IPRO It takes a team! INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 305

Trailer Loading Optimization Group (TLOG)

FINAL REPORT

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INTRODUCTION

IPRO 305 Trailer Loading Optimization Planning Application Tool is the project with a group of IIT students from different majors, both undergraduate and graduate students. We work with the sponsor company, DSC logistics, in developing the trailer loading software solution. By designing a process and a computer-enabled tool, we will create the web-based software, Trailer Loading Optimization Group (TLOG). The team expects to improve the company's system to automate the process for all of DSC's logistics centers.

BACKGROUND

Calculating the optimal load is a challenge all companies face, and unfortunately, it is a manual process for many organizations. For some companies, they prefer spreadsheets while others are using formal enterprise software systems. Many rely on past experience, oftentimes in conjunction with a technology-based tool.

Moreover, many companies believe their current technology solves their load building requirement, despite attempts to provide tools to help. This is often due to the complexity of managing orders in conjunction with load optimization goals. Many traditional Transportation Management System (TMS) and Warehouse Management System (WMS) solutions only look at, for example, weight, and do not take into account full order footprint or loading restrictions that must be adhered to. All of these factors must be combined to truly optimize loads and reduce costs.

DSC Logistics, a third party logistics company with several warehouses nationwide, operates as the distribution center for many companies of various sizes and locations across the United States. They currently have a number of computer systems available for processing incoming product, and storing and tracking the product efficiently. What DSC currently lacks is a solid system for efficiently loading product on to its trucks in preparation for shipment to its customer's locations.

The trailer loading process has been performed manually by skilled technicians who rely on experience to efficiently load the trailers. Solutions exist for automating the trailer loading process, but DSC has the unique problem of serving a variable number of customers, with varying needs, which may change relatively rapidly, rendering existing solutions less than adequate. In addition, DSC needs a product which can integrate with its custom WMS, which existing general purpose products will not be able to do.

By developing a trailer loading solution for DSC, Our IPRO 305 project will be providing them with a more efficient way to operate, which will reduce waste, increase productivity and speed of delivery, and provide a better working environment for its employees. While researching existing

trailer loading technologies and using the knowledge gained to create our own solution, we will have to take care to provide a solution that does not copy or infringe upon any existing product.

PURPOSE AND OBJECTIVES

IPRO 305 begins its first semester as a project designed to provide a trailer loading solution for DSC Logistics. The team will develop a web-based trailer loading optimization software to help create more effective and efficient loading process and standardize working process throughout the business unit. Many factors will be considered, including multi-stops, weight distribution, weight limit, and stackability.

The goal of the project is determining to improve productivity of logistics operation by reducing wasted space and overload, increasing the speed of the operation through the easy user interface, diminishing labor cost resulting from non-productive performance, and reducing the cost of shipment and distribution. In addition, this solution will enforce the consistent process and management through the whole business, increase speed of the business and prevent errors by computerization, enhance the flexibility of operation through rapid response to unexpected changes and customer's needs, and be able to integrate with DSC's in-house WMS and TMS systems.

RESEARCH METHODOLOGY

TERMINOLOGY

The terms that are often used in the report may be described here.

Pallet: a portable platform of box section open at two ends on which goods may be stacked. The open ends allow the entry of the forks of a lifting truck so that the palletized unit load can be raised and moved about easily.

Palletized unit load: quantity of any item, packaged or unpackaged, which is arranged on a pallet in a specified manner and securely strapped or fastened thereto so that the whole is handled as a unit.

ARCHITECTURE AND INTERFACES

Web Page: the user interface, written in HTML, CSS, and JavaScript, contains an input box for the shipment's outbound number.

Background Scripts: written in JSP & SQL, runs in the background at pre-defined intervals to read the contents of three comma-separated-value (CSV) files and add them to the database.

Processor Script: written in HTML, JSP & SQL, the user-requested order is received from the Web page's form and is processed, and a PDF file or Web page is output to the browser containing the optimal load schematic.

Installer Script: Installs necessary database tables. This will allow user to distribute the system and reinstall it when necessary.

Secure Log-In*: Allow users to log in to the system securely, and offers functionality to add and remove users and change their credentials.

