ABOUT QUEST

Quality Enhancement Systems and Teams (QUEST) is a multidisciplinary engineering, technology and management program at the University of Maryland. Students participate in a challenging course of study that focuses on quality management, process improvement, and system design. Funded in 1993 by a grant from IBM to establish total quality on university campuses, the University of Maryland has continued the program which has produced excellent graduates prepared to face the changing landscape of business, engineering, and technology.
May 6, 2015

Dear QUEST Students:

Congratulations on the successful completion of your QUEST capstone project! In a program so academically rigorous and challenging, this accomplishment qualifies as a genuine milestone.

For many of your predecessors, this program has served as a rehearsal for a meaningful career and significant achievement. They found the search for practical solutions in cross-disciplinary teams both stimulating and productive. Also, the international component has helped them navigate the global economy.

I hope you find that same kind of rewarding life experience when you leave the university. The focus on teamwork has helped QUEST maintain a vibrant alumni network—an excellent way to stay in touch once you graduate.

All of us at the university are deeply proud of your accomplishments. We wish you the best today in your conference presentation and in the next phase of your life.

Sincerely,

Wallace D. Loh
President
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The QUEST - ATK Project
Launching Engagement

QUEST Student Team: TEAM ENGAGE

<table>
<thead>
<tr>
<th>Robert Brown</th>
<th>Michael Bryant</th>
<th>Betelhem Lemma</th>
<th>Leah Xu</th>
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<tbody>
<tr>
<td>Aerospace</td>
<td>Economics</td>
<td>Finance</td>
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<tr>
<td>Project Champion: Ann Humphrey</td>
<td>Faculty Advisor: Dr. Nicole Coomber</td>
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<tr>
<td>Controller and Human Resource Director, Missile Products Division</td>
<td>Undergraduate Management Major Coordinator, Department of Management and Organization</td>
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Project Summary
Orbital ATK is a global leader in aerospace and defense technologies as a prime contractor and merchant supplier. Orbital ATK Defense Group, Missile Products Division (MPD) is an industry leader in the development and production of tactical rocket motors and missile systems for air, space, sea, and land-based applications. Missile Products is spread out over several states, with a combination of manufacturing, test, design, and administrative facilities. Orbital ATK would like to improve employee engagement by analyzing how leadership in the Missile Products Division communicates with its employees and by strengthening its corporate culture. Team Engage looked into different mediums of disseminating information to improve communication within all levels of the division. The team focused on standardizing communication across a variety of sites. Improving engagement would increase morale and incentivize productivity. Supported by industry research and management interviews, Team Engage has provided detailed recommendations to improve communication and strengthen the corporate culture within the Missile Products Division.

Contributions and Recommendations
Team Engage used the Define, Measure, Analyze, Improve, and Control (DMAIC) methodology to tackle employee engagement. Through research and interviews with management at various MPD sites, Team Engage discovered inconsistent communication, site variation, and ineffective feedback were root causes of employee disengagement. The team recommends that MPD standardize communication, implement a feedback system, and monitor employee engagement. Standardizing communication will enable increased transparency and accountability within MPD’s communication infrastructure. Studies show that honest, constructive feedback leads to higher levels of employee engagement. Thus, Team Engage recommends implementing a feedback system enabling MPD to continuously improve their corporate culture. Finally, the team recommends MPD track employee engagement by monitoring intranet usage, feedback comments, and newsletter effectiveness. By implementing these recommendations, Team Engage believes that MPD will see a significant increase in employee engagement and individual performance.
LAUNCHING ENGAGEMENT

QUEST COMMUNITY

SPECIAL THANKS:

TEAM ENGAGE

1. Opportunity

IV. Benefits of Engagement

2. Feedback System

- Keep employees informed of strategic initiatives
- Keep employees informed of mission change
- Keep employees informed of offsite events
- Keep employees informed of MIPD
- Keep employees informed of employee engagement

- Standardize Communication lead (SEL)
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- Controlling Defects
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- Controlling Defects
- Controlling Defects

