Performance Improvement in DMV Offices using SIMIO within Lean-Six Sigma
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Overview: The North Carolina Department of Transportation (NCDOT) has a Division of Motor Vehicles (DMV) that operates over 175 local offices that provides license service for vehicles. At North Carolina State University, the College of Textiles Zeis Extension service offers, among others, training and support for Lean-Six Sigma. The Departments of Textile Engineering, Chemistry, and Science (TE) (Professor Jeffrey Joines) and the Edward P. Fitts Department of Industrial and Systems Engineering (ISE) (Professor Stephen Roberts) in the College of Engineering offers simulation courses that are based on SIMIO.

Background: The quest for performance improvement has driven an interest in lean-six sigma methods such as DMAIC and many others. Recently the NC DMV contracted with the NC State University College of Textiles Zeis Extension service to find ways to improve the performance of their DMV offices across North Carolina. Simulation was incorporated into the lean-six sigma study of the DMV offices through a Master's Thesis of Swapnil Landge supervised by Professors Joines and Roberts initially to test different scenarios of running DMV offices. SIMIO was used because of the highly dynamic nature of the DMV office environment, we felt that it would be an interesting modeling challenge for SIMIO's intelligent objects to impact performance improvement.

The simulation team was included in a lean-six sigma project team made up of people from the Extension service and from the NC DMV. The general methods of Lean Six Sigma were employed to examine the DMV offices. These activities not only identified potential areas of improvement but also documented the scope and details of typical DMV office procedures. Such information was critical to the conceptualization and level of detail needed in any simulation model. It became a goal of the simulation team to develop a simulation model of DMV operations that could be readily adapted to many of the DMV offices which were similar but had different layouts and working policies. This decision resulted in a commitment to creating a more detailed model than would be needed in a specific office. However, the hope was that the model might be more readily reused and the investment in the model could be spread across several application sites. A more subtle objective of the simulation was to demonstrate how simulation could be used to augment more common lean-six sigma methods, perhaps adding evidence for wider spread use of simulation as a tool within the Lean Six Sigma framework. We will demonstrate the project through the DMAIC process

Approach: The approach to creating the simulation model generally followed the DMAIC format:

1) The Define phase produced the following:
   - The *problem statement* was: "The process for obtaining services at the driver license office is often lengthy and requires customers to wait more than 30 minutes to initiate a transaction. Currently, there is no target for what is to be considered a reasonable wait time or total transaction; it is known, however, that presently the times are no longer than desired. The extended amount of time spent fulfilling customer needs results in lost productivity, reduced customer satisfaction and low employee morale."
   - The supporting *mission statement* was: "The mission of this project is to reduce the average total time of customers in the driver license office by 20% by October 31, 2015. This will result in more transactions being completed by DMV, less time a customer is required to spend at the driver license office and greater execution of the organizational goal of NCDOT being a great place to work." (DMV office Lean Six Sigma Project Tollgate report 2015)
2) The Measure phase included the following
   a. Document the process flow maps of several targeted DMV offices.

b. Identification of inputs for the simulation
c. Determination of metrics for the simulation
d. Initial ("rough-cut") model to determine "Xs" (for data collection)
e. Set of Issues with data and potential improvements
f. Simulation input modeling fitted 19 input variable to LogLogistic, Lognormal, JohnsonSB, Gamma, Triangular, and Poisson distributions.

3) The Analyze phase (Model Development)
    a. Understanding of the Xs and Ys as related to the simulation model
    b. Revised our SIMIO Simulation model using the Process Maps and Data
        i. Drive model from data so we can make change, document what if scenarios, etc.
        ii. Modified the Worker, Server, and ModelEntity objects to be specialized objects for the DMV problem.
            1. Worker Scheduling
            2. Relational Tables: Customer Type and Processing
            3. Tokenized Processes for workstation availability
            4. Use of Seize Request to accept and reject requests
            5. Discontinuous use for evaluators and DMV workstations
    c. Verification and Validation
        i. Response Sensitivity to Inputs
        ii. Validate Time in System
        iii. Visual Validation by DVM staff
4) The Improvement Phase
    a. Proof of concepts validated and tested with simulation experiments
    b. DMV Improvements
        i. Starting Office at 7:00 am
        ii. Adding additional workers, temps and part-time
        iii. Optimizing staff schedule (using OptQuest and KN)
5) The Control Phase
    a. Recommendations to sustain improvements
    b. Continuous use of simulation to determine if something is out of control.

Results: Based on the simulation the recommendations for the DMV were: (1) to begin opening some offices at 7:00 am since 20 to 40 were waiting at 8 am, (2) the average time in system was statistically similar for 13 or 14 (13 would be less costly) workers for the average time in system, (3) the Photo person should help the greeter to decrease the time in system during the early hours when the photo person is mostly idle, and (4) having temporary workers during peak hours and seasons would be useful. Using the sensitivity analysis, the greeting and photo time were determined to be the most sensitive for the overall cycle time.

Relative to using simulation within a lean-six sigma framework, it is important to identify the use of simulation at early stages of DMAIC process. Doing so, decreases time and resource commitment by identifying root cause or most important areas for simulation focus and needed data collection. For simulation to be accepted, lean-six sigma practitioners need to understand simulation capabilities. Simulation modelling can be used as a lean-six sigma tool as long as systems cost, time, constraints and permission barriers are known. A large number of design alternatives or Improvements can be tested and validated faster and easier using simulation instead of real life experimentation, especially in complex systems. We present the methodology employed, the changes made to the basic objects. and the results.