Maintenance Simulation Report

C230419975

Simul8 Model

Through out this report I will describe how I used Simul8 to demonstrate how the hotel deals with maintenance requests, from this I will give results of the simulation and recommendations from the observations.

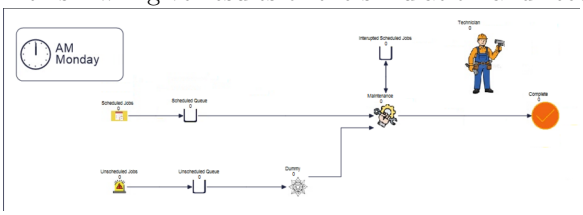

Figure 1: Simul8 Model

The model consists of two starting points, Scheduled jobs and Unscheduled jobs, the two different ways a maintenance report would go to the maintenance unit. From there reports wait in the queues to be sent to the activity 'maintenance' where the job is carried out by the technician.

Routine Maintenance

The scheduled maintenance reports were set to a fixed distribution for 24 hours and batched in following a rounded uniform distribution, (1, 5), in order to replicate routine maintenance being allocated at the start of the day. Routine maintenance could only go into the maintenance activity if there were no urgent maintenance jobs currently being done, if a urgent report came to the maintenance unit whilst a routine job was being carried out the job would have to be paused and sent to the Interrupted Scheduled Jobs queue until the urgent task was complete.

Urgent Maintenance

The unscheduled maintenance reports follow a Poisson distribution with mean time interval $\lambda = 45$. As the unscheduled jobs took priority they would be sent straight to the Dummy activity stopping routine maintenance, allowing the urgent job to be carried out immediately. This is done by setting the distribution to fixed and the value to zero meaning dummy activity takes 0 hours to complete, as seen in Figure 2.

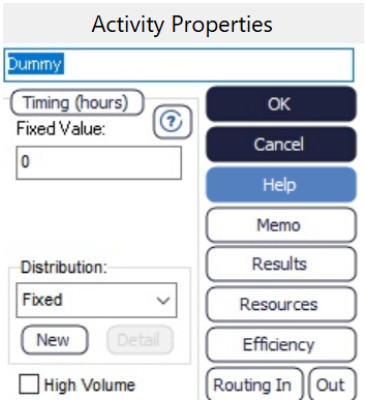

Figure 2: Dummy Activity Properties

Technician

The maintenance technician works 9:00 AM until 5:00 PM 7 days a week. In this simulation, the technician pulls work items through the queues and activities according to the guidelines on handling maintenance requests. The time taken for the technician to carry out jobs was determined by the type of report, scheduled follows a uniform distribution between [1.5,4] hours and unscheduled follows an exponential distribution averaging 3.2 hours for service. Once complete the work items leave maintenance through the end point, 'Complete'.

Assumptions

I assumed the technician would take a 30 minute break each day from 12:00 PM until 12:30 PM, whilst working the technician is at 100% availability. Jobs that aren't finished within the 8 hour work day are suspended until the next day to not allow overtime. Lastly travel time between jobs was set to zero.

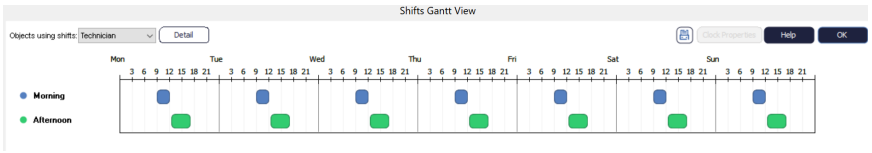

Figure 3: Technician shift pattern

Runtime and Warm-up Period

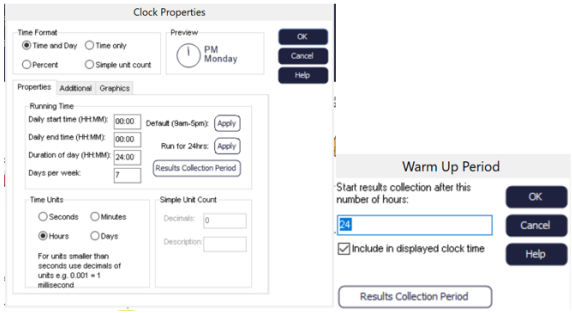

Figure 4: Clock Properties and Warm-up Period

I set my clock to 24-hours to align with the hotel's 24-hour operations. This meant that a warm-up period was needed to ensure the accuracy of the reports coming in. I was able to decide on this by running the simulation in 1-hour increments until reports began to come into the system and found that a 24-hour warm up period was best. In order to gain an accurate picture of how reports come in and the technicians ability to keep up with the work load, I decided a 1 month results collection period would be best for this model.

Validation

In order to validate my results I calculated the expected number of scheduled and unscheduled jobs according to the distributions. The values I got were very close to the simulated results, as can be observed in Table 1.

