

Simulation and Optimization of Warehouse Operation Based on Flexsim

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Abstract: This paper takes the warehousing operation system of a logistics center as an example to study the application of Flexsim simulation in the warehouse operation process. In the course of the study firstly establishes the simulation model based on Flexsim software to realize the storage for a simulation of the operation process and find out the bottleneck existing in the system according to the simulation results, finally, the bottleneck problem to optimize the model, and put forward improvement opinions and suggestions.

Keywords: Flexsim; Warehouse operation; System simulation

INTRODUCTION

Storage is one essential important link in the logistics system, occupies a very important position in the logistics operation process. This paper use Flexsim simulation software of logistics center warehouse operation process simulation. system are found in the simulation process of the bottleneck and the simulation results are further research analysis, by changing the parameters and process strategies, in order to ensure the smooth flow of the warehouse and in the process of the operation of related equipment utilization rate increased, eliminating system bottlenecks, improve operational efficiency, eventually reaching the whole system gets the purpose of optimization.

FLEXSIM INTRODUCTION

Flexsim is simulation software developed by the United States Flexsim company. It is the first in the world to integrate the C++IDE and compiler software in a graphical environment [Zhu *et al.*, 2012]. It is an object-oriented simulation environment based on windows. Flexsim software is a set of computer 3D image processing technology, simulation technology, artificial intelligence technology, data processing technology as a whole, is used to establish the discrete event process [Zhu *et al.*, 2012]. It is more practical software for the logistics industry. At the same time, the software provides the original input data fitting, modeling, virtual reality display, model simulation, optimization results; generate 3D animation image files and other functions. The function of Flexsim simulation software is mainly to solve the problem of service, manufacturing, logistics, and the complex and uncertain discrete event system in our life [Yan *et al.*, 2012]. Flexsim will target for many different parameter combination operation of

the results output for analysts compare, analysts can the preliminary scheme are evaluated from within a relatively short period of time, and choose out the optimum strategy.

THE DESCRIPTION OF WAREHOUSING OPERATIONS

Design Ideas

Input operation: There are three different types of goods in the center of the logistics, after the goods arrive at the storage center, the three kinds of goods are processed.

Unloading operation: When receive an outbound order, the operator can take out the goods from the goods shelf and put it through the synthesizer according to the order.

In the process of the simulation of the operation of the storage, the entities that need to be found in the simulation software. It doesn't need to import the drawing tool to make three-dimensional file.

Table1. Flexsim entity library parameter settings

Name	Property	Data
Source1(goods)	Inter-arrivaltime	Exponential(0, 20, 0)
Process 1-3	Process time	Exponential(0, 10,0)
Transporter	Max capacity/speed	2, 2m/s
Conveyor	Speed	1m/s
Operator	Quantity/capacity	3p/1box/p

Table2. Orders combination

Products	Order1	Order2	Order3	Order4
A	2	5	6	0
B	1	8	6	10
C	6	0	6	5

Setting of sources

According to the logistics center of the actual operation of the layout, the establishment of the Flexsim model as shown below:

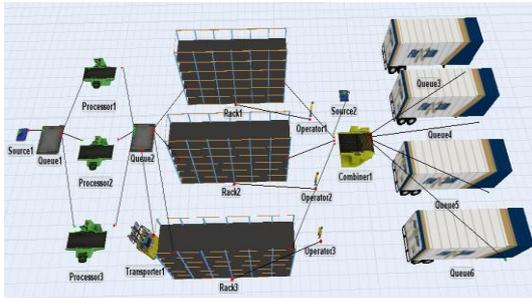


Figure1 Out of storage operations layout

Arrival of goods: The time interval for the arrival of the three kinds of goods is the exponential (0, 20, 0). The three types of goods are used in green, blue, and red three colors.

Process 1~3: The processing time of the incoming inspection is subject to exponential (0, 10) distribution.

Queue: the goods are processed by the processor, which are transported to the appropriate location by transporter.

