CAR REGISTRATION SIMULATION MODEL IN GCC COUNTRY

Shamsuddin Ahmed

UAE University, CBE, POB # 17555, Al Ain, UAE.
&
Edith Cowan University, Australia
Email: Dr_Shamsuddin_Ahmed@Yahoo.Com

ABSTRACT

Car registration and inspection simulation experiment to analyze business functions of the traffic department in Al-Ain city in United Arab Emirates (UAE) is reported. The car registration is managed by a government organization in association with a private network service company that looks after the inspection service. A visual AweSim car registration simulation model is developed from workflow viewpoint. The study reports generalized results to evaluate the service performances. The AweSim model provides information about queuing analysis, service activity utilization and processing time. Results derived from the simulation model helps to develop decision support system. It is seen that approximately 269 minutes in average are needed to complete the car registration steps. In any given day there would be about 29 cars waiting for the services to go through.

Keywords: Simulation, Vehicle Inspection, Vehicle Registration, Queue, Service Quality

VISUAL SIMULATION FOR CAR REGISTRATION

The Information Revolution has brought many new technologies that are continuously and rapidly changing the management of work places especially in service industries (1). Simulation technology offers the edge of competition and information system enables competitive advantage. Information systems consist of various components, some of which are executive support systems (ESS) and decision support systems (DSS). An important subset of DSS is computer simulation of systems (6). The rapid development of computer simulation software over the last decade makes it an important technology to be embraced by organizations in order to improve global competitiveness (8). Improved logistics are another key to customer satisfaction, while simulation has been successfully used to study and improve logistics processes (9). As with any other information technology, the use of simulation makes it a useful, cost-effective and productive tool to improve organizational strategy (3).

Administrative costs are something, which a business would dearly like to minimize. At the same time management recognizes the importance of cost effectiveness, efficient and customized delivery of its services. Nevertheless, there is a need to analyze system procedures so as to find ways by which improvements in efficiency and cost-effectiveness can be achieved without reducing the effectiveness of the system (2). However, system problems are seldom of the kind that led themselves readily to closed-end analytic solutions. This being the case, computer simulation presents a good way of discovering solutions to many problems, which are often found in many systems (9).

This paper utilizes AweSim, the visual SLAM (8); a process oriented computer simulation methodology; to analyze car inspection and car registration process. The traffic department in UAE (United Arab Emirates) subcontracted a *service agency* for the renewal and registration of cars in Al-Ain city. This analysis aims to examine, analyze and identify the potential problems faced at the inspection station. A simulation model along with relevant statistical results is presented for the inspection and registration method.

The Car Registration Process

Series of planned interview with the managers, engineers and workers at the car inspection stations are scheduled to identify the workflow system. The pressing problem is the long waiting time for the customer at the car registration station. The working procedures are reviewed, analyzed at the car inspection station and it identifies the following series of steps (4) that the customer must follow to get the car registration done.

- Any customer needs to register his/her car or renew the registration card, he/she presents the registration card with a period of 13 months insurance coverage from any insurance company. Thirteen months insurance coverage is a prerequisite for car registration.
- Then the customer takes the car to the service agency's inspection station, located adjacent to the traffic police vehicle registration department.
- The customer upon arrival at the inspection station pays charges and takes the payment receipt with an identification number written on a paper.
- The customer pays DHS. 60 inspection fees if the test is a FRESH one for the first time, regardless it is a Re-New, New Registration, Export or Transfer to somewhere. If the car fails to pass the inspection steps in the first attempt, the customer is recommended to repair the fault with the car and RETEST the procedure. In this case, the customer again pays DHS. 20.
- After the customer gets the payment receipt, the customer puts the car into inspection queue and waits until the car reaches the inspection station.
- When customer reaches inspection station with the car, the technician receives the car and initiates the inspection/testing procedure with the necessary equipment.
- The inspection process is performed electronically and manually and technicians record the inspection details into a computerized information system. The following tests are performed:

  - *smoke (hydrocarbon) test;*
  - *tires and rims tests;*
  - *break system and shock absorber tests;*
  - *visual inspections and*
  - *body and chassis test*

- Once the test is finished, the final result is stored automatically and recorded in the computer information system maintained by the service provider company. Then the customer gets the copy of this record from company's inspection department.
- If the final result of car test is recorded as PASSED in the computer system, then the customer brings a stamped test result document of the car inspection process to the traffic department along with the following documents (4):