Dynamic Sorting Algorithm*: Would allow end-users to modify the behavior of the sorting algorithm to accommodate unforeseen circumstances.

*Indicates features suggested for future implementation

WORKING PROCESS

The team worked closely with representatives from DSC logistics on this project throughout the semester. In addition, our team went to DSC's distribution center in Des Plaines, IL in the fifth week of the semester to do more observations of loading process and the in-house software systems in order to better identifying the problem.

At the beginning, the team brainstormed to identify the problem and listed all the tasked needed to be done in order to accomplish the goal. The team created two sub-teams – Research Team and Technical Team. The team leader then assigned the specific tasks for each team. The Research Team was responsible for all the research and non-technical tasks while the Technical Team was responsible for developing the software. Then, sub-team leaders took over the responsibilities and assigned works to individuals. However, each member actively participated in all activities as a whole, therefore demonstrating the attributes of multi-tasking and flexibility among all team members.

The regular meetings took place every Monday to review the whole progress from both Research team and Technical team, discuss any problems that might occur, and assigned new tasks if needed. The conference calls with DSC's engineers also took place on this day. The team reviewed the progress with DSC and discussed all issues that the team encountered. For Sub-teams, the meetings took place every Wednesday, separately. There, the sub-teams discussed each own progress. Details of the meetings were record in Team minutes for every member to review and update information. Communication between team members took place through IGroups. Detail tasks of each sub-group are shown below.

Research Team

This team was responsible for communications within the group. The first step of the research team was to look at existing software and solutions for trailer loading optimization. Here, the team looked at how those existing software operate, in term of inputs, constraints, outputs, and their limits. The team also looked at their functions/features, for example, they had secure user logins, supported different types of trailers, supported multi-stops, and were able to identify stackability, weight limit, and weight distribution.

After enough information was gathered, this team evaluated the best solution for DSC. As the result, the Research Team, in collaboration with the Technical Team, had a final decision that web-based software would be the best solution due to its easy user interface and implementation. Throughout the term of the project, the team constantly re-evaluated strategies and solutions. In collaboration with the Technical Team this team constantly worked on improving the software to reach a finished product within the given deadline.

Technical Team

This team was in direct contact with the IT department at DSC. The team was responsible for first deciding if the final product would be a completed software application or simply a prototype that would be later implemented by DSC's IT department. The main responsibility following this step was deciding the features of the application. This was done in collaboration with the Research Team. Given that the team was to develop a finished product, the Technical Team decided on the platform and language for the application. The final task of the technical team was to write the code for the software.

In the end, every member in the team was responsible for completing the poster, presentation slides, brochures, and making sure that the rest of the team completes their respective tasks and readies for IPRO Day.

ANALYSIS

Once we have decided on the solution, we created two applications to solve the trailer loading problem for DSC. They are Importer application and TLOS (Trailer Loading Optimization System) application. The Importer application is a prerequisite for TLOS while the TLOS is the mail application that DSC would use. The program starts with user types in specific outbound number and also choose trailer dimension from the drop down menu at the login page. TLOS application then grabs pallet data from MySQL data base. including Outbound File, Shipments File, and Comments File. The Importer application then retrieve pallet data from a particular tri-set (Outbound, Shipment, Comments) of CSV files an import that data into the MySQL Data

Base. However, DSC provided us with a set of CSV (Comma Separated Value) files of the pallet data from the Network Directory, as a sample data.

After pallet data from specified outbound number has been found, the data will go to the sorting function and will be sorted according to the requirements, including load sequence, stackability, and weight limit. The final output show pallet distribution diagram as a result.

Complications that can occur during the process is that, we might move a file that DSC is purging to, or move a file that is incomplete. The Importer application that we developed will make sure that these complications do not occur when moving and importing CSV file data.

Note that the two web-pages showed in Chart 2 - form page (the home page), and results page (displays the pallet positions) - are the only visible components of the software. The processing done in the background is not visible to the user.

The Logic-Flow diagrams for the Importer application and the TLOS application include details as to how the two applications work. They also indicate which parts of the application each technical team member worked on. The Login Page Screenshot, Importer Logic Flow, and TLOS Logic Flow are shown below.

