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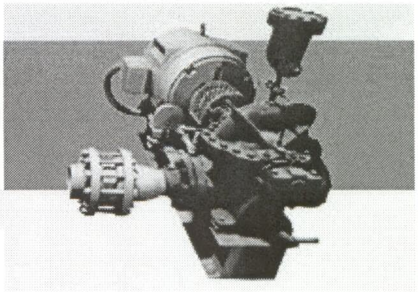

Home

Issues

Simulators

Submission Guidelines

Contacts

News

Issue 1, No. 4

Issue 2, No. 1-2

Issue 2, No. 3-4

Software

Journal of Engineering Systems Simulators

Volume 1 Number 4 Winter 2004

Technical Papers

Methodological Papers

Descriptive Papers

In This Issue

Welcome to the inaugural issue of the Journal of Engineering Systems Simulators. This journal was created to specifically present research advances and creative applications in the areas of engineering, operations, and management related interactive multimedia training simulators. By focusing on the design, development, and use of simulators rather than specific subject areas, we hope to provide more fertile ground for the exchange of information.

In this issue, you will find three technical papers, one methodological paper, and two descriptive papers. Two of the three technical papers focus on the design and development of equipment type training simulators. The third focuses on an engineering design process software training simulator. The methodological paper discusses a new approach for simulation modeling analysis. Lastly, the two descriptive papers present information on engineering application education training simulators. The papers published in this issue should provide readers with guidance on the content of typical journal manuscripts. Prospective authors may review the submission instructions accessible from the main Journal webpage.

As a special feature of the Journal, a number of these papers are accompanied by the simulators described in the manuscripts. We hope that these will be of utility above and beyond the information presented in the papers. While every effort has been made to insure the proper functioning of the simulators, it is inevitable that some reader's systems will have difficulties with the simulators. We suggest that you first contact the paper's author for assistance should these types of problems arise.

Since publicly announcing the Journal, we have received many inquiries into subscribing and submitting manuscripts for publication consideration. There have also been inquiries into publishing a hard copy of the Journal. This possibility is currently under investigation. Lastly, we are in the process of establishing contact with a number of indexing services. This should provide additional value to both journal authors and readers. All of these activities and responses have been very encouraging and we look forward to the continued development and publishing of the Journal.

Erick C. Jones, Executive

Editor

Christopher A. Chung,

Managing Editor

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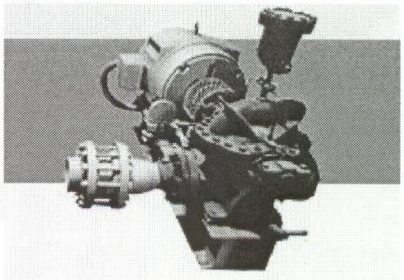

- Home
- Issues
- Simulators
- Submission Guidelines
- Contacts
- News
- Issue 1, No. 4
- Issue 2, No. 1-2
- Issue 2, No. 3-4
- Software

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Design and Development of a Logistics Training Simulator

Erick C. Jones
University of Nebraska, Lincoln
175 Nebraska Hall
Lincoln, NE 68588-0518
(402) 472-3695
ejones2@unl.edu
http://www.engr.unl.edu/~ejones

Abstract

Most organizations that focus on minimizing total supply chain costs over strategic and tactical planning horizons should focus on improving their transportation network knowledge. Transportation costs for companies that manufacture and distribute across the United States can be in the range of 20% or more of delivered cost. In order to minimize these costs effectively, companies can seek to optimize their modes of transportation and facility locations. Consultants, industrial engineers, and other technical personnel can utilize a variety of techniques to minimize these costs when they understand the basics of transportation. This study seeks to demonstrate, test, and educate technical personnel on the basics of logistics through the use of a logistics digital simulator. This exploratory research seeks to show the effectiveness of a digital simulator in the training of technical personnel on modes of transportation and other key logistics terms.

1. Introduction

Transportation networks can be characterized in structural and numerical data network sub-models. The basic structures are directed links connecting origin (supplier or facility) to a destination (facility or market) along which a product may flow. (Shapiro 2001). The transportation components consist of three components which are inbound transportation, inter-facility transportation, and outbound transportation. Inbound transportation traditionally consists of the Original Equipment Manufacturer (OEM) or other suppliers to the companies facilities. Examples include raw materials to companies manufacturing plant or OEM shipping to a companies warehousing and distribution operations. Inter-facility operations are when product is shipped from one of the company's facilities to another one of its facilities. This is represented physically when a product is shipped from manufacturing plant to another of the company's plants or warehouse to warehouse. These types of operations often represent an opportunity to increase efficiency because it may represent redundant work. Finally, outbound transportation represents sending final products to retail outlets or the end customer. This is considered by most businesses as the most crucial transportation network. In most general situations companies optimize there choice of transportation modes for shipments in a link in order to minimize costs and ensure high customer satisfaction.

