Simulation Optimization Research on Logistics Distribution Center Picking Operation

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Abstract—Modern logistics simulation technology is basis on the computer science and electronic technology, combined with the traditional mechanical. On the terms of Management and control of the logistics system, logistics system simulation can reproduce not only the operation of the logistics system but also logistics system planning, design and optimization ,meanwhile it has become an important methods of researching the logistics system . Logistics and distribution center is in an important position in the logistics system, as well as ,which is an important node to ensure the smooth running of the entire logistics system. The processes of distribution center are including "storage - custody - picking - temporary - library operations and the picking operations is a very complicated work. Especially in the face of the order that is varieties but small quantities , the labor of distribution center has increase , so the picking operation optimization problem is particularly important . So, in this paper, firstly, introduces the logistics distribution center and some related concepts and functions of Flexsim Simulation software. Secondly, with Flexsim logistics simulation software , the paper mainly completed the optimization of the logistics center picking operations simulation using the actual case of a food distribution center. To optimize the equipment and processes which is commonly use in picking , then gradually find out the problems in the picking operation , at last research a proper scheme for the food distribution center . Finally, on the basis of the research and read above, introduces the development and research of the logistics and distribution center simulation technology.

Keywords: Logistics and Distribution Center;Flexsim Simulation Software;Picking Operations

I. INTRODUCTION

As the automation level of logistics industry continues to improve, the production system is becoming more and more complex and the production rhythm is increasingly fast. Each decision of production system that production managers make needs careful consideration in case of inappropriate measures, which will tend to increase the cost and make the automation equipment have some setbacks. However, as a new technology, the logistics simulation technology is an indispensable tool in the process of planning, designing, analyzing and transforming complex and detail logistics distribution center, and plays an important role in various aspects such as reducing losses, saving costs, shortening the development cycle and improving the logistics distribution center quality and so on.

At present, it is not fully up to expectations for Chinese logistics development level and the research ability. Due to the lack of accurate data and the necessary simulation of decision support system, when logistics enterprises or business logistics invest to construct new logistics engineering project or transform original technology of system, a waste of funds phenomenon happened occasionally. However, by means of computer technology the simulation technique emulates logistics system. It obtains data recording of various dynamic activities and processes through simulation experiments to optimize the reasonability and effectiveness of logistics system project, which is one of the important methods and means of reasonable logistic system.

II. THE OVERVIEW OF LOGISTICS DISTRIBUTION CENTER

A. The Concept of Logistics Distribution Center

Logistics distribution center, a logistics organization and node to specialize in distributing goods, is a modern materials circulation organization regarding goods agent and distribution as the main function with a blend of commodity-circulate, capital flow an information flow, which is an international circulation and organization form all over the world.

B. The Work Flow of Logistics Distribution Center

The work flow of logistics distribution center shows the whole process that distribution center displays in goods distribution activities, and reflects the overall operation of distribution center. Distribution center not only has the functions of support and guarantee to the logistics activities, but also can connect the whole supply chain and optimize the efficiency. In this process, the distribution center work flow is very important. It is the key factor to guarantee above functions, and need to practice constantly to be optimized and perfect.

Overall, the work flow of logistics distribution center can be divided into 7 operations: customer and order management, purchase operation, tallying operation, loading and unloading, circulation processing, picking, storage operation and distribution operation.

III. BRIEF INTRODUCTION OF SIMULATION SOFTWARE FLEXSIM

A. The Introduction of Flexsim

Flexsim is a set of software tools to design, fabricate and analyze system simulation model. It combines computer 3 d image processing technology, simulation technology, artificial intelligence technology, data processing technology as a whole, specifically for the field of manufacturing and logistics and etc. By using Flexsim simulation software, the 3D model of the research object can be established in the computer, and then the model will be made system analysis and engineering verification, and finally get the optimized designation or retrofit scheme.

B. The Main Functions of Flexsim

1) Modeling

The Standard attributes and special attributes of basic elements can be defined, such as buffer queue, waiting area, task, transport, transport, AGV, stereoscopic warehouse, automatic access device, path and so on.

2) Simulating

Use simulation algorithm optimization techniques (OSAT) running time fixed or variable to simulate the discrete event.

3) Statistics

Make statistical analysis of various probability distributions (uniform, normal, exponential, empirical distribution etc.) with a random number generator.

