Outstanding ISE Capstone Sr. Design Award--2019

Top 3 Finalists:
Georgia Tech/Cisco
Ohio State/Abbott Nutrition
Virginia Tech/Eastman Chemical

Thank you to the sponsors of this new award
ISE and IISE for Life—how IISE supports you for your entire Career.....

Career Ladder vs. Career Lattice

**Defined Steps – Moving Up**

**Multidirectional – In & out of fields**

Another turning point, a fork stuck in the road. Time grabs you by the wrist, directs you where to go. So make the best of this test, and don’t ask why. It’s not a question, but a lesson learned in time. It’s something unpredictable, but in the end it’s right. I hope you had the time of your life.

- Green Day

IAB (Highly successful mid-career ISE’s)

CISE (seasoned executives, ISE thought leaders)

Young Professionals (early career)

IISE Student Chapter

Professional Chapters are: Alumni Affinity Groups, Local/State/Regional Affinity Groups, Industry and Practitioner Focused

You can get involved in Societies, Divisions and also ‘Affinity Groups’ like Young Professionals, Industry Advisory Board and the Council on Industrial and Systems Engineering
Industry Practitioner Track
Program Guide

Welcome to the Annual IISE Conference and the Industry Practitioner Track. This Programming was specially designed for Students, Young Professionals and Seasoned ISE Practitioners.

Your Program Guide for our Track is on the back side, all of our Track Sessions are in Gatlin A-1, A-2, A-3 or A-4 including our CISE Leadership Mixer on Sunday!

Make the most of your time here and enjoy what we’ve programmed for you.
For the benefit of IISE members who could not attend the Annual Conference, we are ‘redoing’ some of the more popular sessions in Webinar format.

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# Program Matrix for the Industry Practitioner Track

## Sunday, May 19

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30-10:45</td>
<td><strong>Conference Keynote</strong>Lt. Gen. Stacy D. Harriss, Insp Gen.</td>
</tr>
<tr>
<td>10:45-12:00</td>
<td>Executive Roundtable</td>
</tr>
<tr>
<td>11:30-12:20</td>
<td><strong>Industry Practitioner Track Kick-Off Session (Gatlin A-1)</strong></td>
</tr>
<tr>
<td></td>
<td>Strategy and Insights on Performance Excellence from Track Leaders</td>
</tr>
<tr>
<td>12:30-1:50</td>
<td><strong>Soft Skills Development</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Career Directions and Trends</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Making Most of and Growing your ISE Foundation</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Creating More Value in your Organization</strong></td>
</tr>
<tr>
<td>2:00-3:20</td>
<td><strong>Making Magic—How Disney IE’s Bring New Experiences to Life</strong></td>
</tr>
<tr>
<td></td>
<td>Eddie Rivera, Joe Melendez, Disney</td>
</tr>
<tr>
<td>3:30-4:50</td>
<td><strong>Next 7 Habits of Highly Effective Young Professionals</strong></td>
</tr>
<tr>
<td></td>
<td>Jared F. Mathes Scota, Cody Havra, Mathews Scota</td>
</tr>
<tr>
<td>5:00-6:30</td>
<td><strong>Young Professionals Town Hall (Gatlin A-2)</strong></td>
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<tr>
<td></td>
<td><strong>IAB Town Hall (Gatlin A-1)</strong></td>
</tr>
<tr>
<td>6:00-7:30</td>
<td><strong>CISE Leadership Mixer (By Invitation)</strong></td>
</tr>
<tr>
<td></td>
<td>The Gatlin Foyer (Outside the four Track Session rooms)</td>
</tr>
</tbody>
</table>