Chart 1: Login Page Screenshot

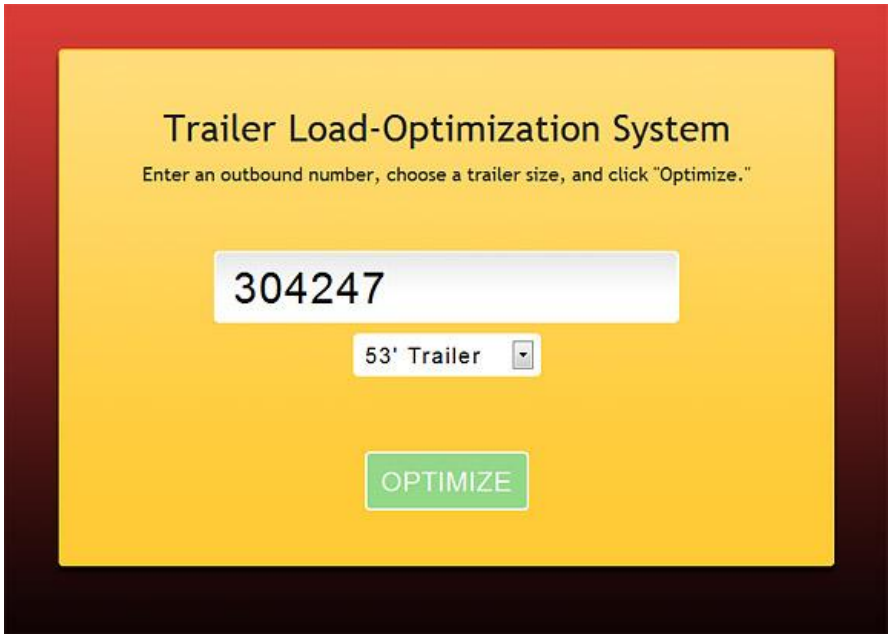


Chart 2: Importer Logic Flow

