

Simulation and optimal solution analysis of airport check-in system

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Abstract: In this paper, Witness software is used to simulate the check-in process of airport terminal. By setting the customer walking time, the number of check-in machines and artificial counters, the percentage of ordinary passengers and business passengers and other values, the customer waiting time and check-in time are simulated visually, and the customer satisfaction of different groups is analyzed. The optimized data including the number of check-in machines and counters are obtained through software. Finally, this paper analyzes the optimization scheme of airport check-in system according to satisfaction and cost.

Keywords: airport, check-in system, simulation, Witness software

1. Background

With the development of computer technology, people are more and more interested in how to use computer technology to find the best distribution of time, personnel and materials. [1] Witness is a system that can help the decision maker to do the best decision, by using its excellent solution system. The witness can assist and support policy making, planning, decision making and associated resource allocation or action deployment. [2] Users can do the simulation by adding some components such as part, machine, labor and else, and define the required rules, it's a good way to translate real events into a way that computers can read, then the software can give a set of conclusion and results of calculation, according to the require of the user. Purpose Introduction.[3]

2. Purpose Introduction

This is a simulation for Check-in operations of Flying Beaver Airline (FBA) at a local airport. [4] Let the traveller do the check in and then go to security. This simulation can be illustrated as followed.

Firstly, the traveller enters the airport, which the arrival time have been given. And there is a 2.5 minutes walking-distance from the airport main entrance to the check-in area.

Once they arrival at the check-in area, travellers of different class will be divided and make their own choice on using which check-in methods, the counter check-in or self-check-in. There is 80 percent general traveller and 20 percent business traveller.

After making their mind, traveller may wait at the queue of each check-in method. Traveller will use the first available machine or counter, and the check-in time varies from each other. If there has no customer in the business counter, there has no stuff.

And if the customer who choose the self-check but don't want to wait, they may move to the counter.

The final step, security, comes after the check-in.

And there has two group of stuffs, the morning stuff runs from 6am to 1pm, the afternoon stuff runs from 1pm to 9pm, both without rest during their shifts.

If it spent over 10 minutes, the business customer will be unhappy, and if it spent over 15 minutes, the normal customer will be unhappy.

By using the WITNESS simulation, decision makers can find out the percentage of unhappy

business customers and the percentage of unhappy normal customers. And find out a solution of adding numbers of stuffs and self- check machines.

3. Building the WITNESS model

The total image of the simulation model is shown as the figure 1.

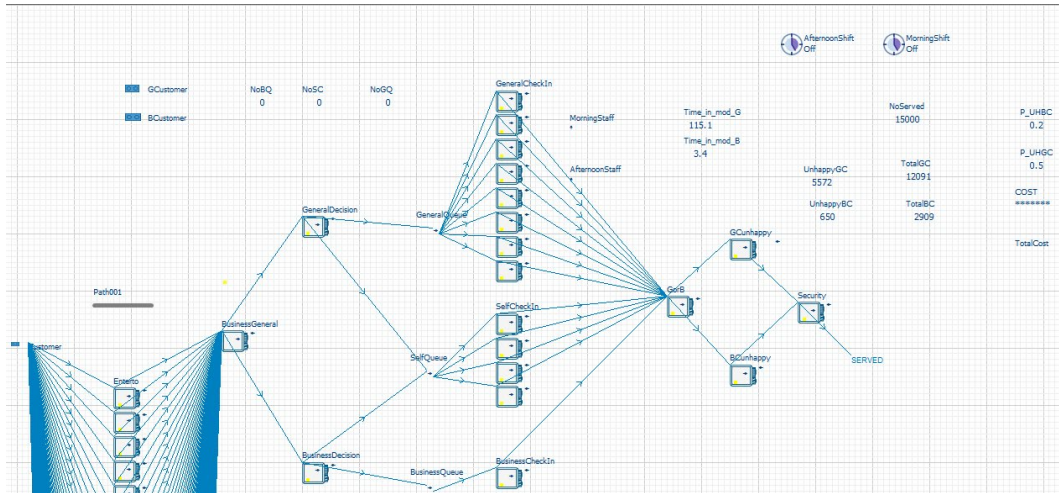


Figure 1: The total image of the model.

But in order to keep the model clear and tidy, set the Ship element as the end of the model, so the customer will leave the model rather than crowded at the model.

3.1. Report of the simulation run: 1day, 10 days, 100 days

Table 1: The table of the simulation parameters

Duration (Days)	Severed Customers	General Customers	Percentage of General Customers (%)	Business Customers	Percentage of Business Customers (%)
1	1500	1203	80.2	297	19.8
10	15000	12091	80.6	2909	19.4
100	150000	120112	80.1	29888	19.9

After we run the model for 1day, 10 days, 100 days, we get the table as shown as the table 1. From the table we can see that, after one day, the percentage of the general customers is 0.802; after 10 days, the percentage of the general customers is 0.806; after 100 days, the percentage of the general customers is 0.801. Thus, the model basically simulates the distribution of the general customers and business customers.