## Monday, May 20

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-9:20</td>
<td><strong>Outstanding Capstone Sr. Design Finalists Presentations</strong></td>
</tr>
<tr>
<td></td>
<td>Elaine Johns, Envision/CISE Moderator</td>
</tr>
<tr>
<td>9:30-10:45</td>
<td><strong>Conference Keynote</strong>Pascal Van Hentenryck, Ph.D., Georgia Tech</td>
</tr>
<tr>
<td>11:00-12:20</td>
<td><strong>Industry Practitioner Track Keynote</strong></td>
</tr>
<tr>
<td></td>
<td>Reflection, Reality, Reinvention: Jim Tompkins (Gatlin A-2)</td>
</tr>
<tr>
<td>12:30-1:50</td>
<td><strong>Transitioning from Entry Level/Technical ISE to a Manager and then a</strong></td>
</tr>
<tr>
<td></td>
<td>Leader Elaine Johns, Envision, Tandy Bailey, UPS, Rich Wilkinson, Ingram Micro</td>
</tr>
<tr>
<td>2:00-3:20</td>
<td><strong>Coaching and Guiding the Next Generation of IS E’s into Management</strong></td>
</tr>
<tr>
<td></td>
<td>Danny Falcotto, Tindall Corp</td>
</tr>
<tr>
<td>3:30-4:50</td>
<td><strong>Capstone Track Keynote Panel</strong></td>
</tr>
<tr>
<td></td>
<td>Highlighting the Industry Practitioner Track and Attendee Q&amp;A and Dialogue Opportunity (Gatlin A-1)</td>
</tr>
</tbody>
</table>
First Year for this Important Award

IIE Annual Conference | Orlando 2019
Industry Practitioner Track

Outstanding ISE Capstone Sr. Design Award
Participate in the ISE Capstone Showcase on Sunday and vote for the top 3 from the top 20 Capstone Projects in the Academic Year 2018-2019.

Then, on Monday morning, come hear in-depth about the top three projects you voted for on Sunday.

Participate in this Award Process

Sunday, 19 May - Gatlin A Foyer
11:00-6:00 Posters on Display
3:30-5:15 Formal "Judging" of Projects
6:00-7:30 CISE Leadership Mixer, Capstone Award Finalists Announced

Monday, 20 May
8:00-9:20 am Top 3 Presentations, Gatlin A-1
7:30-9:30 pm Winners Announced at ISEA Banquet

20 Semi-Finalists from 15 Departments

Colorado State University
Georgia Tech
Illinois Institute of Technology
Kansas State University
Louisiana State University
Marquette University
Michigan State University
Penn State University
University of Cincinnati
University of Idaho
University of Illinois
University of Maryland
University of Michigan
University of Pittsburgh
Virginia Tech

Thank you to the sponsors of this new award

Elaine Johnson, CBE Innovations, CBE
Joel Frederick, Jr., Consultant The Frederick Group
ISS Department Capstone Consultant Rep: Lauren Thomas, Assistant Prof., LSU
SJS Reps: Elizabeth Geary, Assoc. Prof., Lockheed
IJM Rep: Carl Kuper, Marathon Petroleum
CEADH Rep: Jason Terpstra, IME, PSU
SJS Rep: John Smith, Assoc. Prof., Mississippi State Univ.
SJS Rep: Lauren Todd, Dir. Staffing Efficiency, Parsons

Descriptive Titles for the Projects
1. Improving the Defective Package Rate at Johnsonville LLC (MSOE)
2. Prosthetic Pressure Point Reduction (FAMU/RUS)
3. Fort Sanders Regional Medical Center Emergency Dept Process Improvement (UTK)
4. Wildfire Evacuation Simulation (CSU-Pueblo)
5. Improving Steam Sealant First-Pass Yield Using the DMAIC Process for CVG Kings Mountain NC (UNC)
6. Optimization of Shipping Mode (GA Tech)
7. Push to Kanban Pull Process Improvement (OSU)
8. Penn State Beaver Stadium Women's Restroom Wait Time Reduction (PSU)
9. Resource Scheduling for Productivity Improvement (Illinois-Omaha)
10. MAETA Ridership (GA Tech)
11. Simulation Design and Development to support Concept and Detailed Design for a new 2-oz Bottling Line for Abbott Nutrition (CSU)
12. Penn State Beaver Stadium Concession Stand Flow improvement (PSU)
13. Supply Chain Analysis for ERP Operations and Cost-Effective Production Support (Illinois-Urbana)
14. Inventory Optimization for Eastman Chemical (VA Tech)
15. Operational Analysis of TSA Screening Processes, Center for Accelerating Operational Efficiency (ASU)
16. Developing and Implementing Pneumatic Filler Technology (LSU)
17. Emergency Dept Process Improvement (WMU)
18. Automated Suspension-Solution Machine (SIU)
19. Reduction of Perfusion Number Requests in Clarkson University Reh School of Business (Clarkson)
20. Operating Rooms Nurse Staffing Model (VA Tech)
20 Nominations from 15 Departments
Rubric for the Award

