IIE’s Outstanding Capstone Senior Design Competition & Award

Finalist Presentations

Chairperson of the Committee:

Caitlin Kenney
Systems Engineer
International Systems Management Corp.

D. Scott Sink
Moderator
Chairperson, IIE Honors and Awards Committee
Agenda (:75 Total)

(05) Scott Tee up

(02) Caitlin Moderates Presentations

(10) Amazon Freight Cold Chain Design
(10) Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality
(10) Cost-effective Freight Carrier Selection
(10) Personal Deployment Manager
(10) Robins AFB Radome Repair Process Flow and Facility Redesign

(15) Panel Dialogue on Fundamental Questions

(03) Scott Close Out
Thank You to Our Partners and Sponsors

D. Scott and Beatrice Sink Gift Fund

Council on Industrial & Systems Engineering

The Ohio State University

The Ohio State University

College of Engineering

Grado Department of Industrial and Systems Engineering

Virginia Tech.

ISE

Edward P. Fitts Department of Industrial and Systems Engineering

NC State University

Industrial Engineering and Management Sciences
Thank You to Our Sponsors and Partners

IISE Professional Affinity Groups (Partners)

Council on Industrial & Systems Engineering
Tuesday, 11 May: Capstone Showcase

Sunday, 23 May, 9-10:20 Finalist Presentations

23 Teams from 18 Departments

Participate in the ISE Capstone Showcase AND Finalist Presentations and help the committee select the 2020-21 winners!!
Rubric for the Award

Descriptive Titles for the Projects

1. Ergonomic Solutions to Volume Constraints (IaState/Pella)
2. Warehouse Optimization (IaState/Pella)
3. Optimizing flow of trailers (Ark/JB Hunt)
4. Incr Violation Capture Rates (Ark/Ark Parking)
5. Food Kitchen Capacity Planning (ASU/Intentional Foods)
6. Strategic Asset Mgmt Framework (Mich/Grand Rapids FD)
7. Visual Det of Soil Moisture (Lamar/Lamar ISE)
8. Personnel Deployment Mgr (NCState/USAF)
9. Improving Mgmt of Quality Lab Equip (NCState/Pfizer)
10. Impr component material replenishment (WMU/Mann-Hummel)
11. Justification for new endovascular Tech (Wright/EndoGuidance Tech)
12. Sched Opt for LEO Satellites (USC/Aerospace Corp.)
13. PVD Insert Coating Uniformity (Pitt/PVD Coatings)
14. Network Optimization (SJSU/Western Digital)
15. Overweight Trucking Fine Opt (OU/OK Corp Commission)
16. Motivating Remote Workplaces (OU/Lumen & Dataken)
17. TADA---Tool & App Design Arch (VT/Kyocera-sgstool)
18. Mixed Reality Training (VT/Abbott)
19. Process Optimization (UAGM/Flower Shop Inc.)
20. Cold Chain Inbound Opt (Washington/Amazon)
21. Cold Chain Design (GaTech/Amazon)
22. Radome Process Flow Imp (GaTech/USAF)
23. Cost-Effective Carrier Selection (OkState/ArcBest)

Opportunities Addressed: Efficiency, Productivity, Capacity, Throughput, Safety, QWL, Optimality, Optionality……


Award Committee

Caitlin Kenney, CISE, Chair
Scott Sink, Program Lead

Steve Snelling, IAB Rep
Boeing, ret.

ISE Department Capstone Coordinator Rep:
Dima Nazzal, Ga Tech

ISE Dept. Capstone Coordinator Rep: Kanton Reynolds, NC State University

SHS Rep:
Elizabeth Gentry
Asst Prof, Louisville
IIESE’s Outstanding Capstone Senior Design Competition & Award

Finalist Presentations

Kaustuvi Thapa
Oklahoma State

Mariel Jeffis
NCState

Parker Tankersley
Univ of Arkansas

Isabelle Liffiton
Ga Tech

Kathryn Otte
Ga Tech
The Council on Industrial and Systems Engineering, Industry Advisory Board, and Young Professionals Group in IIESE has partnered to create this Track Focused on Performance Excellence for the fourth straight year.

