time} - \text{time the call was dispatched}
\]

\[
\text{Service Time} = (\text{inservice\_time} - \text{dispatch\_time})
\]

Available minutes were calculated by finding the difference between the CDate
([time_logoff])-CDate ([time_logon]). The time difference was stored in a filed named total_time_deployed.

\[
\text{time\_logon} - \text{time\_logoff} (\text{Adjusted logoff time})
\]

\[
\text{total\_time\_deployed} = (\text{time\_logoff} - \text{time\_logon})
\]

234
The calculation for the Utilization Rate, which is the percentage of available time consumed by calls for service, was computed using an MS Excel spreadsheet. Formula: Utilization Rate = (consumed minutes/available minutes).

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Year</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3 HOUR OF DAY**

<table>
<thead>
<tr>
<th>4</th>
<th>DISTRICT 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0000 to 0059</td>
</tr>
<tr>
<td>6</td>
<td>0100 to 0159</td>
</tr>
<tr>
<td>7</td>
<td>0200 to 0259</td>
</tr>
</tbody>
</table>

Sample formula

Performed for each year of the study for each patrol district

=SUM('M:\P&R\PROJECTS\PR2005\078\PHASE II\Patrol Deployment Study\Ryan Prox\Ryan’s Minutes Consumed 2000-2005.xls'!C$6:C$8)/'M:\P&R\PROJECTS\PR2005\078\PHASE II\Patrol Deployment Study\Ryan Prox\Ryan’s Minutes Available 2000-2005.xls'!B5)

Units considered. In order to accurately reflect patrol workload, certain unit types were excluded from the study. Specifically, some units that organizationally belonged to the Patrol Division were not counted as “deployable” units, as they either fulfilled very specialized functions, took very few calls, or were limited to a very small geographic area. In short, they are not patrol units and are typically not dispatched to 911 calls for service. As a result, the following units were excluded:

- Patrol team supervisors
- Mounted Squad
- Waterfront Unit (District 2 “Team 11”)
- Marine Squad
- Youth Squad
- Community Policing Officers
- School Liaison Officers
- Car 86 and Car 87
The following units were included in the study.

- District 1 Bike Team ("Team 11 Bicycle Patrol")
- Uniform Patrol Units (i.e. VA1A11)
- Plainclothes Patrol Units (i.e. VA1D21)
- Patrol Beat (Foot) Units (i.e. VA1B77)
- Beach Patrol Units (i.e. VA4H11)
- Bicycle Squad (i.e. VA2E11)
- CITU/SOCO (VA5S20)
- Telephone Response Team (TRT) (VA5B52)
Appendix B  Districts 1 to 4 and City-Wide Utilization Figures

City-wide Utilization Totals for 2000 to 2005 by Day of Week
City-wide Total Utilization from 2000 to 2005 Combined by Day of Week
City-wide Utilization Total 2000 to 2005 Inclusive by Day and Hour
City-wide Utilization Total 2000 to 2005 by Day of Week

City Wide Utilization Total by Day of Week 2000 to 2005

Sunday  Monday  Tuesday  Wednesday  Thursday  Friday  Saturday

2000  2001  2002  2003  2004  2005
District Totals 2000 to 2005 Inclusive Utilization by Hour
District 1 Utilization – Year Total 2000 to 2005
District 2 Utilization – Year Total 2000 to 2005

[Graph showing District 2 Utilization Year Total 2000 to 2005]

Legend:
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
District 4 Utilization – Year Total 2000 to 2005
District 2 Utilization – Year Total 2000 to 2005 with 82 New Staff in Existing Deployment Model
District 3 Utilization – Year Total 2000 to 2005 with 82 New Staff in Existing Deployment Model

- 2000
- 2001
- 2002
- 2003
- 2004
- Option C

0.350 0.450 0.550 0.650 0.750 0.850

0000 0100 0200 0300 0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300
0059 0159 0259 0359 0459 0559 0659 0759 0859 0959 1059 1159 1259 1359 1459 1559 1659 1759 1859 1959 2059 2159 2259 2359
District 4 Utilization Year Total 2000 to 2005 with 82 New Staff in Existing Deployment Model
Appendix C   Districts 1 to 4 and City-Wide Utilization Figures

