A Dynamic Framework To Estimate the Cost of Security for U.S. Army Installations

David M. Beskow
Department of Systems Engineering
United States Military Academy
West Point, NY 10996

Isaac J. Faber
Department of Systems Engineering
United States Military Academy
West Point, NY 10996

Abstract

Security is a key component of the operation of U.S. Army installations. After September 11th 2001 the cost to operate law enforcement and physical security has increased dramatically causing a resource drain on other vital services. Historically much of an installations security was provided by military members. However, as deployment operational tempo increased between 2001 and 2013 this resource became scarce and demand for contracted security and federal law enforcement increased significantly. These cost increases became a large area of uncertainty for budget decision makers leading to a higher likelihood of poor resource allocation. This study seeks to find the most effective way to predict future costs in areas of security in order to improve the budget process and inform decision makers of possible important trade-offs.

Keywords
Cost Estimation, Military Manpower Analysis, Decision Analysis

1. Introduction

The U.S. Army has an implied responsibility to protect Soldiers and their families within the physical foot print in which it occupies. The protection manifests itself in many settings from individual training to employing a police force. Around the world the Army has well over one hundred physical locations (referred to as bases). A base can be thought of as a small (large) city with the same requirements for municipal like services (utilities, law enforcement, general maintenance, etc.). The significant difference is that the military population of the base must be ready to respond and project force where the government determines. This requirement is referred to as ‘readiness’ and is a key metric within the Army. Critical to readiness is that Soldiers are provided with a secure environment to train and reside. In order to create the secure environment the Army employs two areas of focus; law enforcement and physical security.

In traditional law enforcement there is a considered a link between crime and the cost of execution. Ideas such as the optimal allocation of law enforcement [1] [2] give guidelines on the cost of executing actual enforcement. However, in the military there is a slightly different purpose. While law enforcement is a key component of base security there is a limited role of crime prevention. In fact crime on military bases is very low compared with national rates [3]. The primary reason for the security is of external threats effecting the troops readiness. After September 11th 2001 there was a renewed focus on securing bases. For example in 2009 alone additional expenditures on security included $29 billion additional dollars of funding beyond typical costs[2]. For the past decade the need to secure bases has been a critical point of interest for military decision makers. However, in recent years as the budget has become increasingly scrutinized and costs from all areas (including base security) need to be reasonably justified.

The purpose of this paper is to review and detail a novel approach to costing requirements for the two areas of base security (law enforcement and physical security). There will be a review of the historical process and an introduction
of a web based tool that gives decision makers a dynamic view of costs and impacts to changes in funding. The two web based tools can be found at:

- Physical Security: http://glimmer.rstudio.com/gosystems01/PhysicalSecurity/
- Law Enforcement: http://glimmer.rstudio.com/gosystems01/Law/

The following section will cover some of the common terms and approaches that are taken to each of the installation services of interest.

2. Background
The process in which funding is allocated in the U.S. Army can be complex. However, it is important to cover a general overview of the process so that the costing approaches are understood in the correct context. Installation budgets are determined and requested by a parent organization known as the Army Chief of Staff of Installation Management (ACSIM). This one entity determines policy and guidance for installation (base) operation. Within the ACSIM there are a set of services offered at each base, of which, law enforcement and physical security are two. These two services request budgets through a management decision package (MDEP) which is assigned a manager. The two MDEPs are identified as QLRP (for law enforcement) and QPSM (physical security).

Historically the cost for these services has been forecast by a simple linear regression analysis known as standard service costing (SSC). This approach is based on predetermined pacing measures (cost drivers) that are reported directly from the installations on a report known as the Installation Status Report (ISR). The primary issues with simple regression is that it lacks the ability to answer ‘what if’ questions about funding changes. The following sections will detail an approach to addressing this concern through a dynamic tool that is simple to understand and use by MDEP managers when developing costing justifications.

3. Law Enforcement
The formal definition of law enforcement is given by the ISR, is:

> Provide services for protection of people and property, enforcement of laws, and maintenance of order and discipline. Conduct traffic, game warden, and special event enforcement and civil liaison with civil law enforcement agencies. Investigate crimes. Provide military working dog support.

