APPLICATION OF THE THEORY OF MASS SERVICE AT THE OPTIMISATION OF THE PASSENGER AND BAGGAGE HANDLING SYSTEM

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The Diploma thesis deals with the issue of queuing theory, which nowadays interferes to a wide spectrum of areas in the society and in life. In the airline company, it is important to know the optimal deployment of resources not only in the sphere of deployment of human resources but also in the sphere of costs. Nowadays when the companies are trying to minimize costs and maximize profits it is important to identify how many workers to deploy and when to avoid unnecessary and costly downtimes.

K e y w o r d s. theory of the mass, passengers handling, baggage handling, optimization

1 INTRODUCTION

Nowadays, one of the main problems of the majority of departments in the sphere of trade and services is to determine the number of operation channels. This issue is markedly observed in aviation because if the companies would not be able to deal with enough passengers in a given time, that would mean large losses.

We have chosen this issue for this study mainly because of its persistent actuality. The questions of queuing theory in the sphere of the check-in of passengers and luggage are increasingly discussed in the sphere of airline companies. This is happening more often due to the crisis and optimizing and downsizing associated with it.

The main aim of the thesis was to describe the notions and the theoretical basis of the queuing, to analyze a particular airline company in this area and to propose a simulation model for optimization.

2 THEORETICAL DEFINITION OF THE PROBLEM THEORY QUEUING

After the introduction, I would like to outline and explain some notions, which are crucial for this issue. The queuing theory is a mathematical theory, which is otherwise known as the theory of queues. The theory explores the systems, in which the demands are formed randomly; they are sorted into queues and resolved by the operational processes. The queuing theory was developed in the 20th century. [1][2]

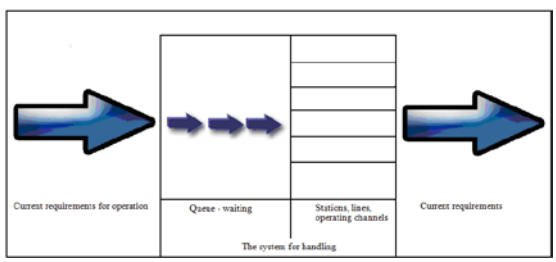

Figure 1 The queuing system (QS)

The queuing theory is a mathematical elaboration and analysis of the systems that provide queuing to the requirements. The queuing system may be defined as a maintenance facility, providing the maintenance. The non-maintained requirements, which need to be maintained in a certain way, enter this facility. The queuing system is composed of the maintenance channels, which provide maintenance to the requirements. If the requirement appears at the time when there is no free maintenance channel, the requirement is put into a queue or in some cases it may leave. [1][2]

3 BASIC CONCEPTS OF QUEUING THEORY

The requirement to meet any need is a generalization of various different types of orders. The requirement is personified with the holder.

The source of requirements is defined by the set of potential requirement holders.

The flow of requirements is a time sequence of maintenance requirements.

The service is a meeting of the requirements of objects. The maintenance channel

is represented by the objects, providing maintenance.

A maintenance knot is represented by several maintenance channels arranged parallel to each other.

The line or the queue is represented by the requests waiting for maintenance. The queues do not have to be necessarily created physically, but they are characterized by their maximum length.

The maintenance system is created by the maintenance knot and by the waiting requirements queue.

The maintenance time is a time spent by one channel to maintenance one request and it is expected that the operation ended and the request to maintenance has been met completely. [3]

4 CLASSIFICATIONS OF QUEUING SYSTEMS (QS)

A) The input current QS is divided as follows:
1) the number of requests;
2) the nature;
3) the type of service;
4) according to arrival:
5) the intensity of the input.

B) The type of service:
1) according to the queue;
2) according to the time delay;
3) by way of departure from the queue;
4) according to the priority items;

C) Since the network is divided QS:
1) Parallel connection;
2) the serial shift;
3) a combination of both.

D) In the SHO operation is divided into:
1) according to the nature of the service period;
2) the intensity of service;
3) the number of channels..

5 SIMULATION PROCESS OF QUEUING

Difficulties in the mathematical models can be easily overcome with the help of a simulation approach. This approach is based on the fact that the queuing process is modeled by random numbers. Numbers have the division of probability compliant with the random variables of real processes. Modeling is performed by a computer. The concrete simulation model is realized by the computer. The computer imitates arrivals in such way that the maintenance requests arrive according to the rules that apply to the transition of the requirements through the system. The value of characteristics is the results of realized simulation model. These values are of the nature of statistical estimates. The results can be interpreted in different ways, for example by a histogram, which provides better information than the estimation of the characteristics. [3]

6 OPTIMIZATION PROCESS FOR SIMULATION MODEL

Optimization should be carried out as follows:
1.) It created the QS.
2.) Various alternatives will be developed QS.
3.) Determine the criteria from the perspective that is important in this case, the most important for our investigation.
4.) Compare the alternatives to the stated criteria. This is done by:
a.) value or characteristics of the system;
b.) designed to function.
6.) We choose the most appropriate option for us.

