IPRO 307: Intermodal Container Facility Improvements for Chicago Region (Focus on Harvey & Dalton)

Team Charter

1. Team Information

A. Team Roster

Gallagher, Ellen
Gima, Daniel
Gregory, Nicole
Guglielmo, Kyle
Hafdi, Kamal
Hartwig, Mike
Haucke, Stephen
Kolesnikov, Andrey
Kruegar, Michael
Kutryn, Anna
Loquidis, Ryan
Maas, Ryan
McCloat, Declain
Mirabella, Peter
Olney, Peter
Pirkle, Matthew
Sun, Yuefeng

B. Faculty Advisor: Laurence Rohter

C. Team colors are black and red: representing our commitment to Mi-Jack to work to the best of our abilities when designing this facility. Our motto is "Run like a race car," referring to our group's ultimate goal of providing quick, smooth and organized performance.

2. Team Purpose and Objectives.

Purpose: Design a system involving cranes, buffers and Pathfinder components for implementing a new intermodal transfer system for the CN Harvey Yard resulting in 1 million lifts per year.

Objectives:

- Determine how an intermodal facility operates
- Identify system requirements necessary for design of foundation, pavement, structure, and superstructure
- Design system based on satisfaction of requirements
- Perform simulations to determine the effectiveness of drafted design

- Organize a phase/stage plan of implementing the design in the Harvey facility

3. Background

A. Sponsor: Mi-Jack Products, Inc.

B. Issue: The movement of goods plays a crucial role in the US economy; $29 billion worth of goods travel on the nation's transportation network on an average day. Moreover, freight shipments are growing, as domestic freight movement is expected to increase 90% by 2020. Studies have shown that national infrastructure has not kept up pace with the growing freight demand. Urban freight is a particular concern, as the high population density of cities creates high demand for goods in a confined space to deliver them. Thus rather than expanding current facilities, we plan on researching improvements that can optimize performance while keeping capital and environmental damage low. Intermodal freight specifically (transport of containers and trailers by rail, truck, or water carriers), is the fastest growing sector of the U.S. freight rail industry. Chicago in particular is the third largest port in the world for intermodal operations.
For the spring 2010 Ipro, we seek to develop an efficient urban concourse for the Canadian National intermodal facility in Harvey.

C. History: Mi-Jack Products, Inc. was founded by John Lanigan, Sr. from a south suburb of Chicago in 1954. Mi-Jack distributed self propelled rubber gantry cranes (RTG) that were utilized in U.S. railroads and ports. As Mi-Jack created innovative new technologies, other industries began to use RTG cranes to increase productivity. Mi-Jack is now an industry leader in the transport industry. Its headquarters is in Hazel Crest, Illinois. Mi-Jack also has four regional operation headquarters, five sales offices and over 60 Intermodal Terminals.

D. Technological considerations: Existing crane technology as well as the use of loading buffers.

E. Ethical issues may include: Safety of workers. Our design should be efficient, while preventing work injuries that would arise in a busy intermodal yard.

F. Societal Considerations: A more efficient system may cause layoffs if fewer workers are needed. However in the current economic environment, a more efficient system may not drastically affect layoffs, as a greater number of workers could be layed off if the company goes bankrupt.

4. Team Values Statement

A. Desired Behaviors:

- Students shall show up on time to class every day (3:15 Tues and Thurs)
- Students shall effectively communicate ideas through organized discussion
- Students shall clearly articulating goals and accomplishments
- Students shall share information with classmates through available technologies, such as Igroups, email, phone, etc.

B. Conflict Resolution:
Conflict resolution will be handled democratically under the leadership of the group leader.

Project Methodology

I. Work Breakdown Structure

1. Define the problems:
   Our foremost task is to immediately identify the broad scope of our project, finding out exactly what our sponsor wants for their specific technology and solidifying subgroups to implement this. Our goal is to design a new trackside system utilize the Mi-Jack Buffer and Pathfinder components. The project will include detailed plans of the foundations, pavement, structure and superstructure.