For the National	For Foreign National
➢ Insurance ➢ Old registration card ➢ Passport photocopy ➢ Driving License photocopy	➢ Insurance ➢ Old registration card ➢ Passport photocopy (citizen of other countries) ➢ Driving License photocopy ➢ Work paper/work permit. ➢ Visa

➢After keying the data into the computer, the agent in the traffic department review all the required/necessary information stored in national database for accuracy. If there are no abnormalities, including traffic violation of any kind against the customer, the registration card is printed out and provided to the customer.

➢If the final result of the car inspection and car registration is FAILED, then the customer is informed of the irregularities and again restarts the process again.

Data Collection and Analysis

The fact-finding method is used to collect the data (5). In this approach, the interview, sampling techniques, review of the existing documentation including memos, database are used to collect information. Data from the inspection department is collected and analyzed statistically to provide some meaningful characteristics of these data.

Simulation Modeling and Analysis

In AweSim simulation model the cars move through a serious of testing stations such as hydrocarbon, tires, rims, break system, shock absorber, visual, body and chassis in the inspection process. Figure 1 illustrates the AweSim network simulation model. At the end of the inspection process, the car performance is determined. If the final result is *passed*, the car is routed to the traffic department to finish the procedure of renewal registration card. Otherwise, the car inspection status is *failed*, if the car is founded to be functioning improperly, and the car is routed to the repair center where the defective components in the cars are repaired. After repairing the car, it is again sent back to repeat the inspection process where the defective parts or components are again inspected.

The entities to be modeled in this system are the cars. The car arrives and is routed to the inspection station. The three independent lines of testing in the inspection station are represented as servers. If the three testing lines are busy, three parallel queues of cars are formed. This process can be conveniently modeled in AweSim with three QUEUE nodes that precede the service activity, which is testing and represents three independent servers. Following the service activity represented by the inspectors, 80 percent of the entities are passed and depart to the traffic department. The remaining 20 percent of the cars inspected do not pass and fail the inspection test and recommended for repair. The repairing process can be modeled as a QUEUE node followed by a service activity with a capacity of 15 cars. Following the adjustment operation, the entity is routed back to the inspection area queues.

The processing and routing of cars through the inspection as well as repairing areas is shown in Figure 1 as an AweSim network model. The entities representing cars are brought into the

system by the CREATE node with time between entities uniformly distributed between 00.01 and 01.06 minutes. Each entity has to advance to one of the QUEUE nodes or locations following a rule with the least number of cars in a queue. A vehicle will proceed directly to into service if an inspection line represented by the three emanating service activities following the queue is free. The three emanating service activities represent three parallel identical servers. The service times for all the servers are uniformly distributed between 00.42 and 12.10 minutes.

Following inspection, the vehicles arrive at a GOON node. It acts as a connector in the simulation network model in which the vehicles are probabilistically routed. One leads to the COLECT node labeled TO_TRAFIC_DEP that gathers statistics of the system. The collect follow a TERMINATE node representing departure from the traffic department. The other activity leads to the QUEUE node representing the waiting line for the repairing activity. Vehicles representing Entities, which are routed to the COLCT node, have interval statistics collected based on the time of creation, which was stored in ATRIB [1] at the ASSIGN node. This interval of time corresponds to the total time that the car spends in the inspection and repairing process. The entities are then terminated. The total *time is system* is a measure of *system response time* and it measures the service quality of a system.

Analysis of Results

The results are summarized in Table 1 using AweSim summary report after running the network as shown in the figure 1. The summary contains statistical information. The model statistics for the variables are based on the observations from the department. The first part contains of interval statistics on the TIME IN SYSTEM that collected from the COLCT statement. During the 536.8 minutes a total of 200 cars of the simulated operation were processed and completed an average time of 268.880 minutes in the system. It is expected a high variability in times in the system between cars for the registration as it is evident from the minimum and maximum times recorded in the system and a high standard deviation in the system suggests that some of the cars can't be repaired in the spot of repair station provided by the service company. The maximum time to complete registration including repair is found to be approximately 524 minutes. The second part of the statistics summary is the FILE STATISTICS. The results show that there was an average of almost 29 cars that is waiting for the service in queue and an average of 12 to 13 (actual value is 12.599) waiting to be repaired. In almost all cases there is long waiting time in any place in the system. Therefore, bottlenecks are identified in all queue location. In particular the queue location 4 has highest waiting time. The standard deviation for the process is also high due to the variation in queue length over time. The SERVICE ACTIVITY STATISTICS show that the four service activities related to activity 8, activity 9, activity 10 and activity 16 are fully utilized. The higher utilization (more that 90%) is recorded during length of simulation.