Focused primarily on practitioners, young professionals, and also students in ISE, our sessions span a wide variety of topic areas associated with Organizational System Excellence—essentially the integration of PEOPLE, STRATEGY, PROCESS and TECHNOLOGY.
The Operational/Performance Excellence Track

Sunday, 23 May
- Finalists for the Outstanding Capstone Sr Design Award and the Innovation in Service Systems Engineering Award
- Industry Benchmarking—how to fully capitalize on ISE
- Healthcare 4.0 Perspectives
- Corporate Culture—Diversity, Equity and Inclusion
- Career and Life Choicepoints Perspectives from Successful Women in ISE

Monday, 24 May
- Successful Women in Industry combating unconscious bias in the workplace
- Operational Analytics—The Analyst Role
- Industry 4.0 Perspectives on the Digital Transformation in Factories
- Simulation 4.0—accelerating benefits realization

Tuesday, 25 May
- How to Design, Develop and Deliver Successful Strategy Workshops
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<th>Date</th>
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<tr>
<td>Sunday, May 23</td>
<td>9:00 AM – 10:20 AM</td>
<td>(973546) Innovations in Service Systems Engineering: Best Practice Case Studies</td>
<td>Scott Sink, Ph.D., P.E. – The Poirier Group, Vittal Prabhu, Ph.D. – Penn State University, SEE</td>
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<td>(973166) The Outstanding ISE Capstone Sr. Design Finalist Presentations for 2020-21</td>
<td>Scott Sink, Ph.D., P.E. – The Poirier Group, Caitlin Kenney, P.E., PMP – ISM Corp</td>
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<td>11:40 AM – 1:00 PM</td>
<td>(973206) Benchmarking Industry: Best Practices in Deploying ISE to Engineer Performance Excellence</td>
<td>Scott Sink, Ph.D., P.E. – The Poirier Group, David Poirier, BSISE, PE. – The Poirier Group, Kevin Vliet, BSISE, MSISE – Google, Dhiraj Sukhwani, MBA – UPS</td>
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Sunday, May 23
2:00 PM – 3:20 PM
Presenter: Scott Sink, Ph.D., P.E. – The Poirier Group
Co-Author: Thomas Davis, PE, MBA – Duke Healthcare System
Co-Author: Michael Caesar, MBA – University Health Network-Toronto

Sunday, May 23
3:30 PM – 4:50 PM
(973161) Diversity, Equity and Inclusion--How ISE's Can Lead Positive Change in Our Organizations
Presenter: Scott Sink, Ph.D., P.E. – The Poirier Group
Co-Author: Tonya Smith-Jackson, Ph.D. – North Carolina A&T State University
Co-Author: Joan Tafoya, BSCS, MSIE – Sandia National Labs
Co-Author: Barrett Caldwell, Ph.D. – Purdue University
Co-Author: Bevlee Watford, Ph.D. – Virginia Tech
Co-Author: Ray Stewart, P.E. – NC Dept of Air & Water Quality

Sunday, May 23
5:00 PM – 6:20 PM
(973198) Career and Life Choicepoint Conversations with Successful Women ISE's
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<td>Monday, May 24</td>
<td>(977961) Successful Women in Industry Combating Unconscious Bias in the Work Place</td>
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<td>Co-Author: Scott Sink, Ph.D., P.E. – The Poirier Group</td>
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<td>Presenter: Mindy Holmes, n/a – Intel Corp</td>
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<td>Monday, May 24</td>
<td>(973157) How to Effectively (and Efficiently) Develop Your Operational Analytics</td>
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<td>Presenter: Scott Sink, Ph.D., P.E. – The Poirier Group</td>
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<td>Co-Author: Matheus Scuta, Industrial Engineer – Ford</td>
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<td>Co-Author: Jared Frederici, BSISE, MBB – The Poirier Group</td>
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<td>Co-Author: Ben Amaba, PhD PE CPIM LEED AP – IBM</td>
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The Operational/Performance Excellence Track (Monday)

Tuesday, 25 May
9:00-10:20 am
Leading Successful Strategy Workshops
David Poirier, Debbie Nightingale, Scott Sink

Tuesday, 25 May
11:40 -1:00pm
Designing and Executing Lean Flow Workshops
Scott Sink with Members of University Hospital East (OSU)
IISE WELCOMES
APPLE CEO TIM COOK
TO ITS VIRTUAL ANNUAL CONFERENCE & EXPO
TO RECEIVE THE CAPTAINS OF INDUSTRY AWARD!

Attend Cook’s virtual Q&A session at the Captains of Industry Forum from 3 to 3:40 p.m. ET on May 24 with IISE’s Auburn Student Chapter President Annie Dorsey

REGISTER NOW: WWW.IISE.ORG/ANNUAL/REGISTER
This session is recorded but live chat is available and encouraged.

The support material utilized will be available along with the on-demand to the recording as part of your conference registration, for a year.

Questions? Please use the chat function provided.

Follow up questions are welcome and contact information is provided at the end of the presentation.

Don’t forget to take advantage of IISE’s Operations and Performance Excellence on-demand learning ‘store’... Membership Has Privileges!!