The reported measures for this services include: percent of timely law enforcement service responses, rating percentage of law and order operations function, percentage of investigations closed by military police investigators and several others. The actual pacing measures used in SSC are number of military members on a post, Department of the Army (DA) civilian, contractors, and family members for whom law enforcement services must be available during the year.

Within the SSC process, law enforcement has struggled to find a powerful cost estimating relationship (CER) from the regression. This is clearly evident in Table [1] where we see very few CERs. Because of this the MDEP manager has used methodologies other than SSC to build the requirement for this service. Recently, the Schedule 75 process (a bottoms up ‘data call’ from installations) has been the primary methodology for requirement generation for law enforcement.

The majority of costs (70-80%) in law enforcement are attributed to civilian pay (see Figure [1]). Additionally, there are contracts for vehicle support, IT support, etc. There are also vehicular and personnel equipment costs, some material costs, as well as some travel costs. Note that a large portion of the travel costs are associated with the movement of prisoners from one confinement location to another.

Historical execution data for the Active and Reserve Components have been relatively stable, as seen in Figure [2]. The historical execution (as reported in ISR cost data) for the National Guard has oscillated between $100,000 and $7,000,000.

There are two primary sets of data for Law Enforcement. The first is a “call-for-service” data set that originated from the Center for Army Analysis (CAA)[6]. This data are used in the current manpower model that CAA runs. The second category of data is the Schedule 75 (executed by the MDEP)for the past five POM cycles. Given this disparate data it is useful to look at other sources for best practices.
The Navy essentially combines law enforcement and physical security services into a single service and models them with their Pro-POM model. This model primarily uses patrol calls for service to generate the law enforcement portion of their requirement. The ProPOM model involves a web interface developed and maintained by several contractors that allows the user to input the data, generate requirements, as well as conduct limited operational planning in regards to the employment and movement patterns for security officers.[5]

The International Association of Chiefs of Police (IACP) recommends analysis of a series factors, to include Calls for Service, for human resource allocation. The IACP does not recommend ratios (i.e. officers per acre or officer per capita) for human resource allocation. The IACP recommends allocating patrol resources such that no more than a third of their available time is used responding to calls for service. One third of their time should be used for proactive patrols, and the final third should be used for administrative duties.

The MDEPs current methodology uses the Installation Law Enforcement Requirements Project (ILERP) to model manpower requirements (70% of the service) and a large installation data call and requirement validation process (Schedule 75) to model the remaining 30% of the requirement.

Currently, ILERP is applied against all Active and Reserve installations. The ILERP model was developed by CAA in 2010. The ILERP model uses actual calls for service recorded by installa- tions to separately model patrols, traffic investigators, investigators, game wardens, and dispatch (see Figure 3). ILERP then top-loads supervisors and administrative positions. ILERP does not model non-habitual special events (i.e. festivals, flea markets, etc.) and installation taskings not mandated by statute or regulation. The ILERP modeling process has assisted in standardizing law enforcement functions across installations.

Part of the ILERP model ensures that patrol personnel do not spend more than a third of their time on calls, and investigators do not spend more than 2/3 of their time on-scene at investigations. As part of this study the sensitivity of this parameter was tested to determine if it inflates personnel requirements. We found that the distribution of calls for service generally required roughly 1/3 of the patrol officers time, and therefore the model results were not very sensitive to this parameter. Increasing the allowed percentage created 0-15% personnel decreases on installations.

Once ILERP generates the personnel requirement for each installation, QLPR will determine what portion of the requirement can be fulfilled by military police. Various regulations (in particular EXORD 146-10 dated 12 March 2010) direct that large installations augment law enforcement with one MP company. Large installations are defined as those with three or more MP companies. These MPs are primarily used for patrolling. Investigative and dispatch positions often require a DA Civilian since MPs generally do not have the time and availability to attend the necessary training for these positions. After applying available MPs to the requirement, QLPR identifies the remaining positions.
As described in this paper a Law Enforcement Decision Support Tool (LEDST) is developed in order to allow decision makers to quickly change levers and see the associated cost and risk quantified. The basic levers used in the LEDST are depicted in Figure 4.