Nominees will be judged by their accomplishments in the following areas:

- Did the project make a difference and was that proven, defendable?
- Does the Project represent the successful application (reduction to practice) of a set of ISE Principles, Methods, Tools? What elements of the ISE Body of Knowledge does it reflect?
- Was there an innovative/creative/discovery component or aspect to the project?
- Does the work demonstrate an ability to identify, formulate, and solve a complex engineering problem by applying engineering, science, and or mathematical principles?
- Does the work demonstrate an ability to apply engineering design to produce solution(s) that meet the specified needs with consideration of the appropriate factors and/or constraints?
- Does the work, deliverables, presentation show that the student(s) have an ability to communicate effective with a range of stakeholders and audiences?
- Does the work demonstrate the ability to analyze and interpret data/facts, and use engineering judgement to draw conclusions?
- The work demonstrates that the student(s) understand the impact of engineering solutions in the following dimensions: Economic, Sustainability of Solutions but also impact on Sustainability, stakeholder impact and system impact (both scope of system but also time horizon).
Our ISE Outstanding Capstone Sr. Design Awards Evaluation Committee for 2019

- Elaine Johns, Committee Chairperson, CEO, Enervision and CISE member
- Jared Frederici, Region IV VP, Young Professionals Representative, Sr. Consultant The Poirier Group
- Elizabeth Gentry, Asst Prof, Louisville, SHS Rep
- Carl Kirpes, Marathon Oil, IAB Rep, CISE Member
- Lauren Todd, Parallon, SHS Rep
- Laura Ikuma, Assoc. Prof. LSU, Capstone Coordinator Rep
- Janis Terpenny, Dept Chair IME, PSU and CIEADH rep
- Steve Savoie, GM, CISE Member
AGENDA

12:00  Scott to tee up the Presentations

12:10  Georgia Tech/Cisco—Guergana Ilieva presenting for the team

12:22  Ohio State/Abbott Nutrition—Talia Zaverdinos

12:34  Virginia Tech/Eastman Chemical—Jad Haj Ali presenting for the team

12:46  brief Q&A

12:55  Close-out Review upcoming Line-up--Scott
Does their strategy to get to DONE make sense?

Is DONE clear, how success was defined at the outset?

Do you think they practiced, applied the right ISE Principles and tools?

Any questions you have about the project?

Any learning, takeaway you got as a result of hearing about this Case Study?

See you at the Annual IISE Annual Conference in New Orleans?
Questions for the Young Professionals

- How did you find locking in on DONE?
- How did getting a strategy to get to DONE go?
- Do you think you practiced, applied the right ISE Principles and tools?
- Did you enjoy it?
- What was your biggest learning, aha, insight?
- See you at the Annual IIESE Annual Conference in New Orleans?
Optimization of Shipping Mode

IIESE Outstanding Capstone Finalist Presentation

Team Georgia Tech:
Agrawal, Karan; Carswell, Shelby; Chen, Weichao; Chokshi, Trishla Gandhi, Shaiv; Ilieva, Guergana; Raabe, Kayla; Sepetas, Pavlos

Advisor: Dawn Strickland | Client Contact: Hamin Oh

NDA Routing Number: NDA-5209

20th May, 2019

This document has been created in the framework of a student design project, and the Georgia Institute of Technology does not officially sanction its content.
Executive Summary

**Problem**
- Incremental $20 M in transportation costs
- Lowered ocean utilization compared to industry
- Heightened Global Carbon Footprint

