

IPRO 307

FINAL REPORT

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Automated Shipping Container Transportation System Design

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Introduction:

Chicago and Northern Indiana serves nationally as a hub for intermodal container traffic. As the third largest intermodal port in the world, the Chicago area hosts numerous rail yards in between which semi tractor-trailers must be employed to ship intermodal cargo. The result is reduced shipping capacity, increased motor traffic, air and noise pollution. IPRO 307 spent the fall 2006 semester assessing the feasibility of implementing Mi-Jack's Thru-Port system to remedy these issues.

Background:

For the United States, substantial numbers of shipping containers must be transferred from one side of the country to the other. As the major highway and railroad crossroads, Chicago is the third largest intermodal port in the world. For various reasons, substantial numbers of intermodal transfers take place. In many instances, containers are even moved from one railroad to another by truck. Chicago has exhausted its street, highway, and rail capacity, in recent years, and meteoric container growth expected to continue. Congestion has skyrocketed with attendant increases in pollution. Also, the amount of intermodal business is expected to double in the next 7-10 years. This means these problems will need to be addressed before it is too late, and is exactly why Mi-Jack Products is sponsoring this IPRO. Mi-Jack is an industry leader in the manufacturing, sales, service, and support of many of the cranes currently in use in today's intermodal rail sites.

The first solutions that IPRO teams researched involved capital intensive solutions for this problem. In the first semester, they developed preliminary designs for an elevated inter-yard transportation system and integrated an intra-yard GRAIL (Grid-Rail) system that utilizes linear induction motor technology. The second semester's team, analyzed the inter-yard network, estimated its costs, and drafted a detailed GRail shuttle design and shuttle flow chart. This group also specified a core and alternative regional connector network. The third semester's team further refined the concepts by proposing an actual working scenario for several specific yards, propose an inter-yard connection which considers the real world obstacles going through an existing urban area, and provided a detailed design and structural analysis for these two distinct infrastructures.

An IPRO team is now working on a second solution to the problem, based on a concept designed by Mi-Jack Products called Thru-port. This endeavor would be achieved by implementing a rail-yard-hub that will organize and shuffle similar geographical destined intermodal containers from differing rail lines. The solution is not only environmental friendly, and relatively cheap, but also minimizes effects on other transportation modes.

In this phase two, the first semester's team evaluated Thru-port as a concept designed to help decrease the travel time of a container through Chicago by bringing all the major rail road company's trains with containers destined for other cities to one location. At this location the containers will be moved from train to train, decreasing the

need for containers to be placed on trailers and driven through Chicago to other rail yards, thus alleviating traffic congestion, pollution, fuel consumption, and road restoration costs. This team evaluated several possible locations and site designs for Thru-port and the impact it will have on the entire transportation industry, and found it viable. A careful review of the hardware was also conducted.

Objectives:

The objective of IPRO 307 this semester is to design a crane and rail yard layout that is an improvement over the current designs today, in order to improve current capacity of intermodal trains through the Chicago-land area. For the semester, the members of IPRO307 will focus their efforts toward several goals as follows:

- The redesign of the current pamphlet that was created by Mi-Jack, in order to illustrate why a redesign of the current intermodal system is needed, as well as our research in terms of efficiency improvements over the old system
- The redesign and revision of the framework standards of the current crane design that was conceptually thought of by Mi-Jack Products.
- The implementation of a model design of an improved facility that can be shown by using the CSX intermodal site at Bedford Park as an example.

Methodology:

In order for the success of IPRO 307, the members of the team will all have to work together on achieving an end goal. The major problem that IPRO 307 faces is the creation of, and grounding of an improved intermodal facility model using the Bedford Park site. This will cause the team to redesign the current pamphlet and crane design that the previous semesters have worked on. The reason the team chose the Bedford park site was for several reasons. First, Bedford Park has the longest track for loading/unloading of intermodal containers in the Chicago-land area. Second, they have a strange 3 track configuration, which may not always prove for optimum unloading/ loading conditions. Finally, we will be working with Earl Wacker who is a very good resource for helping the members of IPRO 307 understand the operations at the Bedford Park facility quite well.