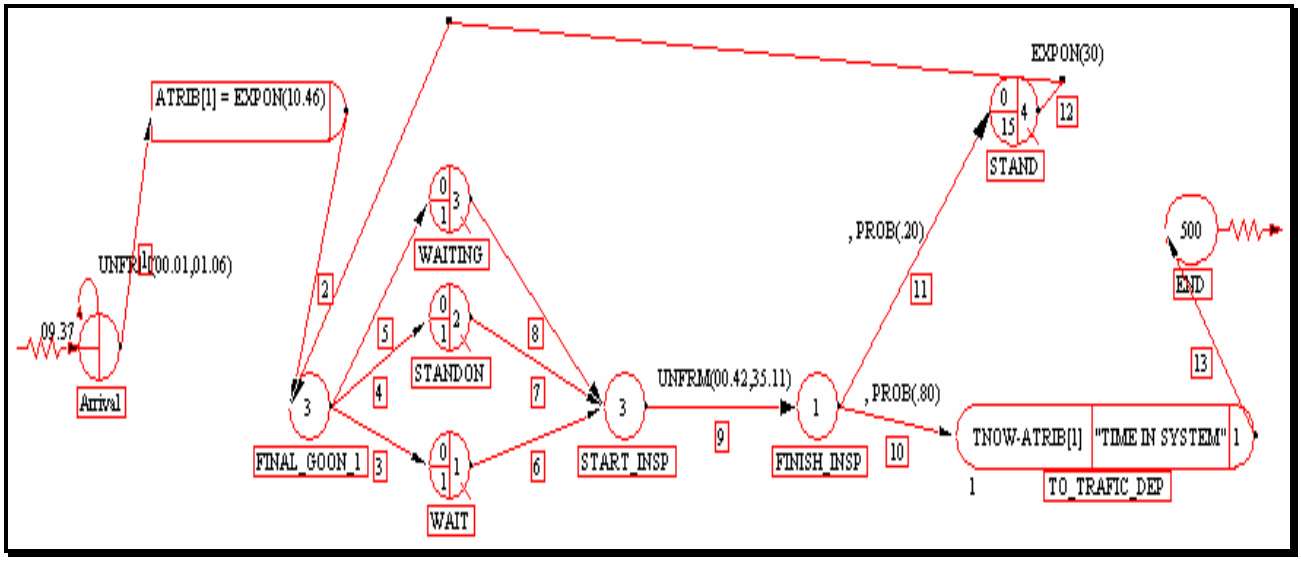

Figure 1: Visual SLAM network of car inspection

CONCLUSION

The analysis of the simulation study suggests that the inspection station may add additional resources and increase the number of inspectors/technicians. This would have the better service time for customer and the quality of the service process would be satisfactory.

Further, the information from the AweSim summery report leads one to assess the performance of the car inspection process relative to the customer satisfaction. The average time to complete car registration is approximately 269 minutes. Usually a customer hires an agent to complete this job to avoid long delay. Additionally, one may analyze whether or not the number of inspection stations or sequences of the process are appropriate. The length of waiting time is high. The average waiting time in queues 1, 2, and 3 are 142, 132, and 137 minutes respectively. Due to high waiting time, the vehicles that enter the service may not finish the registration in same day. The owners of the vehicle have to wait for the next day to complete the remaining steps. These indicate there are bottlenecks in the process. A meta-model simulation analysis is suggested for future analysis to evaluate different service scenarios to study the sensitivity of the inspection process with reference to the facilities. Therefore, further study to re-engineer the car registration and repair service is recommended.