Agenda (:75 Total)

(:05) Scott Tee up

(:02) Caitlin Moderates Presentations

(:10) Amazon Freight Cold Chain Design
(:10) Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality
(:10) Cost-effective Freight Carrier Selection
(:10) Personal Deployment Manager
(:10) Robins AFB Radome Repair Process Flow and Facility Redesign

(:15) Panel Dialogue on Fundamental Questions

(:03) Close Out
This project has been created as a part of a student design project at the Georgia Institute of Technology. This project is subject to a Non-Disclosure Agreement between Amazon Freight and Georgia Tech Capstone students.
Meet the Team

**Top Row**
Matthew Link  
John Browning  
Shrey Udhaya  
Charles Howard

**Bottom Row**
Thomas Culwell  
Viviana Osorio  
Isabelle Lifiton  
Riley Martin

Overview  Routing  Fleet Portfolio  Conclusions
Amazon Freight Overview
Amazon’s Marketplaces
Current System

Producer

Amazon Fulfillment Center

Overview ➔ Routing ➔ Fleet Portfolio ➔ Conclusions
Objective

Develop a first-party, inbound cold goods transportation solution
Key Questions

What is the ideal fleet portfolio?

What are the ideal first-party truck routes?
Capital Investment

53’ Reefer and Tractor

26’ Refrigerated Box Truck
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Source: Coyote Logistics
First-Party Operational Costs

**DRIVER WAGES AND BENEFITS**
$0.693^*$

**TOTAL FUEL COSTS**
$0.437^*$

**TIRES**
$0.036^*$

**REPAIRS AND MAINTENANCE**
$0.173^*$

**INSURANCE**
$0.068^*$

**TOLLS**
$0.034^*$

Source: American Transportation Research Institute
*All costs are in USD per mile*
ROM Objectives

1. Determine route ownership
   - 3PL
   - Amazon Box
   - Amazon Reefer

2. Routing plan for first party shipments

3. Calculate the operational cost of the solution
Platform

Google OR-Tools
Traditional Routing Constraints

Routing Constraints

Time Window Constraints

Truck Capacity Constraints
Cold Chain Constraints

Temperature Zones

-30 -25 -20 -15 -10 -5 0 +5 +10 +15

Deep Freeze Frozen Chill “Banana”

Temperature Zone Flexibility

Degrees Celsius

Overview  Routing  Fleet Portfolio  Conclusions
Industry Standard Constraints

Limit on Number of Stops
Fleet Portfolio
Fleet Portfolio Considerations

1. Minimizing Total System Cost
2. Hedging Against Variability and Risk

Source: C.H. Robinson Equipment Guide, American Transportation Research Institute
First-Party Investment Costs

53’ Reefer and Tractor
- Price: $213,000
- Useful Life: 7 years
- EAC: $37,775

26’ Refrigerated Box Truck
- Price: $140,000
- Useful Life: 10 years
- EAC: $19,360

Source: C.H. Robinson Equipment Guide, American Transportation Research Institute
First-Party Investment Costs

Discount Rate based on Trucks Purchased

Discount Rate

Trucks Purchased

Overview  Routing  Fleet Portfolio  Conclusions
Seasonality in Produce

![Bar Chart: Seasonality in Provided Dataset]

- **High Season**: January, February, March
- **Low Season**: April, May, June, July, August, September, October, November
- **High Season**: December

Overview  Routing  Fleet Portfolio  Conclusions
SIM Search Space

Number of Reefers

Minimization of Operational Costs

Weight Capacity Horizon

Number of Box Trucks
SIM Search Space

Number of Reefers

Minimization of Operational Costs

Weight Capacity Horizon

Number of Box Trucks

Overview  Routing  Fleet Portfolio  Conclusions
Investment Cost
(Bulk-Discounted Two-Year EAC)

+ Operational Cost
(1,000 Two-Year Cost Simulations)

= Total Cost
Results: Effective Horizon
Demand Scenarios

How does changing the demand affect the recommended fleet portfolio?
## Demand Scenario Model

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<td>7/6/20</td>
<td>64141</td>
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<td>6/30/20</td>
<td>7/9/20</td>
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<td>90.22</td>
<td>Deep Freeze</td>
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<td>9610.00</td>
<td>444.48</td>
<td>Chill</td>
<td>1310</td>
</tr>
</tbody>
</table>
Results: Demands Impact on Portfolio

Normal Demand
- 5 Box
- 5 Reefer

3.8% Growth
- 7 Box
- 7 Reefer

15.2% Growth
- 8 Box
- 7 Reefer
Conclusions
Value

**Current System**

- Ideal Fleet: 0
- Value: $1,950,000

**Ideal Fleet**

- Current System: 0
- Value: $930,000

Overview  Routing  Fleet Portfolio  Conclusions
Key Takeaways

Investing in a first-party fleet increases Amazon’s control of their supply chain while decreasing total system cost.