City Wide Total Minutes Available 2000 to 2005 by Day and Hour

City Wide Minutes Available  Total 2000 - 2005 Inclusive by Day and Hour
City Wide Total Minutes Available from 2000 to 2005 Combined by Day of Week
District Totals 2000 to 2005 Inclusive Minutes Available by Hour
City Wide Total Available Minutes by Years 2000 to 2005

2000
2001
2002
2003
2004
2005
Appendix D  Districts 1 to 4 and City-Wide Consumed

City Wide Total Minutes Consumed from 2000 to 2005 Inclusive by Day and Hour

[Graph showing citywide minutes consumed by day and hour from 2000 to 2005 inclusive]
City Wide Total Minutes Consumed from 2000 to 2005 Combined by Day of Week
District Total 2000 to 2005 Inclusive Minutes Consumed by Hour
City Wide Minutes Consumed by Year from 2000 to 2005
Appendix E  City Wide Response Times

City Wide Totals from 2000 to 2005 of Average Response Times and Number of Calls

Note: Logarithmic average calculated for both the response time variable and number of calls variable with a projection to 2006.
Appendix F  Overtime Usage City Wide Totals

All Districts Combined - Extended Tour Over-Time by Day and Time of Day
Over Time (Extended Tour & Callout) for All Districts Combined by Day
All Districts Combined OT Usage by Type (Extended Tour, Minimums, Planned and Other)
## Appendix G  50% Utilization Ratio and Staffing Projections

### 50% Utilization Ratio

#### Adjusted Resource Distribution by District

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumed Patrol Unit Minutes</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
<tr>
<td>Percent of Total Consumed Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Available Unit Minutes</td>
<td>5,856,514</td>
<td>5,581,633</td>
<td>6,297,145</td>
<td>5,732,283</td>
<td>23,467,575</td>
</tr>
<tr>
<td>Percent of Total Available Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>24%</td>
<td>100%</td>
</tr>
<tr>
<td>Number of Calls</td>
<td>32,749</td>
<td>49,606</td>
<td>35,117</td>
<td>38,981</td>
<td>156,453</td>
</tr>
<tr>
<td>Percent of Total Calls</td>
<td>21%</td>
<td>32%</td>
<td>22%</td>
<td>25%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Unit Utilization** 50% 50% 50% 50%
50% Utilization Ratio
Adjusted Patrol Authorized Strength

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Patrol Team Staffing Authorized Strength</td>
<td>89</td>
<td>98</td>
<td>119</td>
<td>103</td>
<td>409</td>
</tr>
<tr>
<td>% Adjustment</td>
<td>27%</td>
<td>22%</td>
<td>30%</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>Evaluated Resource Total</td>
<td>113</td>
<td>120</td>
<td>155</td>
<td>128</td>
<td>515</td>
</tr>
<tr>
<td>District Increase</td>
<td>24.0</td>
<td>21.6</td>
<td>35.7</td>
<td>24.7</td>
<td>106</td>
</tr>
<tr>
<td>Factored Team Increase</td>
<td>-33</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Adjusted District Increase</td>
<td>0</td>
<td>22</td>
<td>36</td>
<td>24</td>
<td>82</td>
</tr>
<tr>
<td>Percentage Proactive Time</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Percentage Allocated Time</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>New Patrol Team Staffing</td>
<td>89</td>
<td>120</td>
<td>155</td>
<td>127</td>
<td>491</td>
</tr>
</tbody>
</table>

Note:
1. Based on obtaining unit utilization percentage range below 50% weighted by day and time for each district
2. Figure based on the calculation (Patrol Team x Percent Adjustment).
3. An adjusted figure that takes into account an even distribution of officers for each patrol team within the district. Most districts have either ten or eleven teams that respond to calls for service. Furthermore, the staff increase for each team is adjusted to compensate for one and two officer units in order to impact unit utilization to the level stated.
4. The actual number of officers required per district in order to effect change in the unit utilization ratio to the level stated.
5. Based on District 2 authorized strength, but excluding CET/BET staffing. See analysis section for complete explanation of FTE figures.
6. Excludes recent addition of 33 officers to District 1 that only became deployable in late 2006.
7. On October 4th 2005 increased the number of officers in District 1 by 33. This resulted in patrol teams increasing from a norm of 9 to a new norm of 13 person teams. The authorized strength for PCs in District 1 is now at 131 officers.
50% Utilization Staffing Projections - Option A