**Opportunity**
- Boost ocean utilization
- Encourage the use of mid-level services
- Improve container consolidation

**Deliverables**
- Automated Mode Selection Tool
- Transportation Mode Split Interface
- Shipment Planning Application

**Value**
- $10.8 M / year in logistics costs savings
- 16 % decrease in carbon emissions
- Increased productivity with standard protocols

**Execution**
- Communicated with 10 PFs on the opportunity
- Set mode split targets for FY20Q1
- Began discussion on purchasing Gurobi license
Project Motivation

- Decreased Ocean Utilization by 42%
- Incremental Logistics Costs of $20 M
- Increased Carbon Emissions by 69%
- External Factors: Material shortages, Booking upsides, Forecast misses

Objective

Reduce logistics costs and carbon footprint for interplant shipments while maintaining service levels

* statistics are for the highest utilized FOC-FTX lane from FY16Q4 - FY19Q2
## Industry Benchmarking

### 2017 Container Shipping - Top 100 Importers

<table>
<thead>
<tr>
<th>Rank</th>
<th>Corporation</th>
<th># TEU</th>
<th># TEU/Revenue (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Philips Electronics North America</td>
<td>140k</td>
<td>65</td>
</tr>
<tr>
<td>37</td>
<td>Sony Corp. of America</td>
<td>45k</td>
<td>5.8</td>
</tr>
<tr>
<td>39</td>
<td>Hewlett-Packard</td>
<td>44k</td>
<td>2.5</td>
</tr>
<tr>
<td>51</td>
<td>Panasonic Corp of North America</td>
<td>35k</td>
<td>6.8</td>
</tr>
<tr>
<td>76</td>
<td>Foxconn/Hon Hai Precision Industries</td>
<td>22k</td>
<td>0.14</td>
</tr>
</tbody>
</table>

- **Cisco’s Mean Value/kg**
  - $209.6/kg (Air, Value/kg)
  - $7.4/kg (Ocean, Value/kg)
Supply Chain Scope

Asian Manufacturers

Contract Manufacturer

CM₁

CM₂

Direct Fulfillment

DF₁

DF₂

DF₃

North American Fulfillment Sites

European Fulfillment Sites
Current Approach

Stage 1
- Manual Data Input
  - Cost-Driven Mode Selection

Stage 2
- Inventory Optimization Software
  - ROP & Safety Stock Setting
  - Demand Information

Stage 3
- Order Trigger with Preferred Mode

Areas of Opportunity

- Inefficient Selection Process
- Divided Ownership
- Lack of Standardized Shipment Scheduling Protocols
Solution Overview

Stage 1: Diagnostic Approach
Determine default shipping mode for each Top Assembly Number (TAN)

Excel and Tableau: Data Analysis
Python: Process Automation

Stage 2: Predictive Strategy
Provide portfolio of solutions displaying mode percentage splits

Gurobi - Python: Optimization

Stage 3: Proactive Tool
Display detailed shipment planning schedule for multiple TANs

JavaScript: GUI
Automate: Methodology

Highlight: Pallet Consolidation

Lack of Scientific Approach

**Bin Packing Algorithm**
Best Fit Decreasing

Improve pallet space usage and obtain maximum number of Units/Pallet

- Inspect all cartons
- Reorder cartons based on size
- Arrange cartons into pallet
Automate: Results

All-Inclusive Python Script

- Item Cost
- Business Unit / Product Family
- Shipped Date / Quantity
- Lane Rates / CT2R
- Item Dimensions

- Refined Costs Calculation for more accurate representation of savings
- Automated SS Setting that removes the need for SmartOps®
- Improved Pallet Space Utilization to obtain maximum Units/Pallet
- Default Mode Assignment of product portfolio of 1100 TANs
Stage 2: Enhance

Motivation • Methodology • Results
Enhance: Motivation

- Fixed Order Quantities
- Limited Mode Options
- Static Calculations
- Actual Order Invoices
- Only Costs Considered

- Consolidate Across Product Families
- Consider Mid-Level Services
- Update with In-Transit Inventory
- Forecast Demand
- Multi-Objective Optimization