Total system cost is not sensitive around the optimum. This allows Amazon to consider minimizing 3PL usage and hedging against variability.

The computational engine provided gives Amazon the tools and flexibility to continue to evaluate their potential cold chain network.
Agenda (:75 Total)

(:05) Scott Tee up

(:02) Caitlin Moderates Presentations

(:10) Amazon Freight Cold Chain Design
(:10) **Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality**
(:10) Cost-effective Freight Carrier Selection
(:10) Personal Deployment Manager
(:10) Robins AFB Radome Repair Process Flow and Facility Redesign

(:15) Panel Dialogue on Fundamental Questions

(:03) Close Out
Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality

Parker Tankersley
Remy Kirk
Grayson Lee
Alyssa Roth
Jacob Underhill
J.B. Hunt uses their online marketplace to pair third party shippers with 360 Box trailers which are located across various customer markets.

Source: Discussion with J.B. Hunt engineers
Poor customer compliance and load seasonality create additional challenges when keeping inbound and outbound trailer flow balanced.

Customer Compliance:

Seasonality:

Resulting Issues:

- Increased Deadhead Miles
- Increased Empty Miles
Critical data sources were queried and analyzed through the creation of a customer and lane specific key.

\[
z = y + x
\]

Source: 360 Box Historical Data Sets
To gain baseline understanding of challenges associated with predicting customer compliance, a multiple linear regression model was created.

\[ Y_n = X_n - 0.0493 \times D_n + 0.52641 \times V_n + 0.02022 \times L_n - 0.01387 \times M_n \]

- Number of orders fulfilled on award \( n \)
- Dollar per mile assigned to award \( n \)
- Customer awarded volume on award \( n \)
- Lanes associated with customer listed on award \( n \)
- Customer estimated distance (miles) on award \( n \)

Model \( R^2 \) Performance:

57%

Source: Consultation received from University of Arkansas Professor, Dr. Justin Chimka
To improve compliance prediction accuracy, we utilized random forest regression on multiple different platforms.

Source: Consultation received from University of Arkansas Professor, Dr. Xiao Liu
To address customer seasonality, a 12-month volume forecast driven by historical data was created using Holt-Winters' method.

Model tuned by minimizing MSE

Source: Consultation received from University of Arkansas Professor, Dr. Justin Chimka
By combining our project deliverables, 360 Box teams are able to draw new data driven conclusions for customer contracts.

![Winters’ Method Forecasting Tool](image)

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<tr>
<td>DZIP</td>
<td>46041</td>
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<tr>
<td>CITY</td>
<td>STRONGSVILLE</td>
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<tr>
<td>DSTATE</td>
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<tr>
<td>DZIP</td>
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<table>
<thead>
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<tr>
<td>AWD_VOL</td>
<td>60</td>
</tr>
<tr>
<td>NUM_CUSTOMER_LANES</td>
<td>582</td>
</tr>
</tbody>
</table>

**Past Commodities**

Beverages, Bottles

**Predicted Compliance**

On Award: 77.769%

**Historical Commodity Information:**

- **Com. Category:** Beverage
- **Increased Activity:** March, July
- **Decreased Activity:** November

**Historical Region to Region Information:**

- **Regional Movement:** Midwest - Northeast
- **Increased Activity:** Not Significant
- **Decreased Activity:** Not Significant

Source: Discussions with Pricing Director, Steven Hill
Our goal was to assist 360 Box in addressing the issues of predicting customer compliance and seasonality related to awarded freight.

Various data analysis, modeling, and forecasting techniques allowed us to create reliable, accurate predictions for compliance and seasonality.

Information provided from our compliance prediction and volume forecasting models will allow for data-driven balancing efforts.
(05) Scott Tee up

(02) Caitlin Moderates Presentations

(10) Amazon Freight Cold Chain Design
(10) Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality
(10) Cost-effective Freight Carrier Selection
(10) Personal Deployment Manager
(10) Robins AFB Radome Repair Process Flow and Facility Redesign

(15) Panel Dialogue on Fundamental Questions

(03) Close Out
Cost-effective Freight Carrier Selection for ArcBest

Spring 2021 Senior Design

Cade Phelan, Kaustuvi Thapa, Torie Richardson

Faculty Mentor: Baski Balasundaram
IAB Mentor: Michael Foss
Agenda (:75 Total)

(:05)  Scott Tee up

(:02)  Caitlin Moderates Presentations

(:10)  Amazon Freight Cold Chain Design
(:10)  Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality
(:10)  Cost-effective Freight Carrier Selection
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(:10)  Robins AFB Radome Repair Process Flow and Facility Redesign