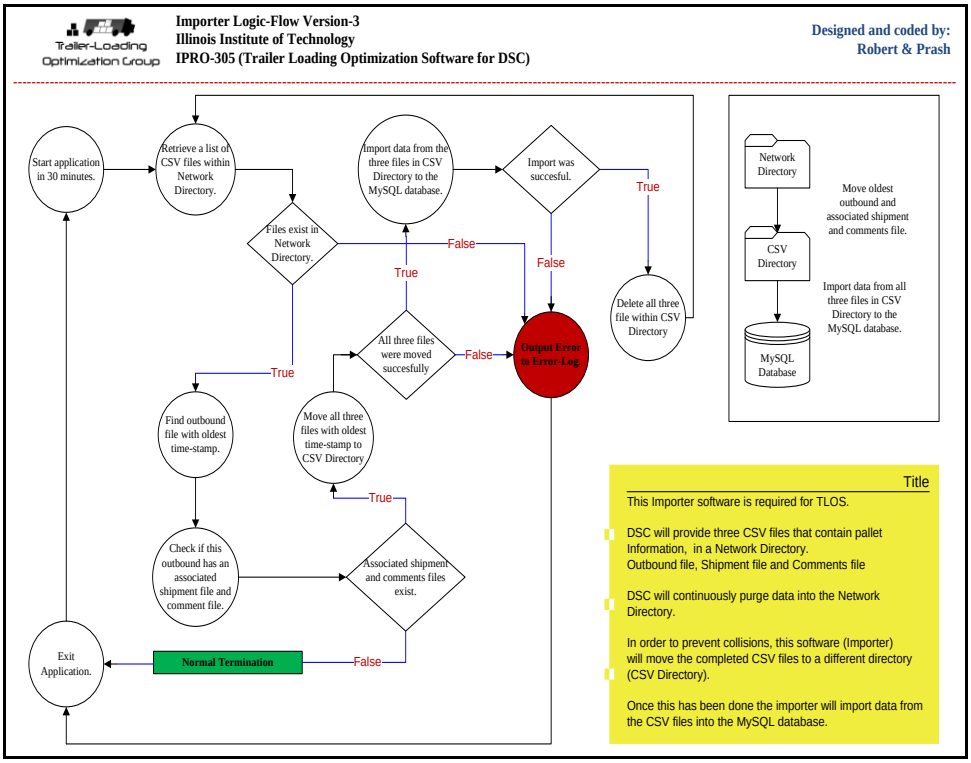
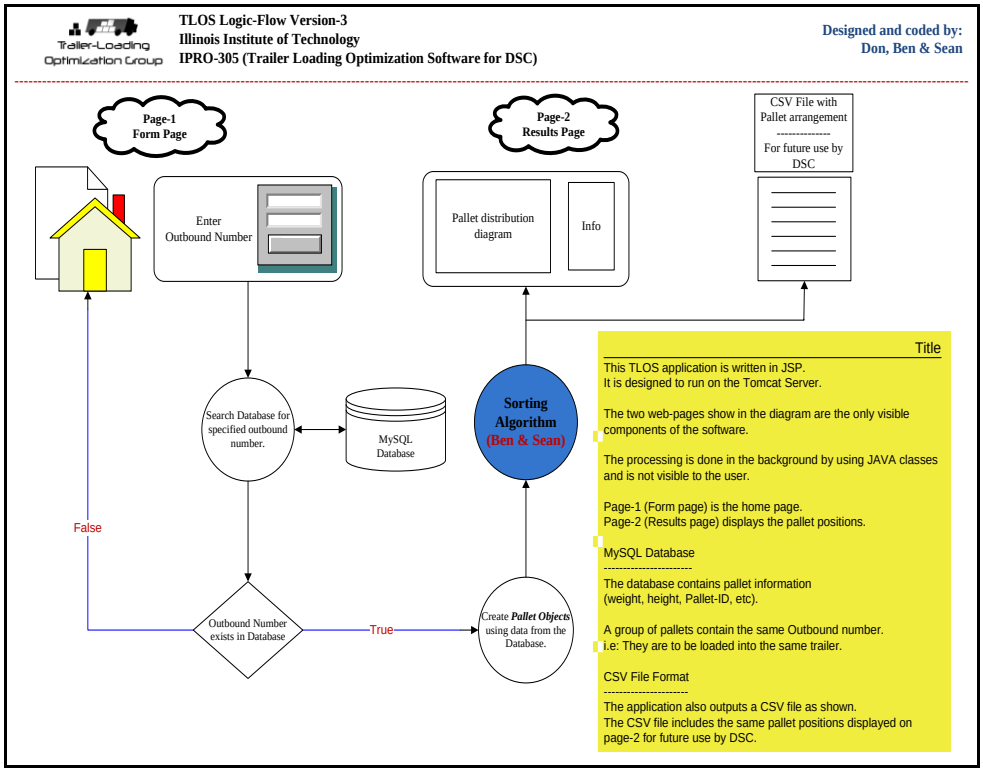