Transportation modes include choices like using large trucks, small trucks, rail cars, air transportation like airplanes or helicopters, and water transportation like barges. In the different modes there are often choices that have to be made in that mode. For example in trucking even if shipments can only be made by one type of truck, the company may be faced with choice of shipment size, which might be full truckload (FTL), or various sizes of less-than-truckload (LTL). Oftentimes these choices appear to be tactical choices, but in order to realize strategic cost opportunities, companies may consider their longer-term plans on decisions like shipment sizes. The type of shipment size constantly used by companies can lead to minimizing costs by using fewer modes of transportation.

Researchers that model the supply chain networks often focus on optimizing the shipment sizes and minimizing the cost of transportation modes. From a modeling perspective the choices regarding transportation mode and shipment sizes require mixed integer programming constructs to represent volume or weight discounts on that transportation link or path. Traditionally FTL shipments cost less per hundredweight (weight of trailers in hundreds of pounds) than LTL shipments thus companies would like to ship more products FTL to reduce costs. The detail knowledge of transportation can represent opportunities for simple rules to be applied before complex and expensive modeling is explored. An example of a cost savings rule would be if the transportation path or link is greater than 1,000 miles than use rail; otherwise send this shipment by truck. These rules can be quickly evaluated by comparing unit cost per mode of transportation. It is important to remember that if there is a complex network of transportation links that integer programming is generally recommended (Shapiro 2001).

2. Previous Research:

A literature search was conducted to identify research of similar work. The literature search yielded a large number of research efforts on optimizing supply chain network modeling. There was very little focus on development of practitioner's knowledge in the common language of logistics. There are trade journals and organizations that focused more on this task of defining key logistics terms. The literature on digital simulators in this related areas include on how the U.S. Army has large number computerized training programs in use (White, Carson, Wilbourn, 1991). U.S. Air force uses digital flight simulators to train their pilots (Hess, 1995). These simulators are not only found in applications for the military but also used widely in other industries. Operators in steel companies are trained with CBT's and students in academic settings use it in class and through distance learning. Previous research has demonstrated CBT's applied in remote training in industrial fields. The literature search showed a limited number of DS in the Logistic training areas.

Background on Logistic Network Modeling

An organizations goal when locating facilities and allocating inventory should maximize the overall profitability of the resulting supply chain network while providing customers with adequate service. Traditionally, revenues come from the sale of product and costs arise from facilities, labor, transportation, material, and inventory holding. Ideally, profits after tariffs and taxes should be maximized when designing a supply chain network.

Tradeoffs must be made by the organizations during network design. For example, building many facilities to serve local markets reduces transportation cost and provides fast response time, but it increases the facility and inventory costs incurred by the firm. Network design models are commonly used in two different situations. First, those models are used to decide on locations where facilities will be established and the capacity assigned to each facility. Second, these models are used to assign current demand to the available facilities and identify lanes or paths along which product will be transported. Managers must consider this decision at least on an annual demand basis, prices, and tariff charge. In both cases the goal is to maximize the profit while satisfying customer needs. The following information must be available before the design decisions can be made:

1. Location of supply sources and markets
2. Location of potential sites
3. Demand forecast by market
4. Facility, labor, and material cost by site
5. Transportation costs between each pair of sites
6. Inventory costs by site as well as a function of quantity
7. Sales price of product in different regions
8. Taxes and tariffs as product is moved between locations
9. Desired response time and other service factors (Chopra 2004)

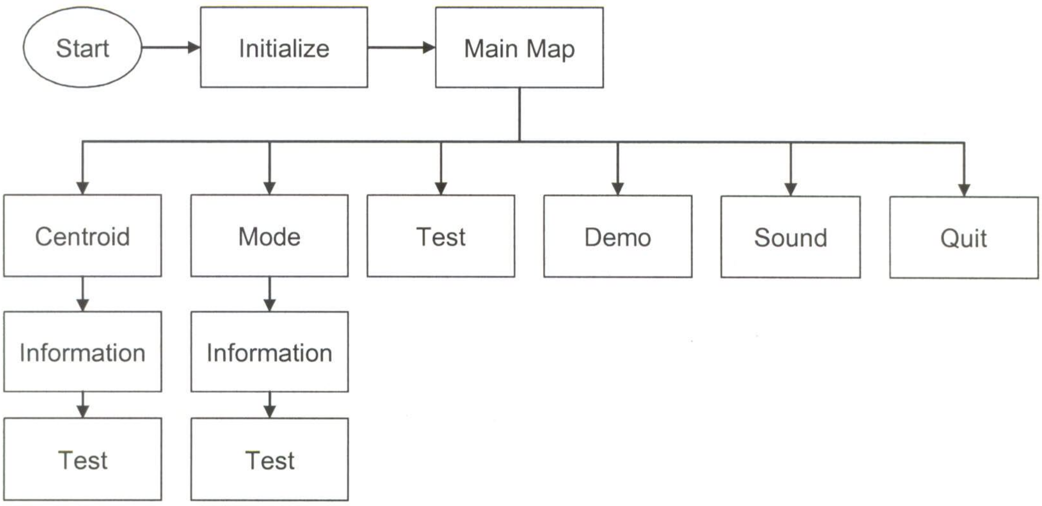
Given this information a choice of model type can be made. Previous literature highlights some general models that have differing goals. Each model has differing objectives; the models that were considered for this study were the Capacitated Plant Location Model and the Gravity Location Model. The Capacitated Plant Location Model seeks to minimize the total cost of the current supply chain network; the problem is formulated into an integer program. The Gravity Location Model's goal is to locate an optimal location based on cost inputs. Beyond optimization models, the engineering manager could build a simulation of their supply chain (Chang 2004).