(:15)  Panel Dialogue on Fundamental Questions

(:03)  Close Out
U.S. Air Force 524th Special Operations Squadron

NCSU Senior Design Group

Mariel Jeffris
Jason Wheeler
Samuel Cynamon
Personnel Deployment Manager

- Intuitive Design
- 70% Time & Click Reductions
- User Error Handling
Personnel Deployment Manager

- Real-time Capabilities
- Reduced Complications
- Scheduling Accuracy

Reduced Complications
Personnel Deployment Manager

1. Current State
   a. MS Excel
   b. Manual input

2. Roadmap and Development
   a. Database structure
   b. Agile methodology

3. Results
   a. Time of input
   b. Error proofing
Goals

1. **REDUCE TIME**
   - 223 Seconds
   - 30%
   - 156 Seconds

2. **REDUCE CLICKS**
   - 77 Clicks
   - 30%
   - 54 Clicks
Process

1. Standard Data Inputs
2. Identify Open Taskings
3. Review Deployments
4. Visualize Deployments
Process
## Process

### Agile Method

**Requirements**

- Requirement Analysis

**Design**

- Design, Document & Prototype

**Development**

- Build, Eliminate & Empower

**Deployment**

- Production & Technical Support

**Test**

- Iterations, Demo & Feedback

---

Public Sub updateDwell()
    Dim rs As DAO.Recordset
    Dim rs_Deployments As DAO.Recordset
    Dim cUserID As Integer, cDwell As Double, daysDeployed As Integer, daysDwell As Integer
    Dim cStart As Date, cEnd As Date
    Set rs = CurrentDb.OpenRecordset("SELECT * FROM Users WHERE Status = -1")
    If Not (rs.EOF And rs.EOF) Then
        rs.MoveFirst
        Do Until rs.EOF = True
            rs.Edit
            cUserID = rs!UserID
            cDwell = rs!dwell
            Set rs_Deployments = CurrentDb.OpenRecordset("SELECT * FROM Deployments WHERE UserID = "+cUserID)
            If rs_Deployments.EOF Then
                rs_Deployments.MoveNext
            End If
            cStart = DateValue(rs_Deployments!dateStart)
            cEnd = DateValue(rs_Deployments!dateEnd)
            If cEnd > Now() Then
                Do
                    On Error GoTo noDwellFound
                    rs_Deployments.MoveNext
                    If IsEmpty(rs_Deployments.Fields!endDate) Then GoTo noDwellFound
                    cStart = DateValue(rs_Deployments!dateStart)
                    cEnd = DateValue(rs_Deployments!dateEnd)
                    Loop Until cEnd <= Now() End If
                    daysDeployed = DateDiff("d", cStart, cEnd)
                    daysDwell = DateDiff("d", cEnd, Now())
                    cDwell = Round(daysDwell / daysDeployed, 2)
                Else
                    GoTo missingDeployment
                End If
            End If
            rs!Dwell = cDwell
            noDwellFound:
            GoTo missingDeployment
            missingDeployment:
        Loop Until rs.EOF = True
        rs.Close
    End If
End Sub
Personnel Deployment Manager

524th Special Operations Squadron Scheduling Tool

- Add/Edit Region: Adds new regions and edits existing regions for positions to be assigned to.
- Add/Edit Position: Adds new positions and edits existing positions for taskings to be scheduled to.
- Create Taskings: Creates taskings for new deployments to be assigned to.
- Create New Event: Create and edit events assigned to specific users.
- View Users: Add new and edit existing users.
- Schedule Deployments: Assign users to deployments.

Update Dwell
Print Deployment Schedule
Personnel Deployment Manager
Career Visualization

<table>
<thead>
<tr>
<th>Year</th>
<th>Position</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>CENTCOM: JSOAC-C Planner</td>
<td>Leave</td>
</tr>
<tr>
<td>2022</td>
<td>CENTCOM: JSOAC</td>
<td>Dwell</td>
</tr>
<tr>
<td>2023</td>
<td>CENTCOM: JSOAC</td>
<td></td>
</tr>
<tr>
<td>2024</td>
<td>CENTCOM: JSOAC</td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td>CENTCOM: JSOAC</td>
<td></td>
</tr>
</tbody>
</table>
Time Study Measures

Task A
- Search for a potential deployer with above a 1:2 dwell ratio who is either an instructor, evaluator or mission pilot to fill a Jan-April tasking
- Input to tracker with formatting
- Copy information shop & dwell tab.