Note that the first decision (or lever) that the decision maker is faced with is to set the number for total Law Enforcement officers in the Army, regardless of what position (patrol, investigations, game warden, etc.) they hold or what uniform (DAC or MP) they wear. The ILERP will have already calculated the ideal number to take care of all calls for service on the installations. This number is depicted as 4153 in Figure 4 and is the result of the most recent iteration of ILERP. Note that a decision maker can pull the lever below 4153. It is currently set at 3739, which is currently the total authorized law enforcement officers. The difference between the ILERP requirement and the actual manning is represented as risk. One of the key contributions of the LEDST is to measure and communicate this risk to decision makers. Once the decision maker has determined the total number of law enforcement officers, he/she must next decide what type they will be (civilian hire or military). Through policy change, the Army can increase or decrease the number of military police available for law enforcement functions. Currently there are 1627 MPs contributed toward the requirement. By adding MPs toward the requirement, who are already on the payroll and who are paid outside of QLPR, the decision maker has reduced the number of DACs required and therefore decreased the budgetary requirement for QLPR. Once we determine the number of DACs required, we can multiply this by the assumed pay rate (or other approved rate) in order to determine the budgetary requirement for personnel. This number will represent 70-80% of the overall requirement (as stated earlier). Using Schedule 75, the rest of the requirement can be placed into the seven “bins” represented as the seven levers in Figure 4.

This tool allows the decision maker to easily manipulate the levers and then see the risks and effects at the installations as well as see the overall budgetary requirement. This models the Active and Reserve component. The National Guard’s only current Law Enforcement requirement is negligible. A screen capture of the tool is given in Figure 5.

The second tab of the tool provides the decision maker with a quantitative measure of the risk that they will assume if they reduce the law enforcement manning. The risk is measured at three active duty locations. In order to measure risk, the overall concept of the ILERP model was used, but started with manning instead of ended with the manning. The following steps in the algorithm measure risk:

1. Go through the historical calls for service in order to determine the size of the shifts for a given installation
2. Compute the portion of any cut that will be applied to the three installations used to measure risk. Apply the
By the following equation:

\[
Cut_A = \frac{Cut_{total} \times ILERP_A}{4153}
\]  

3. Apply the cut to the patrol portion of Law Enforcement (this is a big assumption that is more true for medium and smaller installations than the bigger ones that use MPs for patrols).

4. Go back through the historical data and determine how many calls for service and emergency calls for service will receive a delayed response due to under-manning.

5. Measure the mean wait time for these delayed responses

6. Measure the percentage of time that law enforcement officers will spend responding to calls (and therefore not be available for administrative or active patrolling activity)
Figure 4: Law Enforcement Decision Support Tool Levers

The results of one run through this algorithm are depicted in Figure 6. Under reduced manning, Fort Stewart (an example installation) dropped from a total 161 officers to 145. Given this drop, they will now see 2.6% of their calls for service and 4.1% of their emergency calls for service receive delayed responses. Note that their officers now spend 37% of their time on calls for service, which is starting to creep over the recommended goal of one third of time spent on calls for service. This is most likely taking away from active patrolling, since the administrative requirement usually doesn’t change. Also note that the mean wait time for delayed responses is 18 minutes. These quantitative estimates of risk can be very helpful for a decision maker.

The third tab of the tool gives the user a visual depiction of the level of calls for service activity. This allows them to visually see trends in calls for service as well as better understand the impact of reducing manning to installation law enforcement patrolling functions. This visualization is seen in Figure 7.

The final tab on the tool shows the budgetary requirement as a stacked bar chart broken down by category. Pulling any of the levers will adjust the budgetary requirement. In addition to choosing the total manning requirement, the decision maker can change the total number of MPs applied to law enforcement functions, as well as change the amount applied to the seven other law enforcement categories other than civilian pay. A screen shot of this stacked bar plot is given in Figure 8.