<table>
<thead>
<tr>
<th>Team</th>
<th>Redeployed</th>
<th>Combined Tm</th>
<th>Delta (4/3)</th>
<th>Roving</th>
<th>Total</th>
<th>New FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase</td>
<td>Delta Increase</td>
<td>4 Teams</td>
<td>2 Teams</td>
<td>6 Teams</td>
<td>Increase</td>
</tr>
<tr>
<td>District 1</td>
<td>-8</td>
<td>0</td>
<td>11 (8 + 3)</td>
<td>7</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>District 2</td>
<td>6</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>District 3</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>District 4</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>17</td>
<td>24</td>
</tr>
<tr>
<td>Team Supervisor</td>
<td>4</td>
<td></td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>North Surveillance</td>
<td>9 (D1 6 + D2 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Surveillance</td>
<td>9 (D3 5 + D4 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Only Total</td>
<td></td>
<td>41</td>
<td>28</td>
<td>69</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>35</td>
<td>34</td>
<td>45</td>
<td>75</td>
<td>86</td>
</tr>
</tbody>
</table>

1. District 1 - Team 3 to 10 reduces in size from 13 to 12 constables.
### Appendix H  40% Utilization Ratio and Staffing Projections

#### 40% Utilization Ratio

Adjusted Resource Distribution by District

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumed Patrol Unit Minutes</strong></td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
<tr>
<td>Percent of Total Consumed Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Available Unit Minutes</strong></td>
<td>7,286,057</td>
<td>6,954,166</td>
<td>7,847,211</td>
<td>7,165,353</td>
<td>29,252,787</td>
</tr>
<tr>
<td>Percent of Total Available Minutes</td>
<td>25%</td>
<td>24%</td>
<td>27%</td>
<td>24%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Number of Calls</strong></td>
<td>32,749</td>
<td>49,606</td>
<td>35,117</td>
<td>38,981</td>
<td>156,453</td>
</tr>
<tr>
<td>Percent of Total Calls</td>
<td>21%</td>
<td>32%</td>
<td>22%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Unit Utilization</strong></td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>
### 40% Utilization Ratio

**Adjusted Patrol Authorized Strength**

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Patrol Team Staffing Authorized Strength</td>
<td>89</td>
<td>98</td>
<td>119</td>
<td>103</td>
<td>409</td>
</tr>
<tr>
<td>% Adjustment¹</td>
<td>58%</td>
<td>52%</td>
<td>62%</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>Evaluated Resource Total²</td>
<td>141</td>
<td>149</td>
<td>193</td>
<td>160</td>
<td>642</td>
</tr>
<tr>
<td>District Increase</td>
<td>52</td>
<td>51</td>
<td>74</td>
<td>57</td>
<td>233</td>
</tr>
<tr>
<td>Factored Team Increase³</td>
<td>-19</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Adjusted District Increase⁴</strong></td>
<td><strong>20</strong></td>
<td><strong>50</strong></td>
<td><strong>74</strong></td>
<td><strong>58</strong></td>
<td><strong>202</strong></td>
</tr>
<tr>
<td>Percentage Proactive Time</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>Percentage Allocated Time</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td><strong>New Patrol Team Staffing</strong></td>
<td><strong>109</strong></td>
<td><strong>148</strong></td>
<td><strong>193</strong></td>
<td><strong>161</strong></td>
<td><strong>611</strong></td>
</tr>
</tbody>
</table>

**Note:**
1. Based on obtaining unit utilization percentage range below 40% weighted by time and day for each district
2. Figure based on the calculation (Patrol Team x Percent Adjustment).
3. An adjusted figure that takes into account an even distribution of officers for each patrol team within the district. Most districts have either ten or eleven teams that respond to calls for service. Furthermore, the staff increase for each team is adjusted to compensate for one and two officer units in order to impact unit utilization to the level stated.
4. The actual number of officers required per district in order to effect change in the unit utilization ratio to the level stated.
5. Based on District 2 authorized strength, but excluding CET/BET staffing. See analysis section for complete explanation of FTE figures.
6. Excludes recent addition of 31 officers to District 1 that only became deployable in late 2006.
7. On October 4th 2005 the Department increased the number of officers in District 1 by 33. This resulted in patrol teams increasing from a norm of 9 to a new norm of 13 person teams. The authorized strength for District 1 is now at 131 officers.
### 40% Utilization Staffing Projections - Option A