To achieve this, each member will be assigned specific tasks (described later in section 7), and we will work in some instances as sub-teams, or as a whole group to collaborate our findings and create our end goal. The members of IPRO 307 will then test their findings as follows: The crane design will have to be approved as structurally sound, and the efficiency gain in using the improved crane(s) and design of facility will be plotted against the current efficiency of the cranes and design of the facility. Any other part of testing will also have to be taken into account when/ if any problems arise. We will use linear programming for the efficiencies, and materials and structural engineering equations for the crane design, to make sure the crane is capable of what we need.

Results:

The members of IPRO 307 expect that after their hard work, they can come to a consensus, and implement the designs of the crane and facility renovation in the Bedford Park intermodal facility. The members also expect that by putting together a brochure/presentation about how this facility can be improved, maybe it can someday be put into production from our design. The members are also expecting that after creating this improved design, it would significantly help the congestion, and time delays at that facility, and that the improved efficiency would justify the cost of the creation of what is presented.

Task/Event Schedule:

TASK/EVENT SCHEDULE:

Project Reporting: Estimated Manpower=10%
Project Plan, completed
Midterm Progress Report completed.
Final Progress Report completed.

National pamphlet: Estimated Manpower=10%
Start: 9/15/2006
Draft1: 10/22/2006
Final: 11/21/2006
Status: completed

Animations and Crane Graphics—estimated manpower =10%
Start: 9/15/2006
Final: 11/21/2006
Status: completed

Engineering Specs estimated manpower =5%
Start 9/15/2006
Final 11/21/2006
Status: completed

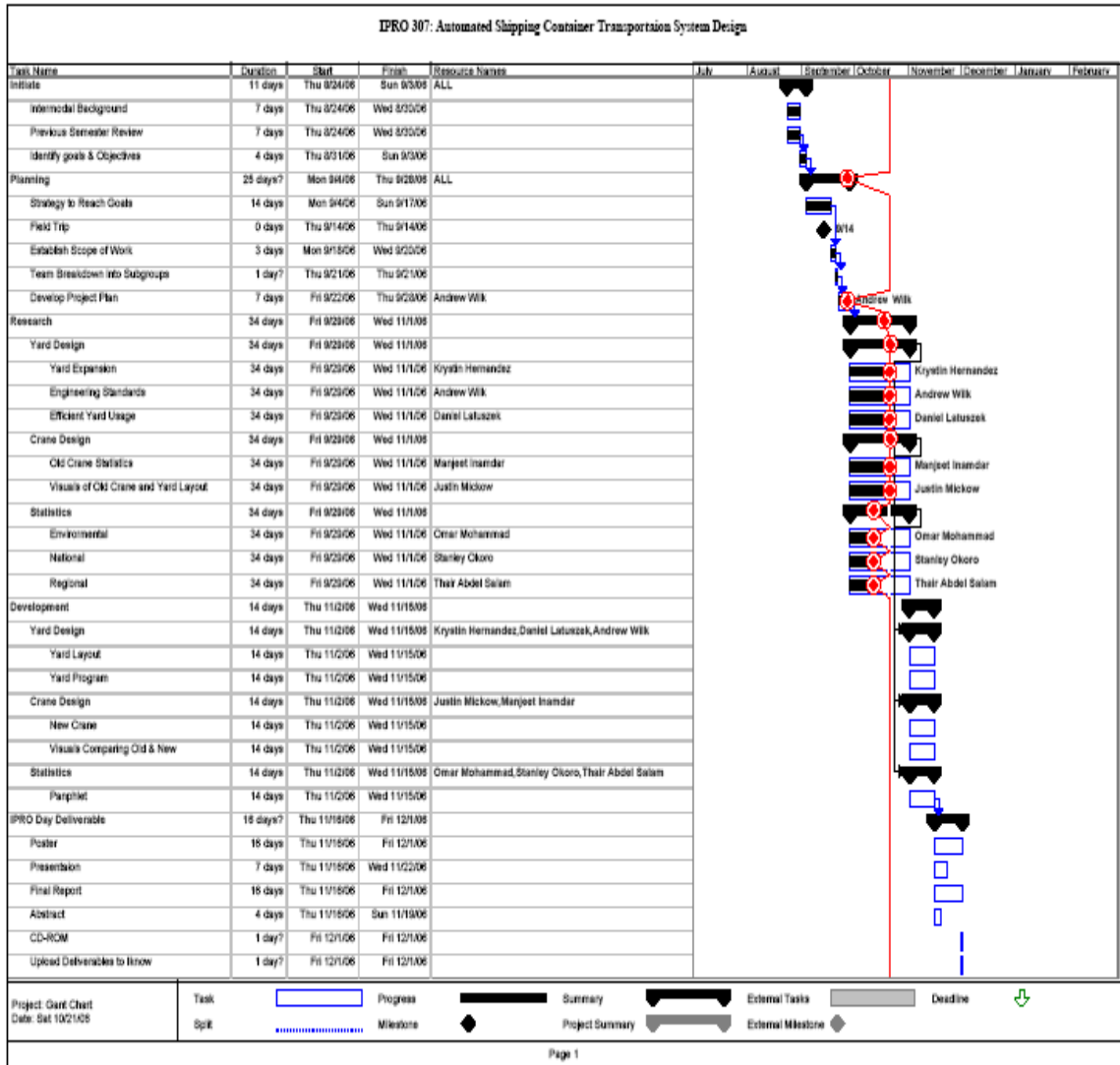
Bedford Park Modeling estimated manpower=65%
Start 9/15/2006
Final 11/29/2006
Status: completed