2. Team Structure:
   Each meeting is run by a Meeting Leader, who was secretary at the prior meeting. At the beginning of each meeting, a secretary is appointed for the next meeting who will in turn become the meeting leader in two meetings time. The role of secretary rotates through so that each member of the group will have the chance to lead and take notes. The group will be divided into sub-groups with three major areas of focus.

   <u>Major Tasks and Sub Tasks</u>
   Define current techniques and explore existing layout of Harvey Yard in Harvey, Illinois.
   i. Existing Facilities and Production schematics
   ii. Equipment Specifications (Crane Specs)
   iii. Intra facility transportation
   iv. Land Specifications

   Divide the work into smaller subgroups to ensure accurate and efficient results.
   i. Site layout group-to provide data on existing area as well as to design an efficient layout to increase productivity from the site
   ii. Pavements Group- designing rigid, flexible, and reinforced aggregate paving systems for truck traffic area

iii. Foundation Group-design the foundations for structure
iv. Mechanical Group-to provide calculations to other subgroups for internal and external forces acting on the system from the Mi-Jack cranes
v. Simulation Group-Come up with an interactive design to phase out old system while implementing new system.
vi. Structural Group-design the main structure of the system so as to support the superstructure of the system.

3. Work Breakdown Structure

Our first order of business as a group was to break the project down into three phase: The System Requirements Review (SRR), Preliminary Design Review (PDR), and Critical Design Review (CDR). The overall system requirements are detailed below.

<u>1,000,000 Lifts per year:</u>

- 3475 Lifts per day (6 days a week)
- 45 seconds for train to buffer/buffer to train
- Takes 43.4 hours to do 3475 lifts with 1 crane (No travel time)
- Take 21.72 hours to do 3475 lifts with 2 cranes (No travel time)
- 3475 Lifts per day is 870 double stack cars (assuming each car is unloaded then loaded)
- 870 cars is about 11 trains (averaging 79 cars per train)
- Assume average speed 30 feet per minute
- Takes 2.7 hours to travel entire train (5000 feet)
- Takes 2 cranes 27.1 hours to do 3475 lifts and travel up and down the train once
- Takes **3 cranes 19.9** hours to do 3475 lifts and travel up and down the train once

Last two numbers will require 320 buffers total, 160 on each side of the set of two tracks. When the trains pull up, one side will be full of containers. The crane will unload one set of tracks and load from the full buffers at the same time. Once it gets to the end, it can unload the other set of tracks to the now empty buffers and load from the other set. This method will only require the crane to traverse the track two times, while limiting number of buffers. It could be done in one pass but would require 640 buffers.

System Requirements Review – The purpose of the SRR is to review the system requirements specification document, to ensure the documented requirements reflect the current knowledge of the customer and market requirements, to identify requirements that may not be consistent with product development constraints, and to put the requirements document under version control to serve as a stable baseline for continued new product development

Preliminary Design Review – The PDR demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design options have been selected, interfaces have been identified, and verification methods have been described.

Critical Design Review – The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. CDR determines that the technical effort is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints. This phase results in a completed product which is detailed in the following list:

- Detailed Drawings (Structural): These drawings will display the frame of the structure which supports the super structure. It will include 15-25 pages.
- Detailed Drawings (Layout): These drawings will illustrate the layout of yard and how it will operate with the new system implemented. It will include 10-20 pages.
- Detailed Drawings (Foundations): These drawings will display the foundation of the entire system. It will include 5-15 pages.
- Detailed Drawings (Pavements): These drawings will illustrate the type of pavements used in the development of the new system. It will include 5-15 pages.
- Calculations (Mechanical): These sheets will consist of the calculations the mechanical subgroup. It will include 5-15 pages.
- Computer Program (Simulation): This will consist of several computer simulations that illustrate precisely the input and output of the intermodal yard during the phase out of the old system and the implementation of the new system.
- Presentation: This will be a collection of all our plans designs and calculations, presented in a clear and concise manner. It will include 2-3 posters, a power point presentation, and detailed brochures.