<table>
<thead>
<tr>
<th>Team</th>
<th>Redeployed Officers</th>
<th>Combined Tm Increase</th>
<th>Delta (4/3) 4 Teams</th>
<th>Roving 2 Teams</th>
<th>Total 6 Teams</th>
<th>New FTE Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>District 2</td>
<td>34</td>
<td>4</td>
<td>38</td>
<td>9</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>District 3</td>
<td>54</td>
<td>3</td>
<td>57</td>
<td>12</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>District 4</td>
<td>42</td>
<td>3</td>
<td>45</td>
<td>9</td>
<td>7</td>
<td>16</td>
</tr>
</tbody>
</table>

| Team Supervisor | 4 |

| North Surveillance | 9 ([D1] 6 + [D2] 3) |
| South Surveillance   | 9 ([D3] 5 + [D4] 4) |

| PC Only Total | 52 |
| Total | 133 | 35 | 146 | 56 | 30 | 75 | 206 |
## Appendix I  Current Utilization Rates

Unit Utilization by District and City-wide Total

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0.569</td>
<td>0.673</td>
<td>0.660</td>
<td>0.575</td>
<td>0.6220</td>
</tr>
<tr>
<td>2001</td>
<td>0.612</td>
<td>0.658</td>
<td>0.693</td>
<td>0.594</td>
<td>0.6406</td>
</tr>
<tr>
<td>2002</td>
<td>0.610</td>
<td>0.676</td>
<td>0.703</td>
<td>0.618</td>
<td>0.6877</td>
</tr>
<tr>
<td>2003</td>
<td>0.672</td>
<td>0.642</td>
<td>0.666</td>
<td>0.642</td>
<td>0.6551</td>
</tr>
<tr>
<td>2004</td>
<td>0.681</td>
<td>0.604</td>
<td>0.697</td>
<td>0.650</td>
<td>0.6575</td>
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<tr>
<td>2005</td>
<td>0.648</td>
<td>0.623</td>
<td>0.666</td>
<td>0.636</td>
<td>0.6575</td>
</tr>
<tr>
<td>2007 Predicted</td>
<td>0.726</td>
<td>0.609</td>
<td>0.688</td>
<td>0.683</td>
<td>0.679</td>
</tr>
</tbody>
</table>

Average Utilization

| 00 to 05 | 63% | 65% | 68% | 62% | 65% |

% Change 00 to 05

| 13.8% | -7.4% | 1.0% | 10.7% | 5.7% |

Forecast % Change 05 to 07

| 12.0% | -2.3% | 3.3% | 7.3% | 3.3% |
## Appendix J  Available and Consumed Minutes

### Available Minutes by District and City-wide Total Excluding CET

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>4,814,835</td>
<td>5,892,017</td>
<td>5,018,285</td>
<td>5,074,320</td>
<td>20,799,456</td>
</tr>
<tr>
<td>2001</td>
<td>4,875,026</td>
<td>5,855,666</td>
<td>5,125,018</td>
<td>5,074,140</td>
<td>20,929,851</td>
</tr>
<tr>
<td>2002</td>
<td>4,645,632</td>
<td>5,393,413</td>
<td>4,764,732</td>
<td>4,299,356</td>
<td>19,103,133</td>
</tr>
<tr>
<td>2003</td>
<td>4,340,923</td>
<td>5,130,425</td>
<td>4,865,334</td>
<td>4,432,502</td>
<td>18,769,185</td>
</tr>
<tr>
<td>2004</td>
<td>4,595,536</td>
<td>4,972,037</td>
<td>4,926,902</td>
<td>4,729,123</td>
<td>19,223,599</td>
</tr>
<tr>
<td>2005</td>
<td>4,611,428</td>
<td>4,575,109</td>
<td>4,843,957</td>
<td>4,622,809</td>
<td>18,653,304</td>
</tr>
</tbody>
</table>