Create a Realistic Portfolio of Shipping Strategies
Stage 3: Enable

Application Demo
Summary

Current Approach

Cost-Driven Mode → Manual Data Input
Inventory Optimization Software → ROP & Safety Stock

+ Demand Information

Order Trigger with Preferred Mode

Revised Approach

Single Python Script + Optimization Solver + Demand Information

Suggested Shipment Schedule
Quantitative Value

10.8 M Logistical savings per year

92% Service level

16% Decrease in carbon emission

Financial

Customer

Environmental
Qualitative Value

- Expansion of current shipment mode options
- Standard procedure for intercontinental shipments
- Increased productivity of supply chain planners and managers

Scalability, Consistency, Productivity
Thank You!
Is DONE clear, how success was defined at the outset?

Does their strategy to get to DONE make sense?

Do you think they practiced, applied the right ISE Principles and tools?

Any questions you have about the project?

Any learning, takeaway you got as a result of hearing about this Case Study?

See you at the Annual IISE Annual Conference in New Orleans?

Dialogue We’d Like to Spark: Please use the Go2Webinar “ask question” Function and we’ll get to as many as we can.
Simulation Development to Support the Concept & Detailed Design of a New 2oz Filling Line

Outstanding ISE Capstone Senior Design Project

Project Leader — Talia Zaervdinos
Project Champion — Carl Norman
Project Mentor — Dhuey Cronk
Project Coach — Scott Sink, PhD
Introduction

Meeting Purpose
To review the incoming supply simulation project’s purpose, accomplishments and final deliverables, providing a project summary and major outcomes of this project.

1. Review Project Aim & Purpose 2 mins
2. Significant Results from the Project 2 mins
3. Process of How We Achieved These Results 3 mins
4. Overview of Analysis Conducted 2 mins
5. Future Use of the Model 1 mins

About Me

Talia Zaverdinos

Qualifications:
The Ohio State University (2015-19)  
* BSc Industrial & Systems Engr

The University of Edinburgh (2019-20)  
* MSc Business Analytics

Professional Experience:  
* Abbott Nutrition  
* Ecolab  
* L’Oréal  
* Marlen Manufacturing
Demand significantly exceeds capacity

**What is the problem?**
Demand for this product is drastically growing and is forecasted to increase by 84% by 2027, which greatly exceeds current manufacturing capacity.

**What are our options?**
- Outsourcing: X
- Do nothing: X
- Loss of market share: X
- Increase our own capacity: ✓
New facility is required to meet capacity

The team must determine how to assess design options of the incoming supply process of a new line so that it is able to sustain future production.

What is DONE for my project?

- Simulation model of incoming bottle supply process
  - Comparative analysis of layout options & design verification
  - Equipment specifications investigated & validated
  - Operations requirement analysis
  - Live dashboard displaying key output metrics
Significant accomplishments from project

1.

Predicted labor cost avoidance
Estimated $300,000 per year

Initial assumption...
1 operator, 4 shifts
1 MC employee, 4 shifts
*$800,000

Based on our model...
1 operator, 4 shifts
1 MC employee, 1 shift
*$300,000
*$500,000

*Assuming an employee costs $100,000 per year
Significant accomplishments from project

2. Confidence in design & operations
   - Layout design is functional
   - One truck bay will support production
   - Validate machine specs
   - Operator requirements
   - Implementation & training

3. Answered fundamental "what if" questions posed by capital project team

4. The simulation will continue to be used as the project progresses!
Journey started by understanding the process

- Equipment state
- Output bpm

- Time in system (queue to sink)
- Bottles per min
- Touches (transport/labor time)

- Dunnage queue
- Bottles per min
- Touches (transport/labor time)

- Labor utilization
- Task time

- Variation
- Equipment state

- Truck unload time
- Truck load time
- Bay utilization
- Truck idle time
Then, understanding requirements/constraints