3. Objective

The main objective of this research is to develop an effective training method to train new personnel in Logistics. This research attempts to accomplish this goal by using a Logistics Digital Simulator (DS) as an effective, cost efficient way of training. Furthermore, this research attempts to demonstrate how using a DS is more effective than traditional on the job training techniques. The simulator addresses basic logistics concepts of transportation modes and the "centroid concept" as a basic method for locating facilities effectively. The simulator provides a written introduction to the concept, visual depiction of the concept, and a follow-up test scenario for the respondent to demonstrate knowledge. Also, the simulator provides a movie demonstration with music as a subliminal reminder of the concepts demonstrated. The Logistics Training simulator was developed in Authorware 7.02.

4. Model Description

The basic flow of the simulator is demonstrated below. The program includes initialization phases, the main map which demonstrates the relevant background and six subsections for the user to access. In the three main subsections of Centroid, mode, and test the user will be able to test their knowledge before leaving the simulator. The main training occurs under the Centroid and mode sections. There is an mpeg demonstration video option included on the main menu. The sound section includes music that allows for music to be played during the usage of the simulator. The quit function is included in order to make sure the user can navigate out of the simulator in a timely fashion.



Simulator Screens

The simulator requires an initial login and password in order to ensure security of the code. When the correct password is given then the user attains access to the main menu and allowed to begin the program. See Figures 1 and 2 below.

Figure 1: Login Screen

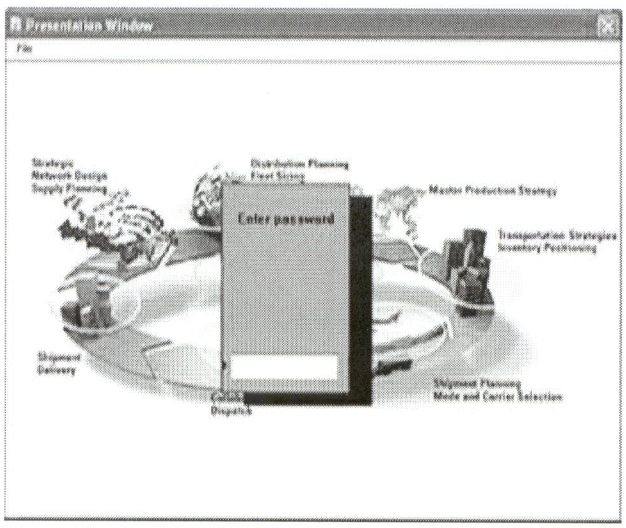
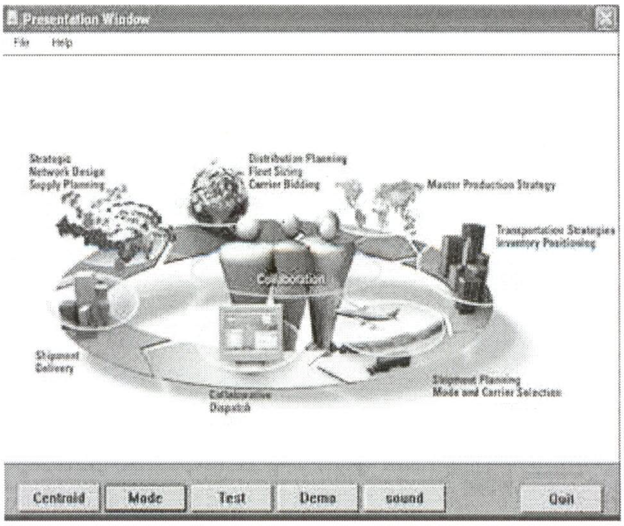


Figure 2: Main Menu Screen



If the user chooses the Centroid option then the simulator will bring up a screen that describes the physical and geographical supply chain. This is displayed in Figure 3. Next an explanation of the Centroid method is given and a timed test screen is initiated and the user is asked to locate a symbol of a truck to the optimal location using the concept of location Centroid. See Figure 4. After the test the user is directed back to the main menu.