Task B
- Input a new Green Flight co-Pilot into the shop and dwell tab
- Task new user as the CP3 to a site between Feb-Mar.
Personnel Deployment Manager

1. REDUCE TIME
   223 Seconds
   69%
   68 Seconds

2. REDUCE CLICKS
   77 Clicks
   71%
   22 Clicks
Thank you!
Agenda (:75 Total)

(:05) Scott Tee up

(:02) Caitlin Moderates Presentations

(:10) Amazon Freight Cold Chain Design
(:10) Balancing Inbound and Outbound Flow of Trailers by Predicting Customer Compliance and Seasonality
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(:03) Close Out
Robins Air Force Base
402 CMXG & 402 EMXG
Final Presentation

Team Members: Vishal Hansalia, Rahil Manji, Matthew Oswald,
Kathryn Otte, Harper Power, John Raj
Faculty Advisor: Dr. Gunter Sharp
Client Contacts: Gregory Sutton, Edwin Rivera, & Dakota Hauesler

This project has been created as a part of a student design project at Georgia Institute of Technology.
Meet the Team

Vishal Hansalia
Supply Chain Engineering

Rahil Manji
Supply Chain Engineering

Kathryn Otte
Analytics & Data Science

Matthew Oswald
Economic & Financial Systems

Harper Power
Supply Chain Engineering

John Raj
Analytics & Data Science
Large Air Force Base Repair and Maintenance Depots in the U.S.

402 CMXG & EMXG
Aircrafts Serviced:
- C-5
- C-17
- C-130
- F-15

Radome
Current Process Flow

**Depack**

**Chemical (C-5, C-130)**

**Repair**

**Paint**

**Test**

**Project Overview**

**Simulation**

**Layout Planning**

**Trade-off Analysis**

**Optimal Layout**
Cycle Times

Fails to meet F-15 cycle time goal

Days

Actual  Goal

C-5
C-17
C-130
F-15

Project Overview  Simulation  Layout Planning  Trade-off Analysis  Optimal Layout
Bottlenecks
Overflowing Queues
Long Transportation Times
High Variability
$30,000,000
CMXG facility budget

75,000 sq ft
Maximum allocated space for CMXG

100%
Must meet all radome repair demand

$36,000,000
EMXG facility budget

52,000 sq ft
Maximum allocated space for EMXG
Project Overview

1. Gather Data
2. Experimental Simio Model
3. Trade-Off Analysis
4. Final Facility Layouts

Methodology
Simulation
Layout Planning
Trade-off Analysis
Optimal Layout
Current State Simio Validation
Demand = 154, 1 FlashJet and 1 Robot Painter

Project Overview
Simulation
Layout Planning
Trade-off Analysis
Optimal Layout
Radome Demand Forecast

Forecasted Demand

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Average</td>
<td>142.5</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>69.78</td>
</tr>
</tbody>
</table>

Demand Forecasting Graph

- **Average Demand**: 142.5
- **Standard Deviation**: 69.78
Radome Demand Composition By Year

- F-15
- C-130
- C-17
- C-5

Year

Demand Composition

2020 2021 2022 2023 2024 2025 2026 2027 2028 2029

AVG Weighted
Equipment Costs

- Chemical Depaint
- Flash Jet
- Robot Paint Station
- Manual Paint Station
- Outdoor Testing Range
- Indoor Testing Range

Cost (Millions)
Optimal Alternatives

- Investment
- Average Cycle Time Reduction

Cost (millions) vs. Days

Assumed Annual Demand Rates

- 143
- 178
- 213
- 248
- 283
- 317

Project Overview, Simulation, Layout Planning, Trade-off Analysis, Optimal Layout
Decreased Budget Alternatives

<table>
<thead>
<tr>
<th>Dollars (millions)</th>
<th>143</th>
<th>178</th>
<th>213</th>
<th>248</th>
<th>283</th>
<th>317</th>
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<tr>
<td>Days</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

- **Investment**
- **Average Cycle Time Reduction**

- **Dollars (millions):**
  - 143
  - 178
  - 213
  - 248
  - 283
  - 317

- **Days:**
  - 0
  - 2
  - 4
  - 6
  - 8
  - 10

**Assumed Annual Demand Rates**
GT - Robins AFB Team

Considerations

Efficiency
Safety Regulations
Flexibility
Client Specifications

Project Overview  Simulation  Layout Planning  Trade-off Analysis  Optimal Layout
Skeleton with a split repair process

Skeleton with a centralized repair process
1 or 2 Flash Jets
3 Robot Painters
No Additional Ranges
Add. Cost: $5.4 or 6.2 million
Key Takeaways:

76% of F-15 radomes meet goal cycle times

100% of Cargo radomes meet goal cycle times

$5.4 Million
Project Overview, Simulation, Layout Planning, Trade-off Analysis, Optimal Layout
Project Overview
Simulation
Layout Planning
Trade-off Analysis
Optimal Layout
Key Takeaways:

- 85% of F-15 radomes meet goal cycle times
- 100% of Cargo radomes meet goal cycle times

$6.2 Million
Transportation Distances
25.14% Reduction

13.5 thousand sq ft saved
~$5.2 million

Efficiency Score
45.7% → 71.7%

Reduced Weather Delays

GT - Robins AFB Team

103

Transportation Time
39% Reduction

Reduced Rework from 9.25% to ~0%

13.3 thousand sq ft saved
~$1.3 million

Project Overview
Simulation
Layout Planning
Trade-off Analysis
Optimal Layout
Improvements: Average Cycle Time

<table>
<thead>
<tr>
<th>Radomes</th>
<th>Current</th>
<th>Alt. A</th>
<th>Alt. B</th>
<th>Goal</th>
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<tbody>
<tr>
<td>F-15</td>
<td>-48%</td>
<td>-51%</td>
<td></td>
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</tr>
<tr>
<td>C-5</td>
<td>-23%</td>
<td>-26%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-17</td>
<td>-31%</td>
<td>-35%</td>
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<tr>
<td>C-130</td>
<td>-30%</td>
<td>-37%</td>
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1. What was your biggest learning from your Capstone Project?

2. What did you learn about reducing to practice Industrial and Systems Engineering?

3. Other...
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<thead>
<tr>
<th>Sunday, 23 May</th>
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<tbody>
<tr>
<td>Finalists for the Outstanding Capstone Sr Design Award and the Innovation in Service Systems Engineering Award</td>
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<tr>
<td><strong>Industry Benchmarking</strong>—how to fully capitalize on ISE</td>
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<tr>
<td>Healthcare 4.0 Perspectives</td>
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<tr>
<td>Corporate Culture—Diversity, Equity and Inclusion</td>
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<td>Career and Life Choicepoints Perspectives from Successful Women in ISE</td>
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<td>Successful Women in Industry combating unconscious bias in the workplace</td>
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<tr>
<td>Operational Analytics—The Analyst Role</td>
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<tr>
<td>Industry 4.0 Perspectives on the Digital Transformation in Factories</td>
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<td>Simulation 4.0—accelerating benefits realization</td>
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<td>How to Design, Develop and Deliver Successful Strategy Workshops</td>
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<tr>
<td>Designing and Executing Flow Workshops in Healthcare</td>
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Thank You!

Thought Leaders & Attendees

Contact us for More Info:

Scott Sink:
• https://www.linkedin.com/in/dscottsink/
• ssink@jumpcurves.com

Vittal Prabhu
• https://www.linkedin.com/in/vittalprabhu/
Our “On-Demand” Op Excellence ‘Store’ provides you with learning videos that support your ongoing growth and development.

THEMES:

• Enterprise Transformation and OpEx
• Operational Analytics
• Cultures to support Perf Excellence
• Integration of People, Strategy, Process and Technology
• Integrated LeanSigma
• Industry, Service, Healthcare 4.0
• Personal and Professional Learning and Development
• Change Leadership and Management
• Navigating through Turbulent (VUCA) times—Business Continuity
• Supply Chain and Logistics Optionality
• Enterprise Service Systems Engineering
Our Global Personal and Professional Development Series for IISE Members and Customers......


IISE PERFORMANCE EXCELLENCE WEBINARS

Boost your career. Add knowledge to your ISE toolkit. Select from any (or all) of the IISE Performance Excellence Webinar tracks below to hone your skillset to its maximum and improve your organization.

Performance Excellence topics include ...

- Accelerating Benefits Realization
- Best Practice Case Studies
- Career and Leadership Development
- Change Leadership and Management
- Industry and Service Systems 4.0
- Integrated Lean and Six Sigma
- Operational Analytics
- Operational and Business Process Excellence
- Personal and Professional Mastery
Quarter 3 Webinar Program/Lineup is shaping up well based on voice of member input

June 1:  *End2End Cold Supply Chain (Food Focus): Perspectives and Foundations*
Register with this link:  https://attendee.gotowebinar.com/register/2782807169723229456

June 15:  *Personal and Professional Mastery—a review of principle & the Science/Art of Motivating Ideal Employee Behaviors (another session with Personal and Professional Mastery Coach Webb)*
Register with this link:  https://attendee.gotowebinar.com/register/6452080881391155980

July 22:  IIESE Networking Event with Remo (Sponsored by CISE)

July 8:  *Operational Analytics: The Science and Art of Creating “AHA” moments with your Analytic Deliverables*

August 10:  *Operational Excellence: Industry Benchmarking Best Practices*

August 24:  *Integrated LeanSigma Case Studies/Benchmarking*

Sept 7:  *Operational Analytics Case Studies/Benchmarking*

Sept 21:  *Creating Cultures to Support and Drive Operational Excellence*
Where to find our digital library of past Webinars

Over 50 recorded Webinars on a wide spectrum of Performance Excellence Topics are available to members of IISE by clicking on this link.