Schedule

Task	Start Date	End Date	Team Members Needed	Hours Needed
System Requirements Review				
Research existing layout	1/19/2010	1/28/2010	3	7
Research Crane Specifications	1/19/2010	1/28/2010	3	7
Project Plan	1/21/2010	2/05/2010	4	4
Preliminary Design Review				
Preliminary Design of Layout	1/28/2010	2/23/2010	2	5
Preliminary design of Pavements	1/28/2010	2/23/2010	3	5
Preliminary Design of Simulation	1/28/2010	2/23/2010	2	5
Preliminary Design of Foundation	1/28/2010	2/23/2010	2	5
Preliminary Design of Structure	1/28/2010	2/23/2010	4	5
Provide early data to other subgroups	1/28/2010	2/23/2010	4	5
Midterm Review	2/23/2010	3/2/2010	4	6
Critical Design Review				
Final Design of Layout	3/2/2010	4/20/2010	2	5
Final Design of Pavements	3/2/2010	4/20/2010	3	20
Final Design of Simulation	3/2/2010	4/20/2010	2	20
Final Design of Foundation	3/2/2010	4/20/2010	2	20
Final Design of Structure	3/2/2010	4/20/2010	4	20
Provide all data to other subgroups	3/2/2010	4/20/2010	4	20
Abstract/Brochure	4/6/2010	4/19/2010	2	20
Exhibit / Poster	4/6/2010	4/19/2010	2	5
Final Oral Presentation	4/6/2010	4/22/2010	3	10
Final Report	4/6/2010	4/30/2010	3	8
			Slack Time	20
Bold=IPRO Deliverable				
			Total Hours	220

II. Expected Results

a. Explain how the IPRO deliverable reports will be generated:
   i. The deliverables will be assigned to teams and/or individuals. They will then be submitted to iGroups for peer review and final submission.
   ii. Individual research and presentations will be prepared and presented at specific dates established by the group. They will be reviewed and discussed by the group as a whole.
   iii. Assignments of deliverables will be decided by volunteers or the IPRO group as a whole.

III. Project Budget

Food for pre-IPRO day practice presentation:		$ 80.00
Drinks for pre-IPRO day practice presentation:		$ 20.00
Printing/Office Supplies		$ 100.00
Total:	$ 200.00	

IV. Designation of roles

Current Team Members and Completed / In Progress Tasks

	Name	Tasks
1	Gallagher, Ellen	Foundations Subgroup Leader
2	Gima, Daniel	Simulation Subgroup Member
3	Gregory, Nicole	Foundations Subgroup Member
4	Guglielmo, Kyle	Structural Subgroup Member
5	Hafdi, Kamal	Pavement Subgroup Member
6	Hartwig, Michael	Layout Subgroup Leader
7	Haucke, Stephen	Pavement Subgroup Leader
8	Kolesnikov, Andrey	Mechanical Subgroup Leader
9	Krueger, Michael	Layout Subgroup Member
10	Kutryn, Anna	Layout Subgroup Member
11	Loquidis, Ryan	Mechanical Subgroup Member
12	Maas, Ryan	Structural Subgroup Leader
13	McCloat, Declain	Simulation Subgroup Member
14	Olney, Peter	Structural Subgroup Member
15	Pirkle, Matthew	Mechanical Subgroup Member
16	Sun, Yuefeng	Simulation Subgroup Leader/Mechanical Member

As stated above, assigned meeting role positions will be rotated through every member of the group each meeting session.

Assigned Meeting Roles:

- Minute Taker: Each meeting time the Minute Taker position rotates between IPRO team members.
- Agenda Maker: The Agenda Maker is assigned to the person who had taken minutes at the previous meeting and rotates between IPRO team members same as the Minute Taker.
- Time Keeper: This position is assumed by the Agenda Maker for the meeting they are running.
- Igroups Moderator: Individuals assigned to deliverables and other subtasks will be responsible for uploading their own work and/or research.