Figure 3: Physical Diagram of Supply Chain

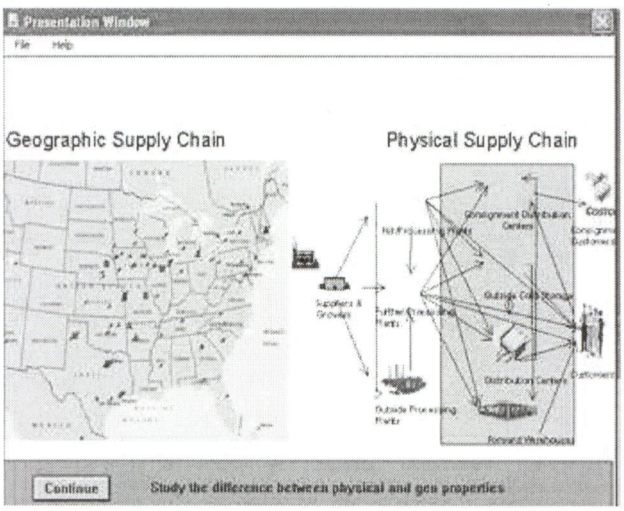
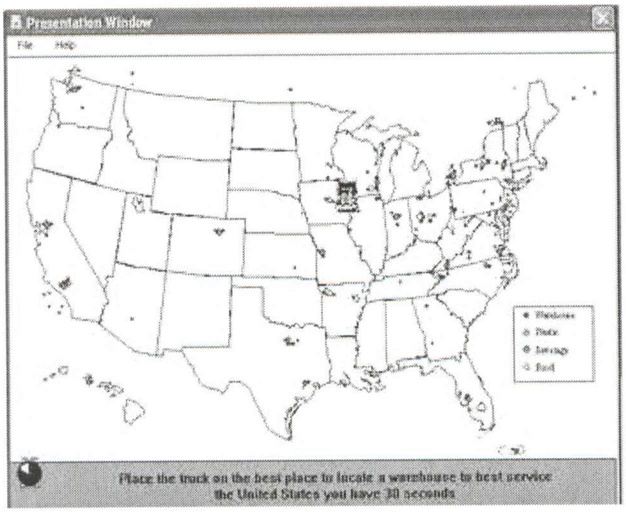
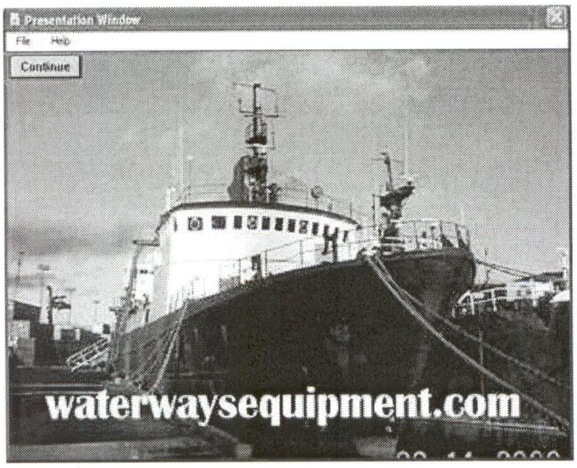


Figure 4: Test locating centroid



The next option on the main menu is the labeled mode. This section follows the same system pattern of providing visual and written information on modes of transportation. Figure 5 shows one of the visual depictions of water mode of transportation with the picture of a barge.

Figure 5: Water Mode Transportation



After the written description the program initiates a program that will test the user on their knowledge. The other options of the program are a general test over the concepts that is designed to be taken as a pre-test and a post test for comparison of improved knowledge in this area. The sound and quit options are used for musical accompaniment and navigation respectively.

7. Results

The Logistics Simulator has a practical application for allowing personnel who are not knowledgeable to gain acceptable knowledge in a rapid and efficient manner. A functional version of the simulator was evaluated for face validity by a number of logistics practitioners. These individuals evaluated the content and have approved the concepts, terms and applications of the simulator. There input included recommendations to expand the digital simulator to include sample cost calculations.

8. Future Work

The simulator will undergo quantitative validity testing. This testing will indicate if the Logistics simulator is effective in training personnel on basic logistics issues. This process will basically determine if an unknowledgeable user can statistically significantly increase their level of logistics knowledge by using the simulator. If there is evidence to support the training validity of the Logistics simulator, then it could be considered as a cost effective solution to basic Logistics training. These results and a Cost/Benefit analysis of the Simulator will be forthcoming in a future publication.

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