### Total 2007 Predicted
- Available Minutes: 4,485,674
- Consumed Minutes: 4,212,344

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,329,221</td>
<td>3,372,083</td>
<td>2,814,838</td>
<td>2,479,887</td>
<td>10,996,029</td>
</tr>
<tr>
<td>2001</td>
<td>2,537,700</td>
<td>3,275,824</td>
<td>3,020,435</td>
<td>2,562,828</td>
<td>11,396,787</td>
</tr>
<tr>
<td>2002</td>
<td>2,409,315</td>
<td>3,099,586</td>
<td>2,847,764</td>
<td>2,259,754</td>
<td>10,616,419</td>
</tr>
<tr>
<td>2003</td>
<td>2,480,150</td>
<td>2,798,128</td>
<td>2,753,936</td>
<td>2,418,421</td>
<td>10,450,635</td>
</tr>
<tr>
<td>2004</td>
<td>2,659,288</td>
<td>2,553,117</td>
<td>2,917,958</td>
<td>2,613,298</td>
<td>10,743,660</td>
</tr>
<tr>
<td>2005</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,492,560.56</td>
<td>2,920,479.97</td>
<td>2,849,704.50</td>
<td>2,472,530.96</td>
<td>10,735,275.99</td>
</tr>
</tbody>
</table>

### Consumed Minutes by District and City-Wide Total Excluding CET

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
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<td>2002</td>
<td>2,409,315</td>
<td>3,099,586</td>
<td>2,847,764</td>
<td>2,259,754</td>
<td>10,616,419</td>
</tr>
<tr>
<td>2003</td>
<td>2,480,150</td>
<td>2,798,128</td>
<td>2,753,936</td>
<td>2,418,421</td>
<td>10,450,635</td>
</tr>
<tr>
<td>2004</td>
<td>2,659,288</td>
<td>2,553,117</td>
<td>2,917,958</td>
<td>2,613,298</td>
<td>10,743,660</td>
</tr>
<tr>
<td>2005</td>
<td>2,539,691</td>
<td>2,424,143</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>10,208,126</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,492,560.56</td>
<td>2,920,479.97</td>
<td>2,849,704.50</td>
<td>2,472,530.96</td>
<td>10,735,275.99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
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</thead>
<tbody>
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<td>2000</td>
<td>2,492,560.56</td>
<td>2,920,479.97</td>
<td>2,849,704.50</td>
<td>2,472,530.96</td>
<td>10,735,275.99</td>
</tr>
</tbody>
</table>

### Note: Excludes CET/BET Data

### % Change

#### 00 to 05
- Available: -4.2% -22.4% -3.5% -8.9% -10.3%
- Consumed: 9.0% -28.1% -2.5% 0.9% -7.2%

#### 05 to 07
- Available: -2.7% -7.9% -2.3% -5.2% -1.8%
- Consumed: 7.2% -17.4% 1.8% 3.2% -1.1%

Note: Excludes CET/BET Data
### Available Minutes by District and City-Wide Total Including CET

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>4,814,835</td>
<td>5,892,017</td>
<td>5,018,285</td>
<td>5,074,320</td>
<td>20,799,456</td>
</tr>
<tr>
<td>2001</td>
<td>4,875,026</td>
<td>5,855,666</td>
<td>5,125,018</td>
<td>5,074,140</td>
<td>20,929,851</td>
</tr>
<tr>
<td>2002</td>
<td>4,645,632</td>
<td>5,393,413</td>
<td>4,764,732</td>
<td>4,299,356</td>
<td>19,103,133</td>
</tr>
<tr>
<td>2004</td>
<td>4,595,536</td>
<td>7,784,721</td>
<td>4,926,902</td>
<td>4,729,123</td>
<td>22,036,283</td>
</tr>
<tr>
<td>2005</td>
<td>4,611,428</td>
<td>6,804,946</td>
<td>4,843,957</td>
<td>4,622,809</td>
<td>20,883,140</td>
</tr>
<tr>
<td>Total 2007</td>
<td>27,883,381</td>
<td>39,252,600</td>
<td>29,544,228</td>
<td>28,232,250</td>
<td>124,912,459</td>
</tr>
</tbody>
</table>

#### Predicted

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>4,485,674</td>
<td>8,322,546</td>
<td>4,732,020</td>
<td>4,382,262</td>
<td>21,922,502</td>
</tr>
</tbody>
</table>

#### Available Minutes

- **00 to 05**
  - **% Change**
    - 00 to 05: -4.2%, 15.5%, -3.5%, -8.9%, 0.4%
  - **Forecast**
    - 05 to 07: -2.7%, 22.3%, -2.3%, -5.2%, 5.0%