Table 1: Simulation Report

```
        ** AweSim SUMMARY REPORT **
        Mon Dec 23 22:09:43 2002

  Simulation Project : CAR_REGISTRATION
  Modeler : TAOUFIK_OBAID
  Date : 23/12/2002
  Scenario : BASECASE

  Run number 1 of 1
  Current simulation time    : 536.877051
  Statistics cleared at time : 0.000000

         ** OBSERVED STATISTICS REPORT for scenario BASECASE **

     Label          Mean      Standard    Number of     Minimum     Maximum
                    Value     Deviation  Observations    Value       Value

TIME IN SYSTEM       268.880     150.930        200      142.346     523.667

         ** FILE STATISTICS REPORT for scenario BASECASE **

  File       Label or       Average    Standard   Maximum  Current    Average
 Number   Input Location    Length     Deviation   Length   Length   Wait Time

       1 QUEUE    WAIT         28.906       5.007       30       29     142.376
       2 QUEUE    STANDON      28.891       4.988       30       30     132.574
       3 QUEUE    WAITING      28.926       4.936       30       30     137.431
       4 QUEUE    STAND        12.599       4.382       15       15     270.563
       0 Event Calendar         5.919       0.533        8        6       0.998

         ** ACTIVITY STATISTICS REPORT for scenario BASECASE **

Activity     Label or       Average    Standard     Entity      Maximum
 Number   Input Location  Utilization  Deviation     Count    Utilization

       1 Line 2                 0.000       0.000         968           1
       2 Line 4                 0.000       0.000         968           1
       3 Line 6                 0.000       0.000         977           1
       4 Line 7                 0.000       0.000         977           1
       5 Line 8                 0.000       0.000         977           1
      11 Line 12                0.000       0.000          79           1
      12 Line 24                0.000       0.000          86           1
      13 Line 28                0.000       0.000          82           1
      14 Line 14                0.000       0.000         200           1
      15 Line 15                0.000       0.000          47           1
      17 Line 17                0.000       0.000         200           1

         ** SERVICE ACTIVITY STATISTICS REPORT for scenario BASECASE **

Activity     Label or      Server    Entity      Average    Standard
 Number   Input Location  Capacity    Count    Utilization  Deviation


       8 Line 10                1          79       0.983       0.131
       9 Line 22                1          86       0.983       0.131
      10 Line 26                1          82       0.983       0.131
      16 Line 20                1           9       0.972       0.166

Activity    Current     Average     Maximum     Maximum
 Number   Utilization  Blockage    Idle Time   Busy Time
                                 or Servers  or Servers

       8           1       0.000       9.370     527.507
       9           1       0.000       9.370     527.507
      10           1       0.000       9.370     527.507
      16           1       0.000      15.290     521.587
```

REFERENCES

1. Aksu, A. A., (2001). Re-engineering revisited: a Simulation Approach, Business Process Management Journal, V. 7, no. 2, pp 131-138.
2. Clark Jr. T.D., Hammond, D.H. and Cossick, K. L. (1992). Management Policies to Improve the Effectiveness of Multistation Service Organizations, Decision Science, Vol. 3, pp-1099-1022.
3. Evans J. R. and Olson, D.L., (2002) Introduction to Simulation and Risk Analysis, 2nd Edition, Prentice Hall, NJ, USA.
4. Fardane T. and Al-Obaidly. M. (2002). Renewal of registration card at Al-Ain Traffic Department. Report Submitted at the Department of Business Administration, UAEU.
5. Kelton W. D., Sadowski, R. P. And Sadowski D.A. (2002). Simulation with ARENA, McGraw Hill, NY, USA.
6. Lopez-Valcarcel, B.G and Perez, P. B., (1994). Evaluation of Alternative Functional Designs in an Emergency Department by Means of Simulation. Simulation, vol 63, no. 1, pp. 20-28.
7. Pritsker, A.A. B., O'Reilly, J.J. (1998). AweSim: The Integrated simulation System. Prceedings of the 1998 Winter Simulation Conference, D.J Medeiros, E.F. Watson, J.S. Carson, M.S. Manivannan. Eds.
8. Pritsker, A.A. B., O'Reilly, J.J. (1999). Simulation with Visual SLAM and AweSim. JW, NY, USA.
9. Valdivia M.T. R and Cowe T.J. (1997). Achieving Hospital Operating Objectives in the Light of Patient Performances, International Journal of health Care Quality Assurance, Vol. 10, no. 5, pp. 208-212.