III. Opportunity

1. DMIC Methodology

- Monitor Engagement
- Monitor Engagement
- Monitor Engagement
- Monitor Engagement
- Monitor Engagement

- Employee Engagement Survey
- Employee Engagement Survey
- Employee Engagement Survey
- Employee Engagement Survey
- Employee Engagement Survey

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- Improve Communication
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II. Current Status

1. Monitor Engagement

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**PROJECT SUMMARY**
Query-Based Design worked with Becton Dickinson, a Fortune 500 medical technology company. The Diagnostics division, at its Sparks, MD production plant, manufactures various medical devices and replacement parts for discontinued products. Promoting and ensuring quality is critical for BD. Specifically, the quality management team ensures the tracking of device information as products are being built, processed, and delivered. The client currently spends over $7000 per year on stock recoveries stemming from human error during the production process. A stock recovery is when inspectors internally recall a batch because they want to ensure their products are correctly labeled. Maintaining quality is a priority, and in order to minimize human error when entering and tracking information, QBD has dedicated itself to ensuring that the generation of sequential serial numbers is accurate. Additionally, QBD has added value and possible sustainability for the Sparks, MD plant by creating recommendations based on a diagnosis of their current and possible future process flow.

**CONTRIBUTIONS AND RECOMMENDATIONS**
As a quality management project, QBD focused on in-depth interviews, focus groups, and general observations during site visits and conference calls. After applying the DMAIC framework for evaluating and solidifying database options, the team was able to use this decision-making process for all qualitative and quantitative analysis. The team quantified savings by calculating time saved should our database and recommendations resolve all human error and serial number tracking issues. QBD also contributed additional value, beyond the potential cost avoidance and time savings, by making recommendations that incorporated all departments involved in the production process at the plant. We defined inefficiencies from our constructed current process flow diagram to make five recommendations, ranging from preventing planners from adding serial numbers in advance, to assigning barcodes to each serial number so that the status of a device can be tracked and monitored by all interested employees.
**PROBLEM** Unvalidated spreadsheet used to assist planners in generating serial numbers through their SAP system.

**RESEARCH AND ANALYSIS**

- **In-Depth Interviews**
  - Quality Managers
  - Planners
  - Labelers
  - Technicians

- **Focus Groups**
  - Current/Future Process Flow
  - Other Areas for Improvement
  - Additional Database Uses

- **Quantitative Data Analysis**
  - Possible savings
    - $7,254 / year due to stock recoveries
    - $1,115 / error due to potential spreadsheet errors

**SEQUENTIAL SERIAL NUMBER GENERATION**

**CURRENT**

- Spreadsheet → SAP
- Spreadsheet → SAP
- Spreadsheet → SAP

**IMPROVED**

- Database → SAP
- Database

**RECOMMENDATIONS**

- Prevent planners from creating serial numbers in advance.
- Create relational tables that include the riskiest sub-assemblies.
- Assign barcodes to each serial number to track a device or manually enter in the status of each device as it reaches different production stages.
- Update and standardize labeling software & hardware.
- Convert to a digital device history packet.

**PROJECT IMPACT**

**RISKS**

- Failure to comply with FDA
- Stock recovery
- Recall
- Unavailable serial number in SAP
- Unsecured spreadsheet
- Mislabeled device
- Damage to paper documents
- Human error

**LEGEND**

- Path Traveled by Risk
- Final Risk Position

**TEAM MEMBERS**

- Abigail Henningsgaard - Bioengineering
- David Howarth - Mechanical Engineering
- Jacqueline Kwann - Finance
- Beshad Talayminaei - Computer Science

**SPECIAL THANKS TO OUR PROJECT CHAMPIONS**

- Robert Kaufman
- Dr. Hassan Ibrahim

- Wei Bao
PROJECT SUMMARY

Bloomberg L.P. provides financial tools, data, and news to its many clients through various products and services, such as its Bloomberg Terminal software. Clientele, including companies and organizations, rely on Bloomberg’s tools and data to effectively conduct their business, making the speed and accuracy of Bloomberg’s data collection incredibly important. Bloomberg is constantly looking to increase the efficiency and accuracy of its tools and processes so as to enhance the quality of the products and services it offers. One of these tools is the name matching software used by the Entities Data team. The name matching software is used to check if entities already exist in Bloomberg’s database before adding information about them. The Entities Data team hopes to be able to implement new name matching software that improves data quality by reducing errors, duplicates, redundancies, and false creations, which will reduce labor time and associated costs, and increase customer satisfaction.