4) Analyzing

Input data analysis including data analysis and the most reasonable suggestions, and import the Microsoft Excel data. Output data analysis includes an output queue graph, histogram, pie chart or a dynamic displaying user-defined chart format, which can output the data into the Microsoft Excel

5) Animation and Document

2D and 3D animation can be produced. It can move, zoom and rotate the camera. Model documentation can be automatic generated in accordance with function or element. It can produce the simulation time tracking reports and input the value list of the parameter.

C. Commonly Used Terms of Flexsim

1) Entities and Entity Library

In general, the system is composed of two categories of individuals -- handler and acceptor. For example, those individuals of warehouse system don't changes with time and withdraw from in the system such as the buffer, shelves, forklifts, trolley, conveyor and the operator, which are used for cargo handling and belong to processor individuals; while the goods of warehouse system belong to those individuals changing with time and withdrawing from the system (After delivered, it no longer belongs to the warehouse system), which receive warehouse system and belong to processor individuals. In Flexsim, the former (processing) is named entity, while the latter (receive handler) is called temporary entity.

The Flexsim entity can be found in the panel of entity library. Entities can be classified as follows:

Fixed entities: such as generator, absorber, processor, conveyor, synthesizer, separator, buffer, network node, shelves, the basic fixed entity;

Task execution entities: such as the operator, handling equipment, palletizer, robot, the basic task of the actuator;

Other entities: such as task distributor, recorder.

Generator: Create a temporary entity to access in the model. Each generator creates a type of temporary entity and can distribute properties for temporary entities, such as type or color.

Buffer: Store them when the downstream entity cannot accept a temporary entity, which is named buffer.

Absorber: Absorb temporary entity which has been handled in model.

Processor: Simulate the process of handling temporary entity in model, and the process is simulated as a mandatory time delay.

Synthesizer: Synthesizer is used to integrate several accessing temporary entities, such as simulating disc loading operation.

Splitter: Splitter is used to decompose temporary entity into several parts, such as simulating the resolution of a temporary entity disc loaded by the synthesizer.

Conveyor: In the model temporary entities move along a series of path. Conveyor can define the path segmented; each segment can be straight or curved.

Shelf: Goods is stored in the goods lattices; the number of shelve layers and columns can be user-defined.

Distributor: Control a group of conveyors and operators.

Operator: Simulate a specific worker. It can be used in presetting, handling goods or repairing process.

2) Entity Type

Entity type is a label on the entity which can represent a bar code, product type or part number. It can arrange entity schedule through referring entity types.

3) Entity Attributes and Parameters

According to the differences of selected entities the attributes and parameters of each entity will be slightly different. Because each entity has a specific function in the model, the parameters must be personalized to allow modelers to use these entities flexible. Some pagination of all entities is similar, while other pagination is very special to the entity. Double clicking an entity can access the entity attributes and parameters.

4) The Probability Distribution of Random Variable

The probability distribution of random variable is a statistical concept. The probability of an event means the possibility of one result of an experiment. To fully understand the experiment, we must know all the possible results and the probability of various possible results, which means we must know the probability distribution of random experiment.

Flexsim provides many kinds of commonly used probability distribution of a discrete random variables, such as the uniform distribution, normal distribution, exponential distribution, the Poisson distribution, Bernoulli distribution, binomial distribution, Erlang distribution, gamma distribution and so on. These distributions are commonly used to describe the random variables, such as time, quantity, product types, etc..

In various temporal drop-down menus, such as the present time, processing time, MTBF/MTTR (mean time between failures / mean time to repair), arrival time interval, we can see a variety of random distribution options. In the code module of other drop-down menu, we

can also see some random distribution function expressions. For example, there are some random distribution functions in some options of the drop-down menu of triggers,

In addition to using standard probability distribution, we often need to use the empirical distribution. For example, we can define overall table to achieve the time or quantity distribution probability in accordance with the percentage of experience. The method is that in the overall table, the first column is defined as the percentage; the second column is defined as the time (or quantity). When it is used, according to the overall table we can determine the random value of time (or number) in keeping with empirical distribution.

IV. THE DEVELOPMENT AND TREND OF SIMULATION TECHNOLOGY IN LOGISTICS DISTRIBUTION CENTER

A. The Development of Simulation Technology in Logistics Distribution Center

As an independent discipline simulation technology has 50 years of history. It is not only used in the development departments of aerospace, aviation, weapons systems, but also has been widely used in various fields of electric power, transportation, communication, chemical and nuclear energy, etc.. Especially in the past 20 years, with the rapid development of systems engineering and science, the simulation technology has extended from the traditional engineering fields to non engineering field, therefore it also has been widely used in the social economic system, ecological environment system, energy system, biomedical system and education system. The simulation technology is holding increasingly strong vitality from its extensive application, and the development of simulation technology in turn to make it applied more and more extensively.