3.2. Percentage of switched business and general customers

As for the instruction, once the customer arrive the check in area, clients who want to use the self-check-in machine will change their minds if the queue at the machine is longer than the queue they would use at the counter, shown as the table 2.

Table 2: The percentage of Switched Customers

Duration	Percentage of switched General customer (%)	Percentage of switched Business customer (%)
1day	0.46	34.9
10 days	5.32	38.7
100days	5.64	37.34

3.3. Percentage of the unhappy business and general clients

We need to add a command to compute the percentage of switched customers. We input the

command in the Actions on Output of the “GCunhappy” and “BCunhappy” machine. The command is shown in the Figure 2.

```

    Edit Actions On Output from Task For Activity GCunhappy
    Select Search Editor Print
    Time_in_mod_G = TimeInModel ()
    TotalGC = TotalGC + 1
    IF Time_in_mod_G > 25
    UnhappyGC = UnhappyGC + 1
    ENDIF
    IF TotalGC > 1
    P_changedGC = (T_GeneralCheckIn - TotalGC * 0.6) / (TotalGC * 0.4)
    ENDIF

    Edit Actions On Output from Task For Activity BCunhappy
    Select Search Editor Print
    Time_in_mod_B = TimeInModel ()
    TotalBC = TotalBC + 1
    IF Time_in_mod_B > 10
    UnhappyBC = UnhappyBC + 1
    ENDIF
    IF TotalBC > 1
    P_changedBC = (T_BusinessCheckIn - TotalBC * 0.4) / (TotalBC * 0.6)
    ENDIF
    
```

Figure 2: command in Actions on output of “GCunhappy” and “BCunhappy” machine

The unhappy client is determined by its pass time. The percentage of the unhappy clients is shown as the table 3.

Table 3: The percentage of unhappy clients

Duration (days)	The number of Unhappy General client	Percentage of Unhappy General client (%)	The number of Unhappy Business client	Percentage of Unhappy Business client (%)
1	565	46.97	84	28.28
10	6052	50.05	824	28.33
100	59592	49.61	8464	28.32

4. Building the cost Witness model

Calculate the Total cost, we need to add a variable named “COST” to represent the expenditure, shown in the Figure 3.

```

    Edit Actions On Output from Task For Activity Security
    Select Search Editor Print
    IF TotalBC > 1
    P_UHBC = UnhappyBC / TotalBC
    P_UHGC = UnhappyGC / TotalGC
    COST = P_UHBC * 100 * 9000 + P_UHGC * 100 * 5000 + (NQty (MorningStaff) + NQty (AfternoonStaff)) * 45000 + NQty (SelfCheckIn) * 30000
    ENDIF
    
```

Figure 3: The rule of the total cost

As we can see from the assignment instruction, there has enough room for ten machines, and there have 9 counters, one is for business customers, others are for normal customers, so there will be has up to 9 stuffs.

The optimization process can be executed in the Advanced Experiment Model. In that page, we need to set the Run length as 14400 which means 10 days, and set the objective as Total cost, set the Target as Maximum as well. In consequence, add the three parameters, the quantity of Morning staff, Afternoon Staff and the Self Check in Machine. After the simulation of 10 days, we get the result of the lowest cost, which is shown as the figure 4.