CONTRIBUTIONS AND RECOMMENDATIONS

Through data collection and iteration-based software development, our team was able to develop a stand-alone name matching software prototype. This prototype features improved core search functionality, an expanded character limit, dynamic libraries for name standardization and word associations, and clear, organized output. If our prototype design is implemented, it can save Bloomberg an estimated 1,000-2,700 hours and $85,000-$239,000 per year. Throughout our development process, we documented the logic behind our prototype so that users will have an easier time getting acquainted with it. We also conducted in-depth interviews and surveys with the Entities Data team and their Research & Development (R&D) team. Moving forward, we recommend that the teams elect liaisons and provide weekly updates keeping the Entities Data team informed on current R&D projects.
II. METHODOLOGY

Recommendations for more effective interdepartmental communication

To improve data quality at Bloomberg by reframing the same

III. CURRENT ISSUES

- Lack of transparency
- 25 characters Name limit
- Output lacks information

Software:

- Research
- Systems survey

IV. SYSTEMS RECOMMENDATIONS

- Weekly updates feeding
- Improved communication
- Clear, defined strategy
- Dynamic libraries for functionality
- Complementary code
- Rules and associations
- Documentation

V. PROTOTYPE SOLUTION

- Weekly updated feedback
- Data analysis, informed decision-making
- Improved user experience
- Efficient implementation
- Clean, optimized platform
- On current, flexible products

VI. PROJECTED IMPACT

- Improved adherence
- Easier to implement
- Cleaner, organized code
- More efficient instruction

![Image of a computer screen with Bloomberg logo and text]

Bloomberg: Improving Data Quality

![Image of a computer screen with Bloomberg logo and text]

Bloomberg: Improving Data Quality

![Image of a computer screen with Bloomberg logo and text]

Bloomberg: Improving Data Quality

![Image of a computer screen with Bloomberg logo and text]

Bloomberg: Improving Data Quality
PROJECT SUMMARY
CFR Engineering provides comprehensive mechanical, plumbing, and electrical engineering design services for the building industry in various market sectors. They are small enough to accommodate different scopes and schedules yet large enough to take on small, medium and large projects. CFR has successfully performed critical design and development for numerous complex, multi-user projects for the National Institute of Health (NIH), National Institute for Standards and Technology (NIST), and a number of private firms. The many projects CFR develops come in the form of Requests for Proposals (RFPs). When CFR receives a new RFP, they must look through the many projects they have done in the past to find comparable projects in order to estimate costs more accurately in order to win the bid. HAAT Consulting was tasked with improving this time-consuming process in order to increase efficiency during cost estimation. With improved efficiency and centralized data, CFR will make more accurate proposals.

CONTRIBUTIONS AND RECOMMENDATIONS
HAAT created a searchable database for CFR Engineering, so that all of CFR’s past project data is in one centralized location. The database can generate a unique report for the proposal at hand, saving the business development team 20% of their total hours worked, during which most of their time is spent looking through past project data. Ultimately, the business development team will have the time to read 16% more proposals. To further improve this process, we have recommended that CFR convert all of their old Excel data into one Access database. With this first step, CFR could be well on their way to creating an automated proposal generator.

Through in-depth interviews, HAAT Consulting was able to understand CFR’s current cost estimation algorithm. Conducting data analysis on CFR’s algorithm and the past project information, we tested the old model against competing new models. With the improved model, CFR will increase their RFP win rate and grow their revenue through the addition of extra projects, which in turn will increase their profits.
The impact of our Cost and Recommendations will be estimated by 6% the average profit margin.