For the logistics distribution center, simulation technology is mainly used to solve the problems that the project large capital is invested into logistics distribution center should be validated before implementation, so that it can be approved, modified or cancelled before investing; reduce the actual cost by avoiding the extra funds investment and reducing operating costs; set different hypothesis, operate a variety of practical process to learn how to make the best use of existing assets, so that the existing resources can play the best role.

In a word, the purpose of simulation is to optimize each process of the logistics distribution center and better control operating cost to best fit logistics distribution center resources, throughput and performance parameters of logistics distribution center. Now, the logistics has become a new industry in the national economy. Many enterprises regard logistics as an important means to improve market competitiveness, and the demand to construct logistics distribution center is very great. Therefore, it is very necessary to put simulation technology into use in the logistics system, and it has tremendous market potential.

B. The Trend of Simulation Technology in Logistics Distribution Center

With the rapid development of computer technology and automation technology, virtual enterprise and virtual manufacturing technology developed deeply. Logistics system simulation software has become an important part of virtual manufacturing system and logistics enterprises and it will be used and developed more widely.

1) The Design and Layout Planning of Multi-dimensional Simulation into Logistics System

In order to realize the layout planning more effectively on equipment and logistics technology, an important tool is the simulation. The simulation software will remove experience guess from the design of logistics system, which is particularly effective to design a complex social process. On the screen, the operator can observe different scenes through various logistics program evaluation of different production capacity and assume some conditions, such as observing situations likely happened after a sub system temporarily stops working,.

The developers of simulation software also continue to improve the software level. Through the three-dimensional design the latest software make the system more close to the real world. It is not only a very good tool in the design, but also can be used as a control tool.

2) The research direction in the future

As the complexity development and application of logistics system continue to lucubrate, the following is the further research direction of the three virtual logistics system simulation system.

Have secondary development interface to achieve the professional logistics virtual simulation needs of different levels and different industries.

Users can add complex process logic and action rules to do dynamically optimized simulation.

Draw virtual reality technology into the further development of multimedia, which not only can simulate 3D, but also can simulate the media environment such as sound, light, vibration and do personnel training.

V. CONCLUSION

A logistics distribution center operation is an important part of logistics system planning including picking operation, distribution operation and other operations. However under the existing conditions, picking operation of logistics distribution center operation is extremely heavy and complicated, so that optimizing picking operation is the main content to improve the efficiency of distribution center. Based on the picking operation optimization of logistics distribution center as the main line, this paper mainly makes a systematic analysis on the optimization simulation of picking operations; it also introduces the basic knowledge of simulation, and makes a simulation study on the picking system of distribution center. This paper mainly does the following works:

On the basis of elaboration on the concept, function and operation process of distribution center, this paper puts forward the basis and significance of the picking operation as main research direction.

The paper introduces the Flexsim simulation software, and combining with an enterprise case, it makes use of simulation software Flexsim to do some related simulation study on the distribution center picking system. Through the simulation, find out the existing problems. After the analysis, find out the causes of the problems and solve them to obtain an optimum scheme.

Make an elaboration and prospect of the development and the future development trend of simulation technology in logistics distribution center.

REFERENCE

[1] Peng Yang and Wu Chengjian. Modeling and Simulation of Logistics System[M]. Zhejiang: Zhejiang University press, 2009

[2] Wang Daoping. Modern Logistics Simulation Technology[M]. Beijing: Peking University press, 2010

[3] Zheng Jihua and Zhou Dancheng. The System Design of Automatic Stereoscopic Library in Logistics Distribution Center[J]. Logistics Technology.2010, (4): 45-51

[4] Ceng Liang and Wang Shanshan. The Research on Key Technology of Logistics Simulation System in Steelmaking and Continuous Casting on account of Flexsim[N]. Journal of Wuhan Polytechnic University, 2011-5-30 (1)

[5] Huang Yindi, Bian Ronghua and Zhang Jun. The Study on Domestic and International Logistics System Simulation Software[J]. Industrial Engineering and Management, 2010,15 (3):124-128

[6] Feng Yun. Simulation Software Flexsim and Its Application in the Logistics Teaching[J]. Logistics Technology, 2009,32 (9):76-81

[7] Peter Baker. The design and operation of distribution centres within agile supply chains [M] . Production Economics.2008.

[8] Frazelle. Supply Chain Strategy: The Logistics of Supply Chain Management[M]. McGraw-Hill.2010.