Job Type	Simulated	Calculated
Scheduled Jobs	86	90
Unscheduled Jobs	15	16

Table 1: Validation Table

Results

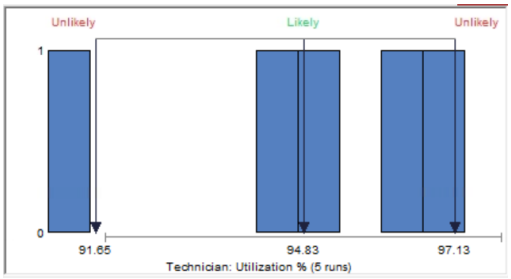

Figure 5: 95% C.I

With the recommended 5 runs in a trail I got a 95% confidence interval using the KPI for the technicians utilization, with interval [91.81, 97.84]

Metric	Min	Average	Max
Time scheduled rooms spend in the system	12.59	103.39	378.58
Number of scheduled rooms waiting for maintenance	0	12.37	34
Waiting time of scheduled rooms for service (hours)	9	63.76	177.02
Time unscheduled rooms spend in the system	12.14	66.39	296.66
Number of unscheduled rooms waiting for maintenance	0	0.19	1

Table 2: Results Table

Table 2 contains the results to the questions presented by hotel management, results come from a 1 month simulation period using KPI.

What if's?

After creating the simulation based on the parameters set by hotel management I explored some real life, 'What if?' scenario's. All 'What if's' are simulated over one month and done individually from one another.

- What if the technician had a day off each week?

  In the proposal for the simulation it was stated that the resource worked 7 days a week, but in most cases people need time off of work, therefore I simulated 1 day off a week for a month, as seen in Figure 6.

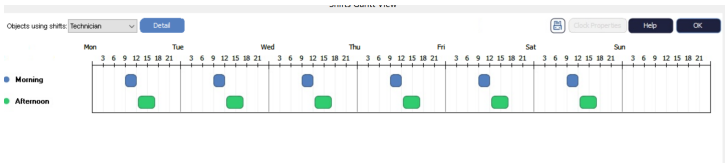

Figure 6: New shift pattern

  By giving the technician 1 day of a week, the average time scheduled maintenance spends in the system increases by 12.9 hours and the number of maintenance jobs that are completed decreases by 6, suggesting it is essential to implement measures to prevent any potential issues

- What if there was significant damage to the hotel?

  It is very possible that a long term repair job could occur and cause the average time of urgent maintenance in the system to increase. I increased the average time taken for an urgent task to 7.8 hours to demonstrate the effects of a large scale breakage. From this alteration, the number of tasks completed decreased by 14% and the average time work items spent in the system increased by 3.29 hours. Hence it is evident that changes in frequency negatively impact the hotel.

- What if the number of urgent repairs increased?

  To demonstrate this, I decreased the mean time interval between unscheduled job arrivals from $\lambda = 45$ to $\lambda = 20$. This caused a 164.16% increase in queue time and the average number of work items waiting for maintenance increased by 67.89%, for scheduled maintenance over the month. Therefore an increased volume of unscheduled jobs has a negative impact on the completion of scheduled jobs.

Recommendations for hotel management

One recommendation I would make to the hotel is to increase the size of the maintenance unit, it is clear when observing the effects of the technician working 6 days a week instead of 7 the back log of scheduled maintenance jobs left at the end of the month increases, as can be observed in Figures 7 and 8. It is important to note that the simulation model is idealistic and doesn't take into account the technician having time off. Hence an additional technician in the maintenance unit, even if it were part time, would prevent this issue from occurring.

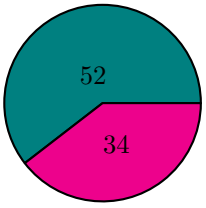

Figure 7: Scheduled Jobs when technician works 7 days

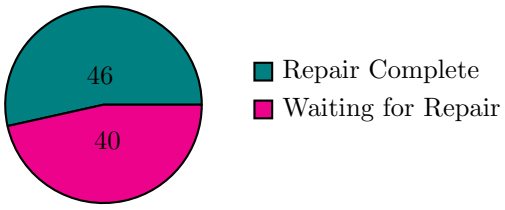

Figure 8: Scheduled Jobs when technician works 6 days

Another recommendation to hotel management is to reassess the way that they prioritize scheduled and unscheduled maintenance requests. With the current structure there is a back log of scheduled maintenance jobs that are essential to the up keep of a hotel and could lead to health and safety violations. One way of combating this is to create a more in depth method of determining the level of urgency of maintenance jobs. Table 3 is how I would categorize reports;

Scheduled Maintenance		Unscheduled Maintenance	
Priority	Secondary	Priority	Secondary
Smoke detector checks, carbon monoxide detector check, elevator inspection, etc.	Radiator checks, cleaning gutters, light bulb checks, etc.	Power outage, broken water pipe, severe plumbing issues, etc.	Bathroom door handle broken, painting touch-ups, etc.

Table 3: Example of Table to Assess Job Priority

I recommend that the maintenance unit prioritize jobs according to Table 3, with unscheduled priority tasks being handled first, followed by scheduled priority tasks, unscheduled secondary tasks, and finally scheduled secondary tasks. Additionally, only unscheduled priority tasks should have the ability to interrupt another task; all other tasks should be completed in order of their assigned priority.