<table>
<thead>
<tr>
<th><strong>Incoming process constraints</strong></th>
<th><strong>Customer requirements</strong></th>
<th><strong>Primary Output Metrics</strong></th>
<th><strong>Secondary Output Metrics</strong></th>
<th><strong>Assumptions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project funding</td>
<td>Supply of bottles meets forecasted demand</td>
<td>Throughput (bottles per minute)</td>
<td>Average time to unload truck</td>
<td>Endless supply of trucks and bottles</td>
</tr>
<tr>
<td>One truck bay</td>
<td>Quality maintained</td>
<td>Labor: Utilization, Requirement (per design option)</td>
<td>WIP of bottle gaylord</td>
<td>Caps arrive and stored elsewhere delivered with Kanban trigger</td>
</tr>
<tr>
<td>Available floor space</td>
<td>FIFO uses released bottles</td>
<td></td>
<td>Number of touches of gaylord</td>
<td>No line clearance for bottles</td>
</tr>
<tr>
<td>Traffic through two doors</td>
<td>1200 BPM (based on filler speed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth of bottles can not exceed 42”</td>
<td>Layout design for RFP in Feb ‘19 and installation in Oct ‘19</td>
<td></td>
<td></td>
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<tr>
<td>Current gaylord – plastic liner</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>24’ ceiling height</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>All labor must be forklift certified</td>
<td></td>
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<tr>
<td>Racking reduces storage capacity, increases cost</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Bottle shape</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Forklift traffic area must remain open</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold bottle concern</td>
<td></td>
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</tr>
</tbody>
</table>
Brainstormed 7 layout options with team, selected 2 most extreme options to simulate & compare

**Result:** Model analysis indicated that a more efficient layout will not offset incremental labor costs.
Understanding the system’s dynamics!
Which input factors significantly affect our key outputs?

To determine where important relationships exist...

Identifying important relationships (DOE)

Output: “________________________”
Screening design of experiment (DOE) results

**SIGNIFICANT FACTORS**
- Delay to label pallet
- Time to pull truck into bay
- Descrambler bpm
- Prepare totes - descrambler
- Descrambler MTBF
- Filler/capper speed
- Frequency op pulled away
- Descrambler MTTR
- Time op pulled away

**KEY OUTPUTS**
- Throughput & Filler idle %
- Operator utilization
- Average time to unload truck
- Gaylord avg quantity (floor storage)
Power of threshold/sensitivity analysis

Threshold Analysis

Changing one parameter at a time to determine when factors cause a significant decline in throughput or require additional labor?

What outputs control the success of the line?

Throughput at a baseline of 1200 bpm

Operator Utilization approximately <70%

1. CONSTANT
2. CONSTANT
3. CONSTANT
4. CONSTANT
5. CHANGING
Advantages of creating a live dashboard

- Troubleshooting to ensure accuracy of the model
- Metrics that illustrate root causes of issues
- Primary & secondary output metrics visualized
- Easily understood by core team members, supporting future use
- Becomes baseline for future manufacturing operations
What I delivered to meet project objectives

| Simulation model from Yard to the Capper |
| Design verification/comparative analysis |
| Operations requirement analysis |
| Detailed spec sheet for hand-off purposes |
| Prepare simulation to be used as a training tool |
| Threshold analysis for important factors |
| Provide team members the ability to use model |
| Live dashboard displaying key output metrics |

Meetings with Plant Team, Capital Project Team & Division Leaders

Spread awareness regarding the power of simulation

Project deliverables since August...

| April |
| May |

Final day at Abbott
Now that the model (cow) has been developed...

You can keep milking it for information!

**Questions we have answered over the past nine months**
- Is one truck bay enough?
- Will a more efficient layout save labor costs?
- What factors control the success of the line?
- How many operators are required?
- At what point do parameters become an issue?

**Questions we can answer before the line is fully built**
- If machine specs change, will issues arise and/or how does this change key output metrics?
- If additional questions arise, the model can be used to address those

**Questions we can answer after the line is up and running**
- If the line is not performing as expected, why is this?
- If demand continues to increase, how will the system react?
- If we want to improve the system in the future, which equipment should we target?
Dialogue We’d Like to Spark: Please use the Go2Webinar “ask question” Function and we’ll get to as many as we can.