7 ANALYSIS OF THE CURRENT STATUS OF PROCESS EQUIPMENT ON PRAHA - RUZYNE AIRPORT IN CSA COMPANY

The airport as a company known today was established in 2008 through privatization. The Prague Airport joint stock company is the operator of the biggest airport in the Czech Republic. In the last years it won several awards for example the IATA EagleAward.

There are three handling companies operating at the airport.

Those are:

Prague Airport Handling Company which is a company authorized for carrying out handling. It provides business and technical handling. Its focus starts with the smallest airplanes for private usage and ends with the airplanes such as those of the Boeing 747 type.

The maintenance is provided 24 hours a day all year.

The second is a Czech Airlines Handling company whose object of activity is the handling

of airplanes and passengers. Nowadays, the company provides its services to about 60% of air carriers in the Prague Airport. This company is addressed into greater details in the chapter Czech Airlines Handling a.s..

Menzies Aviation is a global provider of check-ins of passengers and baggage services. Menzies was established in 1995 and from that time its activities grew rapidly.

8 HANDLING PROCESS OF PASSENGERS AND BAGGAGE CZECH AIRLINES HANDLING

The passenger comes to the airport at the time, which has been set for him to check-in. The time is derived on the basis of the travel class. At the Prague-Ruzyne Airport the check-in is ended 40 minutes before the departure, for Tel Aviv, this time is 60 minutes. This time cannot be exceeded. There are 250 employers appointed for the work at the check-in desks. The individual check-in desks are solidly assigned to handling companies at the Prague Airport. The check-in of the passengers usually lasts from a few seconds to a few minutes. From the experiences of the workers from ČSA handling, the check-in at the check-in desk lasts approximately 90 seconds. When the passengers are checked-in at the kiosk, it lasts from 15 to 60 seconds. The actual time depends on several factors. For example, as regards to the situation, the violation of the rules applied to the number of luggage by the passenger, luggage weight, size, etc.

The passenger comes to the airport, goes to a terminal and subsequently goes to a departure lounge. In the lounge, the numbers of check-in desks are given at the information boards. The passenger is therefore navigated by the numbers and then can use the auto check-in kiosk or a check-in desk. The passenger is checked-in and his luggage travels into the luggage system.

There, the control and transport of the luggage happens. In case that the passenger travels out of the Schengen Area, the luggage is sent to the passport and customs control. There, the few counters are open by the workers according to the need. They are opened operationally, according to the number of passengers. In case of all the papers are all right, the luggage is sent to the security control habitat.

The security control is carried out according to the principles of the deployment of the workers similarly as the passport or custom control.

Subsequently, passengers pass through to sterile areas of the airport where they wait until they are invited to enter the board. The following is a passage through a Gate and boarding.

Concurrently with the passengers boarding, their luggage enters the system for luggage. We ware personally concerned in the check-in at the terminal number one. In this case, the luggage enters the system at the conveyor belt; it passes through the RTG control. If it is not clear whether the luggage is all right, it is moved to the hand inspection. The owner of the luggage is present at the inspection.

After the luggage passes RTG, the code on the luggage is scanned by the worker and the luggage is then transferred and placed to a trailer used for the luggage transport for the specific flight.

9 THE SIMULATION MODEL

The last part will focus on the model, created to streamline and optimization. During the production the model was optimized for general usage at the other airports.

First, I would like to describe the functions and parts of the model and then I will focus on the proposed examples of its usage and the usage in practice.

I have chosen Excel as a program for processing the output of my work mainly because in the works having the character of the predecessor, the other programs and programming languages have been used. Microsoft Excel is widely used in the form of integrated program in Microsoft Office package; therefore it is relatively easy to apply it to a managerial practice.

After opening the file, the sheet named "Hlavný" will appear, the whole file consists of 15 working sheets.

The part of the shaded worksheets in the picture at the left is used for entering inputs, extracting outputs and displaying of the graphs. The right part of the sheets is used only for checking and supporting calculations.

Sheet called HLAVNY will be explained into details in the next subchapter, because the main part of the work is placed there.

G1, G2, G3, G4, G5 – represent graphs of individual calculations and results. Those are for example the graphs concerning the number of passengers, number of check-ins, number of workers in different phases et cetera.

CELKOVY- it is a graph representing the total number of passengers during the course of operations at the airport.

PREPOCET is the most important of all the subsidiary sheets. In this sheet we can find 4 776 inscribed formulas divided between 199 lines, which gradually convert the number of passengers on the basis of 24 chosen indexes. Then there is the number of passengers for the whole day in a 5 minute intervals calculated. The help comes from the PREPOCET sheet where the number of passengers for the sheet CELKOVY is sorted, to create an overall graph.

The graphs, 2nd phase, 3rd phase represent the assistant, control and partial calculations.

Gen, gen2, gen 3 are sheets for generating random numbers. Each sheet contains 10 000 generated numbers and a calculation of their average for the need for further calculations.