3.1 Conclusions/Recommendations/Thoughts

The tool provides a great ‘proof-of-concept’ for the reasonable effective supplement or replacement for SSC and meets a need for the Law Enforcement MDEP. The primary value added is in the easy to use web-interface as well as the quantitative evaluation of risk. Future efforts could continue to integrate the Investigator and Game Warden models into the tool. Instead of applying cuts only to the patrol section of each installation, the tool could proportionally
Figure 6: Law Enforcement Decision Support Tool Levers

apply the cuts to Game Wardens, Investigators, and Patrol. Then assessments of the risk of the Game Wardens and Investigators could be done by measuring their new work load and comparing against industry standards.

4. Physical Security
The physical security service of Army installations is described by the ISR report as:

Provides planning and services for blast mitigation, physical security communication systems, explosives detection, electronic intrusion detection, personnel protection, site improvements, and security forces and technicians.

The performance measures reported through ISR for physical security include; Number of visitors unable to access secure installations, number of active barriers, number of force protection assessments done and many others. Additionally, the pacing measures include; total number of inbound traffic lanes at primary and secondary installation access control points (IACP). Similar to law enforcement physical security has a history of using SSC. As seen in Table 2, the SSC process has struggled to identify and use a clear cost estimating relationship in the Physical Security service. Note that the primary pacing measure is supposed to be the total number of inbound traffic lanes, which should arguably affect the amount of personnel and equipment needed for physical security. Visualizing the regression model for this SSC model (see Figure 7), there is a “shotgun” of data with a very poor fit. Note that $R^2 = 0.02$, quantitatively meaning this model is an extremely poor fit given the context of installation requirement generation.
This visualization is a very powerful picture of why the SSC process is not working for physical security. The service can be broken down into its basic categories from the ISR cost data. A visualization of this breakdown is given in Figure 10. Note in this cost breakdown from 2010 that the largest category is contracts. During this time frame all security guards were contracted. From 2010 to present they have shifted from contracted to DA Civilians. A current cost breakdown would have a much larger civilian labor amount.

The Active Component has seen a gradual increase in execution since 2004, while the Reserve Component has seen a gradual decrease over the same time frame (see Figure 11). The National Guard’s execution jumped from $20,000,000 in 2005 to over $100,000,000 in 2006. Since then the National Guard execution has seen a gradual decrease, finishing just below $80,000,000.

Schedule 75 is currently used to collect data from all installations in order to build the requirement for both Law Enforcement and Physical Security. Installations use a web interface (contractor supported) to input their needs/requirements. These include contracts, material, equipment, services, and civilian payroll. This may be as large as all physical security personnel or as small as cellphones and other miscellaneous equipment. Command’s and MDEP managers review and validate requirements. Validated one-time requirements are then placed into a given year, while annual costs are placed in all POM years that these costs/requirements are relevant. One important facet of Physical Security is that it can be broken down into Army Program Elements (APE), which are given in Table 3.

The Physical Security currently models manpower using traffic flow data collected for both weekday and weekend activity. The data collection is conducted at each Access Control Point (ACP) at Active, National Guard, and Reserve installations over a two week time period. The model uses hourly traffic flow at the ACP in order to calculate security guard (SG) requirements. A recent study showed that security guards could process 375 vehicles per hour, which is currently the number used to drive the model (see Table 4). An example of mean hourly traffic data for ACP #3 at Fort Bragg (an example installation) is visualized in Figure 12. The model first calculates the minimum manning requirement given that two guards must be assigned to every open gate. The equation is given below:

$$\text{Minimum Requirement} = \frac{\text{Hours per Year Gate is Open}}{1740}$$

where 1,740 is the current Army Availability Factor. Figure 13 shows the manning requirement given that every open gate must have two security guards, and Figure 14 and 16 shows the application of security guard shifts to the minimum requirements. After this minimum requirement is established, the model essentially adds the remaining annual hours required and applies the Army Availability Factor. To visualize this at Fort Bragg’s ACP #3, we would use Figure 15 and count up the annual man-hours that are still shown in gray. These extra man-hours are added up for weekdays and weekends and then divided by the Army Availability Factor.
### Table 2: SSC Cost Driver Pacing Measure