Chart 3: TLOS Logic Flow

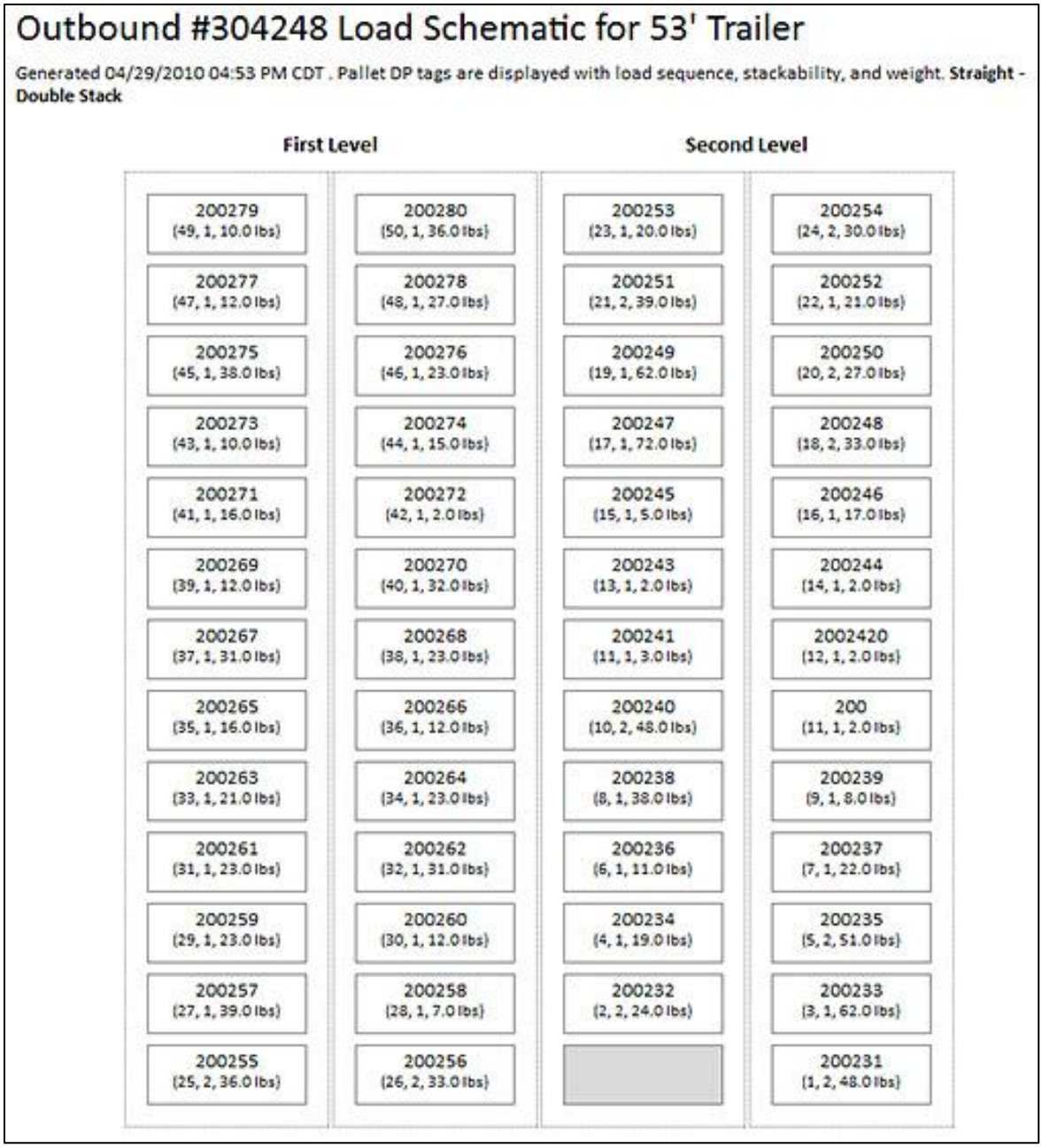


RESULTS

Our team delivered a two part solution to DSC that will allow them to more efficiently load their customer trailers, which will result in time and money savings.

TLOS will provide a printout of the given outbound, for the fork lift operator to use when loading the given trailer. The printout provides the loader with the correct loading sequence for all pallets in the load.

Chart 4: example printout from the software



CONCLUSIONS

By developing a trailer loading solution for DSC, we provided them with a more efficient way to operate, which reduced waste, increased productivity and speed of delivery, and provided a better working environment for its employees. The benefits of the software are shown below.

- Avoid overweight fines and associated costs
- Minimize labor time needed for creating load plans
- Axle weight calculations help minimize transient damage
- Minimize cargo damages with good load planning
- Reduce transportation costs by optimally loading cargo in vehicles

In term of the overall project, our members had learned several important aspects. First of all, we learned how to work as a team. Everyone had responsibility for their own parts but in order to finish the whole project we had to work together and put in efforts. Also, we realized that communication is the key. Discussion and participation in both the regular meeting and sub-team meeting gave us better understanding of each part of the project and kept us on track. However, there were problems during the project but we were able to resolve them based on the final decision of the group. In the end, everyone had developed some degrees of leadership and management skills. It really takes a team.

RECOMMENDATIONS

For the near future, DSC can revise the codes to improve its adaptability with the company's existing system. There might be a period of beta testing and revising. Also, there can be a secured login function to protect the company's privacy.

As of the future uses of this project, it can be derived to be used for other loading systems such as cargos and commercial airplanes. This would require the software developer to change the codes on a case to case basis. For further trailer loading optimization, the changes can be made at the staging area instead of the loading step. If the workers in charge of staging the load can stage the pallets in the way they should be loaded, it should save the loading working another couple of minutes each load.

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