The main part is located on the worksheet named HLAVNY. The sheet consists of 300 (white cells) cells for data entering and of 957 (colored cells) for the list of the output data.

The whole sheet is divided into four parts:

- Part for the number of passengers at the time of departure entries
- Part for entering the inputs
- Part for displaying the outputs
- The input-output part, where the entries from the input and output of the luggage system and costs for the technology and workers are put.

10 RESULTS

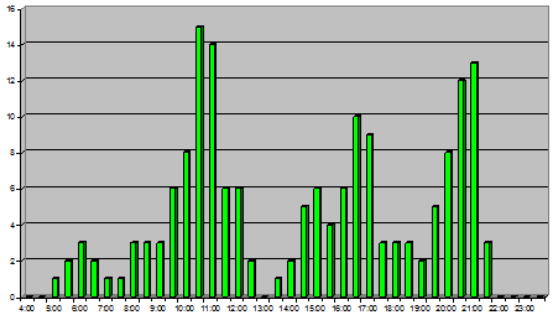

Figure 2 Required check-in counters for the CSA

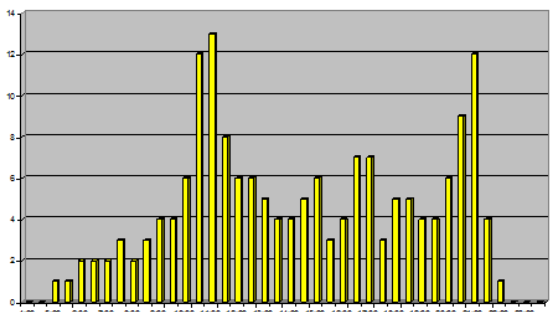

Figure 3 Number of counters for customs and passport control for all passengers

11 RESULTS OF SIMULATION EXPERIMENTS IN PROBLEM POINTS AND APPLICATIONS CONCLUSION AND SOLUTIONS

In this case, the simulation model proved and determined the possible weak points, which are created when the lines are busy or in the case of the so-called overbooking of the flights. In practice, it is clear that such utilization occurs very rarely but it is necessary to deal with it.

The maximum loading occurs for a number of reasons:

- The part of the passengers is handled for the flight with the help of an internet of telephone equipment
- Acceleration and significant shortage of time is achieved by the usage of kiosks for the auto check-in.
-There is a choice for the group check-in and booking at the kiosks

- The important people are boarding to the plane through the other entrance

- There is a 24 hour earlier choice for check-in

- A certain, smaller part of the passengers will not come to the flight et cetera.

Airline handling company for capacity planning, that means opening of the check-ins, uses hand-held system which is operated by a supervisor. A supervisor has the number of passengers and flights, from this information he marks the schedule of services and the approximate number of check-in desks.

The proposed model which illustrates the whole day would complement the work and would illustrate the need for more check-in desks and help in the estimation of the critical points. The model does not only addresses the ČSA handling but also shows the customs, passport and detection control which are not covered under his control but the cooperation of these components is necessary.

The indexes of distribution do not only show in detail the fixed passenger arrivals, but they as well determine their distribution in the time before the closure of check-in desks.

From the study of various crisis phenomena, we know that we must always prepare the options and the solutions for the worst scenario possible. Therefore, my graphs were calculated and drawn on the basis of maximum calculations by which the flights can be occupied. From the graphs it is clear that in some half hour or hour intervals the capacity will not be sufficient.

The main parameters that are monitored during the queuing theory are the input flow of requirements, the time of maintenance, respectively how can a maintenance station can serve the requirements per a unit of time and the number of this maintenance stations.

In case of the check-in of the passengers at the airport we cannot change their number. The speed of check-in or the time spent by the passengers can be influenced only slightly. It is only possible by the good organization of work in combination with the disciplined passengers, who fulfills all the conditions of transport. The second option is the application of modern technologies, which is usually very costly. The only task for supervisors left is to determine according to the presented model the number of check-in desks in order to avoid large queues and delays.

In the analytical part some characteristics were calculated and the combinations of check-in desks for a small number of passengers were shown. The CSA Company has 8 permanent check-in desks and one that is not listed is used as a backup check-in desk. The problem areas are defined for the case discussed in the previous chapter:

- Lack of check-ins for ČSA

- Lack of customs and passport desks

These problems are not nationwide and the proposed model determines the points, in which they may occur. For the lack of desks of customs and passport control it is only on half hour interval. This interval in the graph at the Figure 2 can be seen as easily manageable due to a decrease and transfer of only a small number of passengers in the coming minutes.

The other problem may be the check-in of the passengers. Supervisors argue that sometimes, 4 or 5 desks are rented in excess if it is necessary. At Figure 3, the axis Y shows the number of desks and from the graph we can easily see where the number of desks is exceeded.

If passengers are not handled quickly, or would not want to use the kiosks it is necessary to use the maximum number, it means, 4 or 5 desks more in the time of handling and increase their number before and after this limit for some period of time. More detailed information can be found in [4].

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