Below could allow Graf to immediately assess a bid based on parameters:

Future Implications

The Optimized Process

The Current Process

Requirements and time consuming of finding similar past projects is extremely

different scopes and schedules yet huge enough to take on small medium and large projects.

CFR Engineering provides comprehensive mechanical, electrical, and structural design

STREAMLINING THE BID PROPOSAL PROCESS
THE QUEST - HOWARD COUNTY PUBLIC SCHOOLS PROJECT
OPTIMIZING SCHOOL BUS ROUTES

QUEST STUDENT TEAM: QuestTransit

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<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Major/Department</th>
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<tbody>
<tr>
<td>Lauren Berman</td>
<td></td>
<td>Electrical Engineering</td>
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<tr>
<td>Bobby Fitzgerald</td>
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<td>Operations Management</td>
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<td>Mulindi Johnson</td>
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<td>Anna Lee</td>
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<td>Joel Samelson</td>
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<td>Computer Science</td>
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Project Champion:
Douglas Kampe
Transportation Planner and Analyst

Faculty Advisor: Dr. Jeffrey Herrmann
Academic Director, QUEST Honors Program
Associate Professor, Department of Mechanical Engineering and Institute for Systems Research

PROJECT SUMMARY
The Howard County Public School System (HCPSS) is located in central Maryland and serves over 52,000 students, utilizing 324 buses sent out at staggered times throughout the course of the day. This past year, legislation was proposed in Howard County that could shift start times for all schools. HCPSS is currently in the process of evaluating the feasibility of such changes. The ultimate decision hinges on the availability of limited bus resources. HCPSS identified three main goals to be achieved in the project. They first required an understanding of the costs inherent in the current bus system. Secondly, HCPSS believed that their current assignment of buses was suboptimal, and desired an ideal current state with corresponding financial analysis. Finally, they wanted to model the ability of their limited resources to accommodate shifted school start times. If accomplished, these goals would allow HCPSS to comprehend the entire transportation system and derive value from it regardless of the potential implementation of shifted start times.

CONTRIBUTIONS AND RECOMMENDATIONS
QuestTransit utilized Esri’s ArcGIS Network Analyst software to approach this project. This suite of tools allowed the re-creation of current bus routes to use as a baseline for financial analysis. The team formulated inputs to the software’s Vehicle Routing Problem tool that could accurately represent a school system as a delivery service. The optimal assignment of buses to trips was calculated for current start times. Following an iterative simulation process, QuestTransit determined the maximum savings to the county to be $189,963 per year in expenditures while also eliminating four buses from the fleet. The team expanded this ArcGIS model to interface with Excel so that the Department of Transportation can input any start and end time for schools. This system will either assign the optimal number of buses to their best trips or determine that the start times are not compatible with current county resources.
Optimizing School Bus Routes
For the Howard County Public School System

Client Information
The Howard County Public School System is located in central Maryland and serves 52,000 students. HCPSS maintains a fleet of 324 buses responsible for daily student transportation. Howard County is considering a bill to change school start and end times.

Opportunity
HCPSS seeks to understand if their bus system can accommodate new school start times and whether the current state has potential for cost savings.

Mission
Develop a model that creates optimal bus routes for variable school start times.

Current State Analysis
$18,600,000 Estimated Annual Cost

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<table>
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<tbody>
<tr>
<td>Total Daily Mileage</td>
<td>13,100 mi</td>
</tr>
<tr>
<td>Deadhead Daily Mileage</td>
<td>4,660 mi</td>
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<tr>
<td>Coast to Coast</td>
<td>3,200 mi</td>
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<tr>
<td>Total Daily Cost</td>
<td>$103,500</td>
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<tr>
<td>Total Time Cost</td>
<td>$59,800</td>
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<tr>
<td>Total Distance Cost</td>
<td>$44,700</td>
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Optimization Model
Input factors for the model:
- Last Stop in Trips
- School Locations
- Number of Buses
- School Pickup Windows
- Vehicle Routing Problem