<table>
<thead>
<tr>
<th>Year</th>
<th>Active</th>
<th>ARNG</th>
<th>Reserve</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>3-Year Avg (Adjusted by Total Pop)</td>
<td>CER-Total Pop</td>
<td>3-Year Avg (Adjusted by Total Pop)</td>
</tr>
<tr>
<td>2011</td>
<td>3-Year Avg (Adjusted by Total Pop)</td>
<td>CER-Total Pop</td>
<td>CER-Sqft/Tot Acres</td>
</tr>
<tr>
<td>2010</td>
<td>3-Year Avg</td>
<td>CER-Total Pop</td>
<td>2-Year Avg</td>
</tr>
<tr>
<td>2009</td>
<td>CER-# of MEVA's</td>
<td>CER-Total Pop</td>
<td>3-Year Avg</td>
</tr>
<tr>
<td>2008</td>
<td>CER-# of MEVA's</td>
<td>3-Year Avg</td>
<td>3-Year Avg</td>
</tr>
<tr>
<td>2007</td>
<td>2-Year Avg</td>
<td>3-Year Avg</td>
<td>3-Year Avg</td>
</tr>
<tr>
<td>2006</td>
<td>CER-Total Pop</td>
<td>CER-Total Pop</td>
<td>3-Year Avg</td>
</tr>
<tr>
<td>2005</td>
<td>3-Year Avg</td>
<td>3-Year Avg</td>
<td>3-Year Avg</td>
</tr>
</tbody>
</table>

#### Active Historical SSC Model (2008–2010)

![Graph showing historical regression with inbound lanes as explanatory variable.](image)

**Figure 9**: Historical Regression with Inbound Lanes as Explanatory Variable

### Table 3: APE’s within Physical Security

<table>
<thead>
<tr>
<th>APE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>131039100</td>
<td>General Installation Physical Security SEC Equipment</td>
</tr>
<tr>
<td>131039200</td>
<td>Physical Security Site Improvements</td>
</tr>
<tr>
<td>131039300</td>
<td>Physical Security Management and Planning</td>
</tr>
<tr>
<td>131039400</td>
<td>Security Forces/Technicians</td>
</tr>
</tbody>
</table>
Supervisors as well as the Rapid Intervention Team are added on top of the basic security guard requirement. Supervisors are added at a ratio of 14:1. Rapid Intervention Teams consist of two personnel that are on standby 16 hours a day for five days a week and are prepared to respond to a crisis. Small installations are authorized a single RIT, and larger installations are authorized two RITs. Using the Availability factor, an installation requires five personnel in order to man a single RIT.

Note that in Figure 17 that a single shift cannot completely cover the morning surge traffic at Fort Bragg’s ACP #3. In Figure 16 and Figure 17 simulation results indicate that not covering the entire requirement will result in very long lines at ACPs. In Figure 18 however, that covering all of the requirement with SG shifts results in inefficiency in that there are hours when we have “over-manned” the gates. One solution to this is that we apply available military police and borrowed military manpower (BMM), who arguably have more flexibility in assignment, to cover the surges in traffic flow. We created an assignment optimization program in Microsoft Excel (with OpenSolver) in order to optimize the assignment of security guard shifts given a user input of available MPs/BMM. This model would create a more accurate requirement than the current model. We found that our improved assignment model did not vary drastically from the current model (though it did measurably increase the manning requirement). Current leadership decided not to apply additional time and energy to this improved model since they felt the current model was complete and adequate.

5. Conclusion
The two approaches and tools detailed in the paper for base security allow for an improved view of cost and impact of changes. The web based tool that incorporates all of the information presented in this paper can be viewed and explored at the URLs listed at the beginning of this paper. This work demonstrates a value-added approach to costing the important function of base security.
Figure 11: Execution as Reported in ISR (not including OPA Funds)

References
Figure 12: Fort Bragg ACP #3 Traffic Flow

Figure 13: ACP #3 hourly manning requirements (given minimum of 2 security guards)

Figure 14: Initial Model places minimum required guards

Figure 15: Current model adds up remaining man-hours in order to calculate additional personnel even though these do not match a SG shift

Figure 16: Alternate Model #1: Don’t apply additional personnel to morning surge

Figure 17: Alternate Model #2: Apply a single SG shift

Figure 18: Alternate Model #3: Inefficiencies noted if we “cover” all traffic flow with SG shifts