Does their strategy to get to DONE make sense?

Is DONE clear, how success was defined at the outset?

Do you think they practiced, applied the right ISE Principles and tools?

Any questions you have about the project?

Any learning, takeaway you got as a result of hearing about this Case Study?

See you at the Annual IISE Annual Conference in New Orleans?
Inventory Optimization
Team 17
Advisor: Dr. Weijun Xie
Company Representative: John Robertson

Jad Haj Ali
Tushar Jain
Jiyao Shang
Haonan Zhou
Company Description

- Headquartered in Kingsport, Tennessee
- Product applications
- 8000+ products
- Two manufacturing facilities and 15 distribution centers

Eastman Performance Films
Window Films (solar, safety, etc.)
Problem Description

Current Inventory System:
Demand increases by 5%, increase inventory by 5%.
Inventory level ~ $115M

Demand & Supply Variability:
Stock-outs and excess inventory.

Low Service Rate:
Some products have ~60% service rate.

Cash Flow of Operations:
North America – 85%
EMEA & South America – 60%
Inefficiencies in supply chain operations increase cost
## Terms to Remember

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campaign Products</strong></td>
<td>Custom products based on customer requirements</td>
</tr>
<tr>
<td><strong>Non-campaign products</strong></td>
<td>Universal products made on a regular basis</td>
</tr>
<tr>
<td><strong>Inventory level</strong></td>
<td>On-hand inventory at a given time</td>
</tr>
<tr>
<td><strong>Service level</strong></td>
<td>Type 1: Percentage of cycle demand met</td>
</tr>
<tr>
<td><strong>Stockouts</strong></td>
<td>Product not available to fulfill demand</td>
</tr>
</tbody>
</table>
Objectives

Quantify safety stock levels
Safety Stock levels for non-campaign products

Increase Service Level
95% - NA
90% - Other

Improve Cash Flow
10% reduction in inventory related costs
Approach to Solution

Sort by Campaign and Non-Campaign products

Identify top 5 products, 8% of sales

Scaled with bottoms-up strategy

Research inventory models

Implement EOQ model, 95% SS

Implement (Q,R) model

Validating via Python Simulation

Scale solution to 20 products, 20% sales volume
Assumptions

- Demand is known and follows normal distribution
- Constant lead time
- Costs remain the same throughout the year
EOQ Model 95% SS

- EOQ and 95%SS:

  - Fixed quantity $Q(0)$ based on EOQ formula

Finite Production Rate Model

- Calculation of average annual cost:

  \[
  G(Q) = \frac{K\lambda}{Q} + c\lambda + \frac{hQ}{2} \left(1 - \frac{\lambda}{P}\right)
  \]
Q,R Model

- \((Q,R)\):
  - Minimize cost \(\rightarrow Q^*, R^*\)
  - Safety Stock directly Related to \(R^*\)

- 95 percentile Safety Stock

\[
G(Q,R) = \frac{K\lambda}{Q} + \lambda c + h\left(\frac{Q}{2} + R - \tau\right) + \frac{p\lambda n(R)}{Q}
\]

\[
S = R - \tau \cdot \lambda
\]
# Cost Factors

<table>
<thead>
<tr>
<th>Cost Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed order cost</td>
<td>cost incurred per order ($/order)</td>
</tr>
<tr>
<td>Holding cost</td>
<td>cost incurred to store inventory ($/roll)</td>
</tr>
<tr>
<td>Purchase cost</td>
<td>cost incurred to purchase or produce products ($/product)</td>
</tr>
<tr>
<td>Penalty cost</td>
<td>cost associated due to unsatisfied demand ($/stockout)</td>
</tr>
</tbody>
</table>
Python Coding for Simulation model

Simulate with real data

Implementation of (Q,R)

Visualization of Inventory Strategy provides insights
Simulation – (Q,R) policy

Order Target: Q+S  Order Cut-off: R  Safety Stock
Sensitivity Analysis of Demand

(Q,R) strategy:

- Stockout occurs after increasing the demand mean by 45%

(Q,R) strategy:

- Stockout occurs after increasing the variance by 30%
Cost Comparison of top 20 products

<table>
<thead>
<tr>
<th>Proposed Inventory Strategy</th>
<th>Annual Ordering Cost</th>
<th>Annual Holding Cost</th>
<th>Annual Purchase Cost</th>
<th>Annual Penalty Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$178,200</td>
<td>$245,489</td>
<td>$10,329,768</td>
<td>$0.00</td>
<td>$10,753,457</td>
</tr>
</tbody>
</table>

| Eastman Inventory Strategy  | $2,202,400           | $144,811            | $13,242,800          | $647,000            | $16,236,011 |

Savings: $5,482,554
33.6%
Impact

No stock-outs using (Q,R,SS) strategy
- Service Level improved by 30% for some products

Lower number of yearly orders
- Reduced number of orders by 92%

Higher average inventory level
- Trade-off between inventory level and Service Level

Financial Savings: $5,442,554.00 (33.60%)
Deliverables

- Excel inventory template
- Simulation model for forecasting
- Safety stock and service level relationship
- Cost comparison table
Is DONE clear, how success was defined at the outset?

Does their strategy to get to DONE make sense?

Do you think they practiced, applied the right ISE Principles and tools?

Any questions you have about the project?

Any learning, takeaway you got as a result of hearing about this Case Study?

See you at the Annual IISE Annual Conference in New Orleans?

Dialogue We’d Like to Spark: Please use the Go2Webinar “ask question” Function and we’ll get to as many as we can.
13 June—Chapter #1 Annual Virtual Meeting

9 July—Operational Analytics: ideas on how to sustain visible measurement systems and the process improvement benefits you’ve worked to achieve (Scott Sink)

13 Aug—Virtual Mentoring: Career Choicepoint learnings, lessons, tips from Senior ISE Leaders (David Poirier, President, The Poirier Group; Ron Romano, Sr. Mgr. Business Process Reengineering, Walmart, Canada; Yves Belanger, VP Supply Chain, Wolseley Canada)

27 Aug—The next 7 Habits of Highly Effective Young (ISE) Professionals (Allen Drown, United Airlines; Michael Beardsley, Law Student, Case Western Reserve; Jagjit Singh, Discover)

10 Sept—Winners Presentations from the IISE Outstanding Capstone Sr. Design Projects from 2018-19 (Georgia Tech/Cisco; Ohio State/Abbott Nutrition; Virginia Tech/Eastman Chemical)

1 Oct—Being Successful as a “Covert” ISE (Sean Gionvese, IE Manager, Lockheed Martin)

29 Oct—Service Systems Engineering: Three of the top 6 finalists from this years IISE Outstanding Service Systems Engineering Award will present.

12 Nov—ISE and Data and Implementation Sciences (Scott Sink and Ben Amaba, CTO, IBM Manufacturing)

3 Dec—The Art and Science of Selling your Ideas to various stakeholder groups in different situations (e.g. Private Equity supported firms) (Brent Miller, West Monroe Partners & David Poirier, CEO, The Poirier Group and President-Elect IISE)
Upcoming Chapter #1 Events—10 October

Use this Link to Register


Being Successful as a ‘Covert’ ISE: case examples and guidance, tips, learnings

It’s not uncommon, actually it’s quite common that ISE grad’s enter roles that aren’t, in name, an ISE role and often not really commonly linked to ISE. My first job at Kodak was with a Service Engineering group filled with ME’s and EE’s, they had never hired an ISE, didn’t know what we did, took a chance on me. I had to feel/find my way in terms of how to educate them and introduce things that my ISE background that would clearly add value for our Field Service Engineers and Customers.

This webinar will share cases like that and talk about strategies for being successful as a “Covert ISE”.

Sean Genovese is the Industrial Engineering Manager at Lockheed Martin and he will moderate this Webinar. This session was one of our most popular sessions at the IISE Conference in Orlando in May and so we are ‘redoing’ it for those of you who were unable to attend.

The Registration link for this webinar isn’t ‘live’ yet but the link above will take you to where it will be shortly.