Our IISE TV Channel is allowing you to customize what you have personalized access to.

Industry and Service Systems 4.0

Explore the major “movements” and hear thought leaders in Industry 4.0, Healthcare 4.0, Supply Chain 4.0, Service Systems 4.0, more.

- Supply Chain 4.0: Benchmarking to latest Innovations in Logistics and Supply Chain Leadership and Management
- Service Systems Engineering Outstanding Innovation
- The Industry Practitioner Track Orlando 2019: Sneak Preview
- Smart Supply Chains and Industry 4.0
- The Impact of Industry 4.0 on Business Models
- The ISE Role in Service Systems Engineering: Service 4.0 Overview, Digital Transformation in Healthcare and Enterprise Shared Service
- Whetting your Appetite ("Aperitivo"): All you Need to Know about Industry 4.0

[ Back to top ]

Operational and Business Process Excellence

Some organizations integrate Business Process Excellence perfectly. Others need a well-designed program. We’ll show you how to jump-start a great Op Ex Program.

- Industry Benchmarking: Operational Excellence Best Practices
- How to Design, Develop and Execute “Flow Workshops”
- Principles and Tools to Ensure Optimal Process Performance
- IISE Outstanding Capstone Senior Design Projects
- Pioneering and Engineering a New World
- Resilience Re-examined: Reengineering How We do Business and Ensure Public Safety
- Restarting the Economy: Guidance on the Backside of the Disruption
- Business Continuity Strategies and Tactics in Periods of Major Disruption
- Navigating Your Business Through the COVID Crisis
- Creating and Ensuring Superior Client Experience
- How to Create People Centered Operational Excellence Strategies
- Diversity, Equity, and Inclusion: Progress and Performance Assessment from an ISE Perspective
- Creating Cultures that Support Full Potential Performance/Operational Excellence
- IISE Performance Excellence Event of 2020: Sneak Preview

[ Back to top ]
Op Analytics Development Options

- **On campus or Hybrid MS Programs**
  - Time/Cost: 1-2 yrs, $50-100k
  - Hybrid Model
    - 4 days to 6 mos. $600-$5,000
    - On-Line, Virtual
  - $475/675 member/non-member + $250 for the certification

- **Hybrid Model**
  - Time/Cost: 120 hours ++, $400 students + $250 for certification

- **On-Line, Virtual**
  - Time/Cost: 4 days to 6 mos. $600-$5,000
  - Applied Business Analytics
    - Decision-making with data

Op Analytics represents huge opportunity for ISE’s

In Partnership with:
The Poirier Group
Moresteam University

Delivered Uniquely:
IISE Digital Op Ex ‘Mall and Stores’
- 10+ Video Modules for easy, self-paced consumption/learning
- ‘Chat’ Support with Coaches
- Periodic Huddles for virtual coaching
- Certificate requires an on-line final exam
- Certification requires the Certificate plus a reduction to practice, proof of skill project

Module 1: OA Thought Leader Perspectives
Module 2: Operational Analytics Perspectives, Points of View and Foundational Principles and Methods and Models
Module 3: Operational Analytics: The Foundational Data Management Role
Module 4: Operational Analytics: The Analyst, Decision/Action Support Role
Module 5: Data Sciences and The New Industrial and Systems Engineering
Module 6: Operational Analytics: The Evaluation Role
Module 8: Operational Analytics: Putting it All Together: Case Studies
Module 9: The Role of Data and Information (Engineered Management Systems) in Periods of Major Disruption, Reducing the Latencies
Module 10: Creating Cultures that Support Full Potential Performance/Operational Excellence
10 fundamental modules make up the certificate program.

On-demand Learning Management System.

Chat Coaching and periodic ‘huddle’ coaching included.

Approximately 120 hours of studying designed to be completed in 6 months or less.

<table>
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<th>Module</th>
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<tr>
<td>1. Op Analytics Certificate and Certification Program Overview Module</td>
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<td>2. Op Analytics: Perspectives and Overview Module</td>
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<tr>
<td>3. Op Analytics: Data Management Role Module</td>
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<td>4. Op Analytics: Analyst Role Module</td>
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<td>5. Data Scientist Role Module</td>
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<td>6. Op Analytics: Process Improvement (M0r0steam) Module</td>
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<td>8. Op Analytics: Management Systems Engineering Role Module</td>
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<td>9. Op Analytics: Case Studies Module</td>
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<td>10. Op Analytics: Data Sets and Skill Development Practice/Exercises Module</td>
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