Note: CET/BET data included from 2003 to 2005

### Consumed Minutes by District and City-Wide Total Including CET

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,329,221</td>
<td>3,372,083</td>
<td>2,814,838</td>
<td>2,479,887</td>
<td>10,996,029</td>
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<tr>
<td>2001</td>
<td>2,537,700</td>
<td>3,275,824</td>
<td>3,020,435</td>
<td>2,562,828</td>
<td>11,396,787</td>
</tr>
<tr>
<td>2002</td>
<td>2,409,315</td>
<td>3,099,586</td>
<td>2,847,764</td>
<td>2,259,754</td>
<td>10,616,419</td>
</tr>
<tr>
<td>2003</td>
<td>2,480,150</td>
<td>3,352,552</td>
<td>2,753,936</td>
<td>2,418,421</td>
<td>11,005,058</td>
</tr>
<tr>
<td>2004</td>
<td>2,659,288</td>
<td>3,512,781</td>
<td>2,917,958</td>
<td>2,613,298</td>
<td>11,703,324</td>
</tr>
<tr>
<td>2005</td>
<td>2,539,691</td>
<td>3,385,224</td>
<td>2,743,295</td>
<td>2,500,998</td>
<td>11,169,207</td>
</tr>
<tr>
<td>Total 2007</td>
<td>14,955,363</td>
<td>19,998,049</td>
<td>17,098,227</td>
<td>14,835,186</td>
<td>66,886,825</td>
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#### Predicted

<table>
<thead>
<tr>
<th>Year</th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2,723,452</td>
<td>3,484,782</td>
<td>2,792,011</td>
<td>2,581,130</td>
<td>11,581,375</td>
</tr>
</tbody>
</table>

#### Consumed Minutes

- **00 to 05**
  - **% Change**
    - 00 to 05: 9.0%, 0.4%, -2.5%, 0.9%, 1.6%
  - **Forecast**
    - 05 to 07: 7.2%, 2.9%, 1.8%, 3.2%, 3.7%

Note: CET/BET data included from 2003 to 2005
## Appendix K  Response Times with Forecast

### Response Time by District and City-Wide Totals

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>7.22</td>
<td>7.91</td>
<td>9.21</td>
<td>9.18</td>
<td>8.38</td>
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<tr>
<td>2001</td>
<td>8.03</td>
<td>8.63</td>
<td>10.18</td>
<td>9.82</td>
<td>9.17</td>
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<tr>
<td>2002</td>
<td>8.40</td>
<td>8.76</td>
<td>10.18</td>
<td>10.43</td>
<td>9.44</td>
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<tr>
<td>2003</td>
<td>9.89</td>
<td>10.58</td>
<td>11.72</td>
<td>11.52</td>
<td>10.93</td>
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<tr>
<td>2004</td>
<td>10.26</td>
<td>9.71</td>
<td>11.65</td>
<td>11.24</td>
<td>10.72</td>
</tr>
<tr>
<td>2005</td>
<td>9.35</td>
<td>11.08</td>
<td>13.21</td>
<td>13.21</td>
<td>11.71</td>
</tr>
</tbody>
</table>

| 2007   | 11.34      | 12.21      | 14.43      | 14.23      | 13.1      |

### Average Response Time 00 to 05

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
<th>District 3</th>
<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>11.34</td>
<td>12.21</td>
<td>14.43</td>
<td>14.23</td>
<td>13.1</td>
</tr>
</tbody>
</table>

### % Change 00 to 05

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
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<tbody>
<tr>
<td>2007</td>
<td>11.34</td>
<td>12.21</td>
<td>14.43</td>
<td>14.23</td>
<td>13.1</td>
</tr>
</tbody>
</table>

### Forecast % Change 05 to 07

<table>
<thead>
<tr>
<th></th>
<th>District 1</th>
<th>District 2</th>
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<th>District 4</th>
<th>City-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>11.34</td>
<td>12.21</td>
<td>14.43</td>
<td>14.23</td>
<td>13.1</td>
</tr>
</tbody>
</table>
Appendix L    Shift Deployment Models Current & Proposed

District 2 & District 4 Weekend Shift Deployment
From 2000/01/01 to 2005/02/05

District 1 Weekend Shift Deployment
From 2000/01/01 to 2006/02/05
Shift Deployment Model Midweek for All Districts & District 3 Weekends from 2000 to 2006/02/06

Current Shift Deployment Model for All Districts 2006/02/06 to Current
Proposed Shift Deployment Model All Districts “Option A”