Process flow for the model:
1. Setup vehicle routing problem
2. Create matrix of costs between every trip and school
3. Create initial feasible solution
4. Adjust trip grouping
5. Compare against current best solution
6. Is this the minimum cost solution?
   - Yes: Save output as bus routes
   - No: Repeat process

Results
$190,000/year optimized current state savings

Model:
- Input school start times
- Output optimal bus routes

Interface:
- Input school start times
- Optimized current state savings
- Buses saved

Acknowledgements
Dr. Jeffrey Herrmann, Faculty Advisor
David Ramsay, Director of Transportation
Douglas Kampe, Project Champion

Lauren Berman
Bobby Fitzgerald
Mukund Johnson
Anna Lee
Joel Samelson

UESTransit

Electrical Engineering
Operations Management
Mechanical Engineering
Finance & Information Systems
Computer Science
**PROJECT SUMMARY**

Lutron Electronics, headquartered in Coopersburg, PA, is a world-renowned lighting controls company that offers light management solutions for residential and commercial buildings. Although Lutron Electronics is known for its residential dimmers, the company has expanded to create motorized window shades and other advanced lighting control solutions. Lutron lighting systems have been installed in notable buildings, such as The New York Times Building in New York, and the White House. Universities and colleges form a significant part of Lutron’s customer base. Lutron would like to assist the University of Maryland at College Park (UMD) in their efforts to reduce its carbon emissions by 2050. UMD has already purchased lighting control technologies to promote energy efficiency including one of Lutron’s more advanced lighting control systems, Quantum, in Prince Frederick Hall (PFH). In this study, we seek to evaluate the potential savings that Lutron’s Quantum system can achieve in this residential dorm. Lutron can use this information as they continue their collaboration with UMD.

**CONTRIBUTIONS AND RECOMMENDATIONS**

The Energy Star ranking of PFH was determined to be 56, thus suggesting a great potential to reduce the building’s energy consumption. Using energy consumption data collected by the Quantum system, the team calculated the energy savings made possible by Quantum in PFH. As Lutron continues to assist UMD to reduce its electrical energy consumption, Lutron should expand lighting control technologies in PFH by installing dimming drivers, daylight sensors, and light emitting diodes. Incorporating these solutions into the Quantum system in PFH will enable Lutron to determine the relationship between its lighting control technologies and the energy savings of a university dormitory. In the future, Lutron and UMD can investigate the savings made possible by lighting control technologies in academic and recreational buildings and publish this study to increase awareness of lighting control technologies.
**PROJECT SUMMARY**

Northrop Grumman is a leading global security company that provides innovative systems, products, and solutions to government and commercial companies worldwide. The company has four sectors, and we are working with the Information Systems sector. Within the sector, there are seven divisions, and we are working solely with the Integrated Air and Missile Defense (IAMD) division. Northrop Grumman has the opportunity to improve its sales. Ideally, the company would like its variance, the difference between its projected sales and their actual sales, to be less than ± 10%. However, the variance is not within the ± 10% range as consistently as the company’s management would like. Mission: QUEST was tasked with analyzing prior financial data to determine what changes could be made to existing models to project future variance rather than simply reflecting prior data. By improving the variance, Northrop Grumman can better report to its stockholders which will lead to happier investors and increased investment in the company.

**CONTRIBUTIONS AND RECOMMENDATIONS**

After learning about Northrop Grumman, we analyzed variance sheets that indicated the dollar amount of variance in each month and the factors to which this variance was attributed. Based on Pareto diagrams, we found that different factors tend to impact each program’s variances; therefore, programs should be examined individually. We then graphed the percent variance of three programs and found that two programs had stationary data while one’s data was more seasonal. For the program with seasonal data, we used the Holt-Winters forecasting model. This model yielded improvement, as the actual variances were similar to those forecasted by the Holt-Winters model. We took a qualitative approach and began to compile recommendations as to how Northrop Grumman can collect better data for financial predictability.
Northrop Grumman: Information Systems Sector

Improving Financial Forecasting

I. Client
Northrop Grumman is a leading public global defense, technology and aerospace company. Within the Information Systems sector, we are working with the Integrated Air and Missile Defense (IAMD) division.

