Analysis of Military Entry Control Point Queueing

INTRODUCTION

Military Entry Control Facility (ECF) mission and purpose is to provide security to the installation from unauthorized access and intercept contraband while maximizing traffic flow. Design of an ECF should maximize traffic flow without compromising security, safety or causing undue delays that may affect off-installation public highway users or installations operations. Overflow from the ECF queue can disrupt civilian traffic utilizing the surrounding roads of the installation.

PURPOSE

Examine interactions that would minimize the interference of military EFC traffic with civilian population. Focus on arrival rates of vehicles, processing time of the guards, customer actions, and deploying additional server.

Endstate: Provide insight to ECF operations that could lower interference with civilian traffic.

METHODOLOGY

All Models:

- Service Distribution: $\text{Exp} \left( \frac{1}{\mu} \right) + 3$
- Utilized discrete event simulations in SIMIO for models
- Each model was replicated 30 times

Model 1: Split to Individual Queue

Model 2: Illogical Customers

Model 3: Additional Server to Queue System

RESULTS & ANALYSIS

Model 1: Split to Individual Queue

- Three options were tied with a score of 4 (Queue = 3, 5, & 9)
- Tie breaker goes to the longest queue length
- "Best" option to open 2nd server for this model is when queue length = 9

Model 3: Additional Server Tandem

Model 2: Illogical Customers

- Each model was replicated 30 times
- Utilized discrete event simulations in SIMIO for models

Model 3: Additional Server to Queue System

- Model 2: Illogical Customers
  - At each probability of choosing left lane we can find a point at which the overall queue length is no longer affected by the illogical customer choice.
  - Insight: Fully open both lanes for queue not be affected by the illogical customer decisions.

Model 3: Additional Server to Queue System

- Insight: If an ECF is capable of opening a parallel server, choose parallel server over tandem server.

- Parallel
  - Utilization levels $p \leq 1.6$ open 2nd server at queue length $\leq 17$.
  - Utilization levels $p > 1.6$ open 2nd server at queue length $> 13$.

- Tandem
  - Tandem model is only capable of sustaining a queue less than or equal to 20 for models with utilization levels $p < 1.1$
  - Insight: Tandem model servers act as batch server with batch service time equal to the max of the individual service times.

CONCLUSION

Model 1: Split and Model 2: Illogical Customers both emphasized the importance of fully opening both lanes of traffic to allow vehicles access to both queues.

From our analysis it was observed that tandem servers acted as batch server with the batch service time equal to the max of the individual service times.

If the focus of adding additional server is to reduce overall queue length, then the ECF should utilize parallel servers.