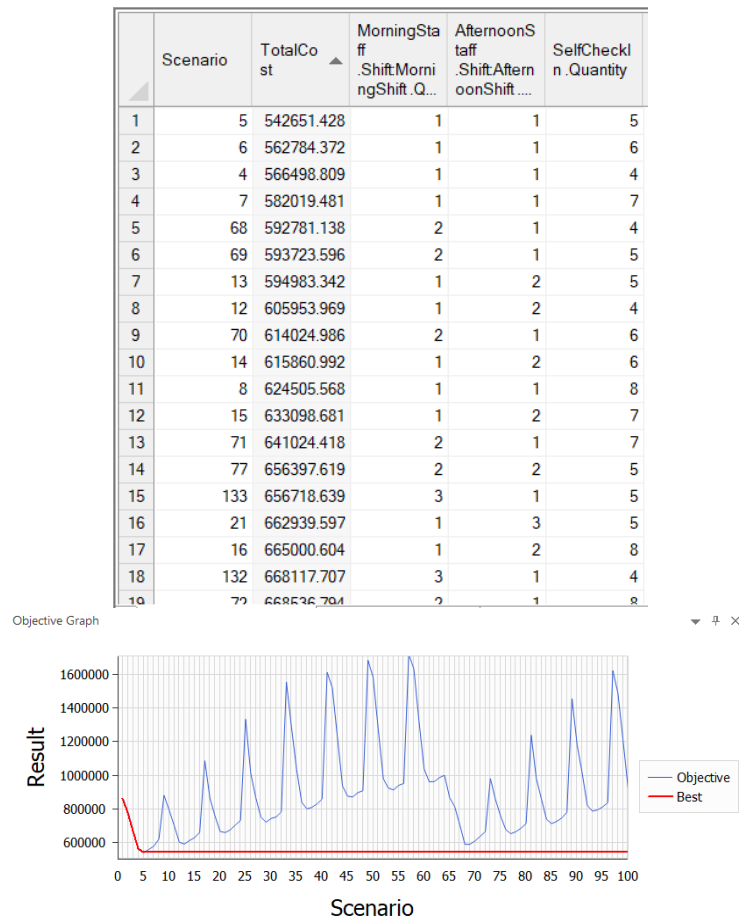


Figure 4: The result of the 10 days' simulation

The best solution is having 1 morning staffs and 1 afternoon staff and has 5 self-check-in machines. In that scenario, the total cost is 542,651.428 dollars.

However, in that scenario, we found that the model could not serve all the customers per day. So, this goes against the real situation. Aiming to solve this question, we add the NoServed in the response, to ensure that the minimum cost scenario must serve all customers.

In the final scenario, even though it is not the minimum cost in the optimization, it is the minimum cost that can served the whole traveler.

Accordingly, we recommend the airport could add 1 morning staff and 2 afternoon staff and 1 self-check in machine. Hence, the result is shown in the Table 4 and Figure 5.

Table 4: The cost information of the final scenario (10 days' duration)

Quantity of Moring staff	Quantity of Afternoon staff	Quantity of Self-Check-in machine	Percentage of Unhappy General Customer (%)	Percentage of Unhappy Business Customer (%)	Final cost
4	7	6	48.53	11.83	909,028.575

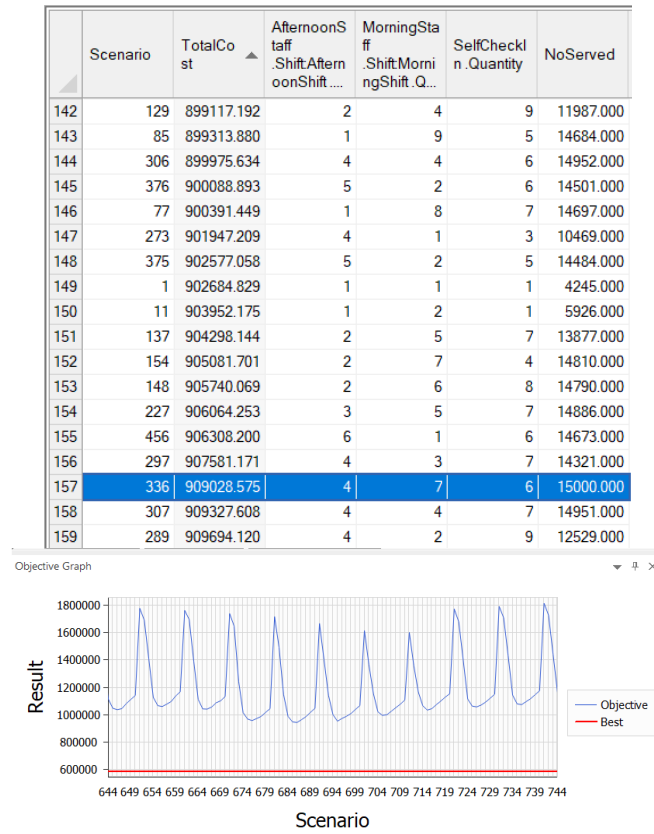


Figure 5: The final result of the optimization

5. Conclusion and discussion

The WITNESS model can clearly simulate the operation of the airport check in process. This is an airport checking in model. Using this model, we do the simulation of the real situation of the airport. We compiled WITNESS software on the turnover of airport customers, the shift of staff, the speed of business handling, the queuing and the patience of customers, and else. To find out the percentages of the unhappy business customers and the unhappy normal customers, the percentage of the switched customers. Then to find out the best set of the number of stuffs and the machines, which means the lowest cost for the airport. Then the decision maker can do the best decision for the airport according to the result of simulation.

By learning and using this software, we have learned how to do the decision by the more professional methods, and we need to be careful enough to consider all the circumstances of real events as much as possible so as to make more effective judgments.

References

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