Subtasks—Yard Expansion (complete)
Crane Re-design (complete)
Yard Scheduling (complete)

Website (delivery type)

Start: 10/24/2006
 Final: 11/27/2006
 Status: not completed

Gantt Chart Follows:



Task Assignments And Designation Of Roles:

Designation of Roles for the members of the group:

Thair Abdel-Salam Electrical Engineering

UG4

Statistics: Tables of Facilities and their usage, pamphlet stats, and crane performance. He also will be in charge of the collecting of timesheets for the second half of the semester.

Krystin Hernandez Concentration in Political Science UG2
Zoning: Laws and Restrictions of areas surrounding intermodal yards
And she was assigned to help Stanley in re-designing the pamphlet

Manjeet Inamdar Aerospace Engineering UG4
Crane Design: Design improved designs that offer more flexibility, also exhibition coordinator

Daniel Latuszek Electrical Engineering UG4
Yard Layout: Design yard usage, and a look at what is most efficient.

Justin Mickow Architecture UG5
Communications: Create a new animation to illustrate the new design

Omar Mohammad Biomedical Engineering UG5
Environmental: Assessments, VOC's, fuel usage changes, pamphlet manager. He will also be working out some statistics on the trains and train yards.

Stanley Okoro Aerospace Engineering UJoint
Crane Design: Design improved designs that offer more flexibility. He is also in charge of the redesign of the pamphlet (one of the team's deliverables).

(Withdrawn)Joshua Sullivan Materials Science and Engineering UG3
Standards: Engineering guidelines pertaining to the designs

**Joshua withdrew from the course after the project plan was completed, but before the midterm. His tasks were re-assigned to Andrew.

Andrew Wilk Computer engineering UG4
GIS: Utilization of GIS software toward the redesign of the yard. He is also in charge of the Engineering Standards of the intermodal yard, the typing and submitting of both the project plan and midterm report, and the software for the deliverables including assisting on string chart plotting.

The breakdown of who is in charge of what subteam is as follows:

Thair Abdel-Salam: statistics
Krystin Hernandez: zoning
Manjeet Inamdar: crane design
Daniel Latuszek: yard layout
Justin Mickow: communications
Omar Mohammad: environmental

Stanley Okoro: pamphlet
Andrew Wilk: engineering standards

Obstacles

The team hasn't had too many obstacles that were outside the normal boundary of difficulty. Some problems our group had were: Finding the zoning issues, as to if we are able to expand the yard or not, finding the most efficient crane design/configuration, finding engineering standards for intermodal yards, and solving the problem of how to be most efficient at sending out trains that are blocked off to go to the same destination, and keep the number of "fix ups" low. The zoning issues were found with zoning maps layered on top of aerial photography, the most efficient crane design is still to be solved, the engineering standards are awaiting some help from either a rail yard designer, and the problem of keeping the "fix ups" low, and the train blocked is one of the most difficult, and will be worked on throughout the semester.

If anything, one of the biggest barriers seems to be the lack of teamwork and communication. This can be seen by the group as a few things the team has worked on have been poorly executed and compiled. Some members missed deadlines that were important; some failed to follow instructions, etc. This barrier of working together could quite possibly be one of the biggest obstacles faced.