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_LOAD**	**Planned Starting Semester**	*Aug 2019*

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		Electrical	
Computer		Systems	5
Other ( )			

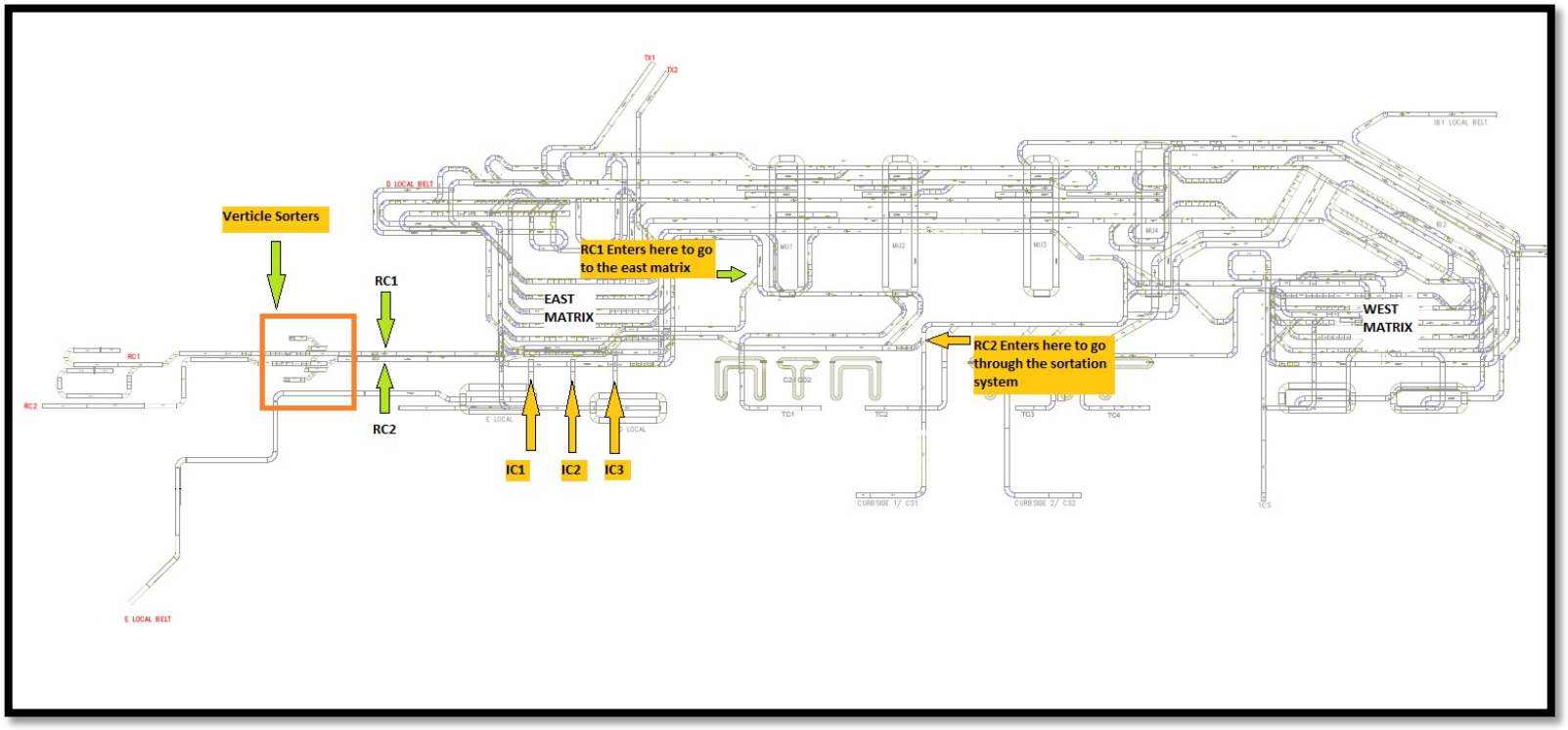
Company and Project Overview:

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.

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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The objective of this project is to analyze current and future loading information and develop algorithms for automated RC1/RC2 load balancing. In the first semester, the student team will build a simulation model that replicates the operations of the current CBIS system. The model will include physical information such as conveyer belts, speeds, capacity, entry, exit points, etc. Data gathering will be done for the physical assets and arrival rates, loads, etc. During the second semester, the team will a) validate the model against the current operation and 2) develop optimized automation algorithms which will provide logic to drive the vertical sorters to balance the loads more efficiently between RC1 and RC2. As the point of the project is to develop the automation logic for the Vertical Sorters, the simulation only has to model enough of the CBIS system that is relative to the inputs and outputs of the vertical sorter area. Downstream carousels and conveyer lines are not required to be part of the model.

A follow on Electrical Engineering Technology Senior Design team is planned to start in January 2020 that will work with the Systems team to implement the optimizations developed into Siemen's PLCs that control the Vertical Sorters. Those PLC's and associated code were used in the former configuration and are available to be used as a starting point to automate the flow balancing between RC1 and RC2. The Electrical Engineering Technology students will work on the design and implementation of the logic optimization that flows from the System Engineering simulation project. The second team's first semester will be spent understanding the CBIS operation, understanding the available PLCs/existing code and designing the parts and systems that will be used to implement the System team's optimization logic load balancing algorithms.

Expected Deliverables/Results:

- Collection of characterization data to build a simulation model of the existing CBIS system.
- Propose multiple solutions for load balancing with recommended scheme
- Automation logic should optimize the system based on the current and future expected loading conditions
- Work with follow-on project team to support their design efforts for a PLC system implementation.
- Validated simulation model of relevant portions of CBIS system.

Disposition of Deliverables at the End of the Project:

Simulation model and Report would be the deliverable.

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

- Strong interest and ability in Simulation modeling
- Must have completed SEGR 3102 System Simulation, Modeling, and Analysis.

- Data gathering at the airport will be required, so the ability to travel to the airport as required for the project is required. Travel cost reimbursements which are correctly filed to ISL procedures, are reimbursable to students.