Make some control with the volume of the storage, and then we compile code for “OnSet” content and “OnExit” content with the shelves.

```

If (content (current)>=80)
{closeinput(current);} /**If the inventory of the shelf is 80, close the input port)
If (content (current) <20)
{openinput(current);} /** if the inventory of the shelf is less than 200, open input port)
    
```

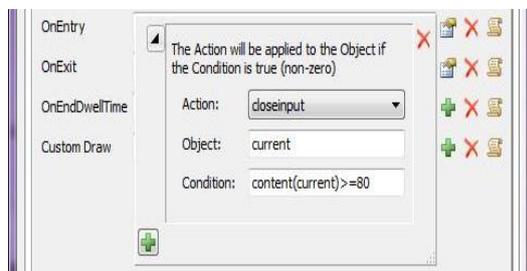


Figure2 the setting of rack

Materialization of the order

In the warehouse, we passed the customer orders for our stockroom operations, in the simulation we make the order generator tray, let the abstract order entity.

Specific steps as follows: In the properties of the generator, we set type of the entity as Pallet, and set different type and color to different orders, the specific operation is adding “set color” in “on exit” tab of source Trigger.

- Case 1: colorpink(item);break;
- Case 2: colororange(item);break;
- Case 3: colorgreen(item);break;
- Case 4: colorteal(item);break;

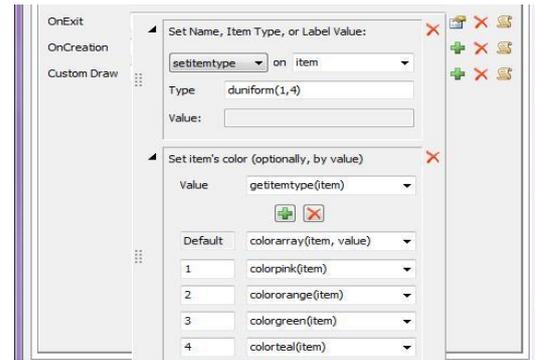


Figure3 Parameter setting of tray generator

When the order is completed, we set the queue for shipping orders and shipments in order to make the corresponding queue. Specific implementation methods are as follows:

Take type 1 as an example, Parameter settings as shown below:

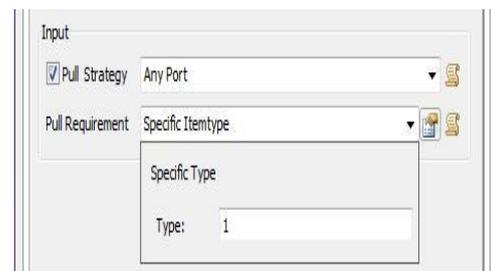


Figure 4 the setting of queue

After setting, the order will flow into the corresponding queue by the delivery direction flow. Then Package delivery.

The setting of combiner

We choose the pack command in the three modes of the processor. When meet orders combiner of goods package, and then output to different queue.

The work principle of combiner: Input port 1 for each combiner is the output port of the order generator. This completes the "order of a distribution". Now we are different according to different customer orders to set different order distribution ratio. For example, in the case of order 1 demand for A products 2, B 1 products, C products 6. Then Package delivery. The parameters of the combiner are set as shown in the following figure:

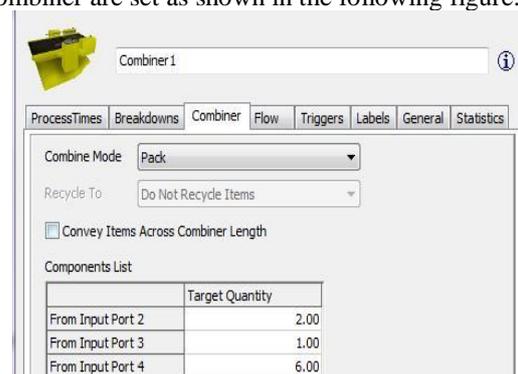


Figure5 combiner parameter setting

Global table

Let us add a new global table from the menu bar of the tools, and attaching data according to the order. Because there are three varieties of goods, so the number of rows is 3, the case mentioned there are 4 orders need to be

distribution, so the number of columns is 5.As shown in table:

	订单1	订单2	订单3	订单4
Row 1	2.00	5.00	6.00	0.00
Row 2	1.00	8.00	6.00	10.00
Row 3	6.00	0.00	6.00	5.00

Figure6 global table settings

After completion of the global table setting, we need to start from the trigger tab of the synthesizer properties, modify the starting type: update the combiner component list, and the update of the data source set the global table.

