UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*Charlotte Douglas Intl Airport*	**Date Submitted**	*5/10/19*
Project Title	*Baggage Handling Load Balancing and System Optimization* **(CLT_LOAD2)**	**Planned Starting Semester**	*Spring 2020*

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	1 (MET)	Electrical	3
Computer		Systems	2
Other ( )			

Company and Project Overview:

Charlotte Douglas International Airport (CLT) is ranked among the top 10 busiest airports in the world, averaging 1,400 daily aircraft operations. CLT serves approximately 175 nonstop destinations around the globe and welcomes more than 46 million passengers annually including 3.2 million international passengers. The Airport has an annual economic impact of $23 billion and accounts for 5% of the State of North Carolina's gross product. Charlotte Douglas received the prestigious Eagle Award in 2010 from the International Air Transport Association (IATA) for "Best Airport." It is considered the most distinguished of awards in the aviation industry. CLT was recognized for its quality service and economical value to airline customers.

Supporting over 46 million passengers and their luggage is a huge undertaking. CLT Airport's Facilities Maintenance operates & maintains the Checked Baggage Inspection System (CBIS), which is a large automated conveyor system for handling luggage. CBIS supports the airlines by conveying baggage from the ticket counters through TSA inspection to carousels on the ramp level, where the airlines collect the baggage and load on to the aircraft. The system has been in operation for the past four years. This project, using the operational data available, will seek to optimize and improve the efficiency of the CBIS system. The project will be executed by two overlapping Senior Design teams. The first team CLT_LOAD, started in Fall 2019. The second team, CLT_LOAD2 will start Spring 2020. The teams will work together the first semester to complete the optimization design work and the second team will implement the design into the airports Siemens PLC system as described below.

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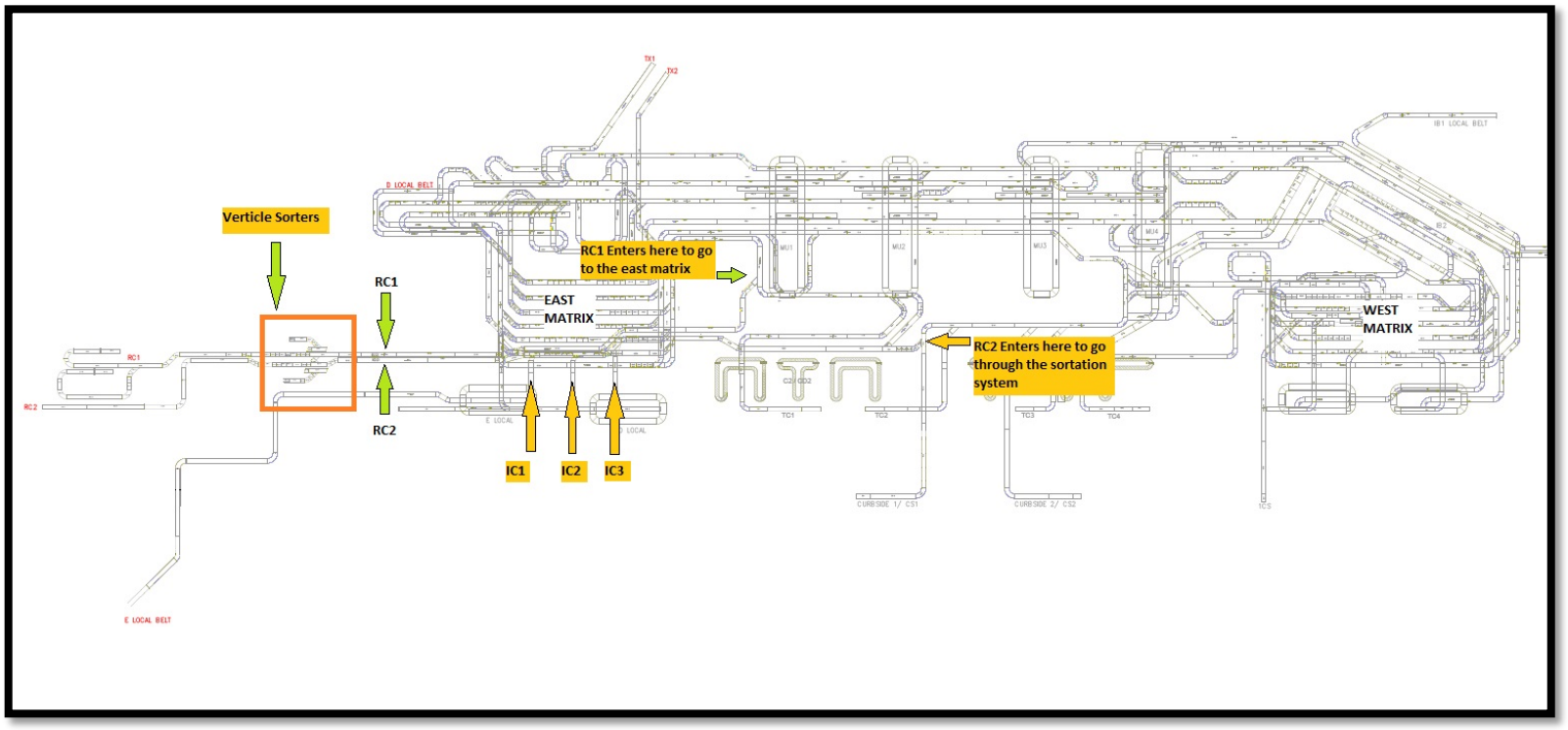
Project Requirements:

Below is a diagram of a portion of the current baggage handling lines.



Bags enter the Vertical Sorters from the left. They are processed on either the RC1 or RC2 lines. The RC2 line was added in recent years along with other modifications to keep up with capacity demands. RC2 carries the most traffic or load out of the two for it carries luggage from the international flights, along with merging the luggage from ticket counters IC1, IC2, and IC3 into the mainline of the CBIS system. In order from a bag from the IC lines to enter RC2, a 6 ft. space must be available. During peak international flight times, these spaces can be limited which can back-up processing for bags coming from the IC lines. To prevent this from becoming a problem, load can be shifted, under manual controls, from RC2 to RC1. The vertical sorting equipment has the capability to do this load shifting which is activated from a control room by a manual operation based on the operator's judgement.

In a former iteration of the CBIS system, there was an automatic mode for RC1/RC2 load balancing based on planned staffing levels of TSA baggage inspectors. The airport is interested in researching the merits of reintroducing the automated load balancing and using actual flow dynamics (versus an Operator's judgement) for when to shift load between RC1 and RC2.

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This project is the second senior design project in a series of two projects that aims at improving the load balancing of the CBIS system. The objective of this project is to implement the control algorithm in the vertical sorter via PLC for automated RC1/RC2 load balancing. In the first semester, the student team will review the simulation model that was developed by the CLT_LOAD team, analyze the feasibility of the simulated process, understand the PLCs in the CBIS system, implement a prototype control algorithm developed by the previous team (CLT_LOAD), and collect data from the pilot implementation. During the second semester, the team will 1) implement the finalized load balancing algorithm, 2) investigate further improvement based on the data collected from the implementation.

The team consists of Electrical Engineering Technology and Systems Engineering students. Electrical engineering students are responsible for coding the load balancing algorithm into the PLCs, verifying the implementation, and validating the load balancing algorithm. The systems engineering students will iteratively monitor the implementation, collect/analyze data, and improve the load balancing algorithm.

Expected Deliverables/Results:

- PLC implementation of the load balancing algorithm.
- Data analytics that demonstrate the impact of alternative load balancing algorithms on the down time of CBIS.
- Report that describes alternative load balancing algorithms with supporting data.
- Manual that describes rules used in the load balancing algorithms.

Disposition of Deliverables at the End of the Project:

Deliverables will be the final report, PLC code implementation, and the manual of the final design.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Coding skills for implementation of PLCs (Mechanical and Electrical Engineering Technology) Co-requisite is ELET 2241
- Simulation skills (SEGR 3102, Systems Engineering)
- Optimization skills (OPRS 3111, Systems Engineering)
- Since data gathering and implementation of PLCs at the airport will be required, the ability to frequently travel to the airport is required for the project. Travel cost reimbursements which are correctly filed to ISL procedures, are reimbursable to students.