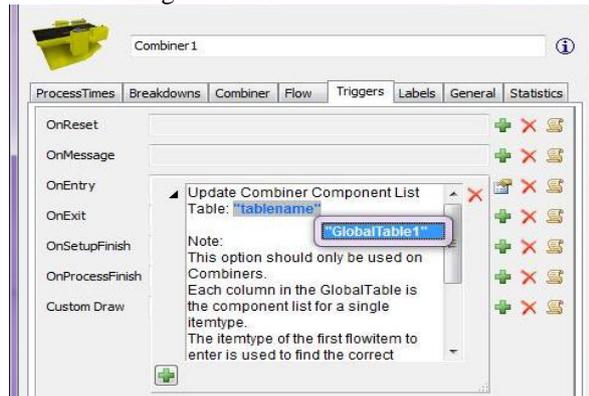


Figure 7 Combiner setting

Simulation result analysis and optimization

1 unit in the system simulation time is equivalent to the actual 1s, set the simulation run time for the 28800s that is 8h, and get the simulation results:

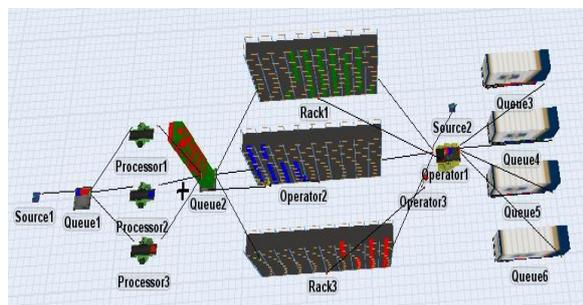


Figure 8 the results of simulation

Output the following simulation statistics:

Results of the output are shown as table3 to Table6.

Simulation result analysis and optimization

After running the simulation model, the simulation process is observed and the simulation results are analyzed. We can observe some unreasonable places in the process of running.

Through the observation of the simulation results can be seen in the process of entering the process of the accumulation of goods. It indicates the location of the process creates a system bottleneck. Through the analysis of the data, it is concluded that there are two reasons for the bottleneck of the system, first in the process of storage in the three processor idle time is 53.1%、52.4%、44.6%. And in the process of warehousing transport idle rate of 32.8%. This situation reflects the working efficiency of the processor and the transport does not match, so that caused the idle and waste of equipment. Secondly, the average inventory of the three shelves with a capacity of 100 is only about 33, and the utilization rate of the warehouse is relatively low.

Through analysis of the simulation results can output data, comprehensive efficiency and storage warehousing operation system, coordinated operation of equipment and personnel are closely related. In order to eliminate the system bottleneck in the process of operation, the following measures are adopted: to reduce the utilization rate of the equipment. In addition, in order to improve the shelf of the use rate and the average inventory and the safety inventory adjustment inventory on the shelves more than 90 is stop replenishment, when the shelf inventory level is less than 30 is continuing replenishment.

According to modify the program run again the simulation model, the queue does not appear for a long time accumulation phenomenon and current stocks are in the allowable range. The average idle time of the processor is reduced from 50% to 23%, while the average inventory level is increased from 33 to 46, and the whole system is optimized.

Conclusion

In this paper, Flexsim simulation method is used to model, simulate and optimize the process of warehousing operations. The bottlenecks and problems existing in the system are found through the analysis and research of the warehouse operation simulation results.

Then put forward the corresponding solutions, in order to improve the efficiency of warehouse operations and solve the bottleneck of the system target. The Flexsim software application to the warehousing operation system analysis and optimization can be seen, this approach can not only the warehousing system has been optimized, if can be

fully applied to the actual life will to logistics industry bring enormous economic benefits.

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Table3 transport and operator work efficiency

Entity	idle time	Unload time	load time	Offset Unload time	Offset load time
work1	53.7%	15.9%	21.7%	7.5%	1.3%
work 2	21.6%	21.1%	36.5%	18.2%	2.7%
work 3	49.2%	13.7%	23.5%	11.7%	1.9%
Transport	32.8%	24.8%	21.4%	5.1%	15.9%

Table4 Processor operating efficiency

Entity	idle time	Processing time
process1	53.1%	46.9%
process 2	52.4%	47.6%
process 3	44.6%	55.4%

Table5 Inventory level

Entity	Max inventory	Average inventory	Average time
rack1	92	25.46	4912.37
rack 2	49	28.38	1899.19
rack 3	100	44.47	3404.10

Table6 the parameters of queue

Entity	Max inventory	Average inventory	Current inventory
queue2	384	145.44	381