II. Opportunity
Improve the accuracy of IAMD’s financial forecasts by identifying controllable factors that impact variance. Currently, IAMD misses its variance target an unacceptable portion of the time.

III. Analysis

Potential Explanations of Variance in Financial Forecasts

- Group 2
  - Added Scope, Staff, Shipping
  - Material Purchases and Receipts
  - Fee Pick-Up/Rate Changes
  - Timing in Subcontractor Invoices

- Group 3
  - Program A
  - Program B
  - Program C

We focused on “Group 2” because the Pareto diagram indicated that it had the most occurrences.

The programs listed are major programs that were impacted by controllable factors differently. Red signifies a major impact; yellow, a moderate impact; green, a minor impact.

Holt-Winters is a seasonal data forecasting tool that accurately forecasted variance for one program. Moving forward, this method could potentially be used across the organization.

IV. Recommendations

If IAMD wishes to reduce financial forecasting variances, they must begin tracking variance by controllable factors each month. Additionally, IAMD should standardize variance reporting to ensure data is consistent, accurate, and easily accessible for analysis.

- **Problem**
  - Added Scope
  - Sub-K Invoices
  - Material Purchases
  - Fee/Rate Changes

- **Solution**
  - Reactive scope changes that are aligned with project development
  - Incentivize on-time invoicing payments through “reverse” interest charges
  - Develop relationships and promise future business to on-time suppliers
  - Analyze past data and incorporate it into the model to manage expectations

Acknowledgements
Faculty Advisor: Dr. Pamela Armstrong
Project Champion: Michael Trombley
A special thanks to our Subject Matter Experts and Project Sponsors

Aksiva Futter
Rahul Kashyap
Shannon Ridge
Christopher Riggs
Chloe Soetalski

Computer Science
Finance and Information Systems
Finance and Marketing
Finance
Finance and Government & Politics
**PROJECT SUMMARY**

TAMKO Building Products, Inc. is a manufacturer of residential and commercial roofing products with over 70 years of continued customer satisfaction. TAMKO employs vertical integration by owning both raw material and manufacturing plants, enabling TAMKO to control the entire manufacturing process of their roofing products. Its mission is to consistently provide customers with the best roofing materials available. Embedded into the company’s name are the primary states in which they initially serviced; Texas Arkansas Missouri Kansas Oklahoma (TAMKO). RTR Consulting sought to increase the TAMKO warehouse inventory capacity by approximately 385 pallets, improve the efficiency of the inventory management process, and recommend a fully managed warehouse system (FMW) software solution. The purpose of this project was to increase the overall efficiency of the TAMKO warehouse by adding storage space and utilizing a FMW to track data. The FMW system will also create a checking system for following First In First Out. This aligns with the overall strategic goals of TAMKO and its commitment to total quality management principles and extraordinary customer service.

**CONTRIBUTIONS AND RECOMMENDATIONS**

To increase capacity within the warehouse, RTR Consulting researched shelving solutions such as drive-through racking and movable and stationary shelves. Each of these recommendations will utilize vertical space across the facility to increase capacity by a minimum of 385 pallets. To increase efficiency of inventory management, the team conducted time studies to evaluate the feasibility of routes directly from the production line to peripheral storage points. From our results, we were able to rule out one storage location because the round trip time would back up the production line. At the same time, we confirmed that traveling from the line to two other locations would be within the time frame of the production line. These time studies helped us validate the feasibility of alternating between long and short trips from the production line. Finally, we researched multiple FMW software to propose two final solutions to TAMKO. After evaluating ten software solutions against our client’s requirements, we narrowed down our recommendations to two software vendors: HighJump Software, Inc. and TecSys, Inc.
Over the next 5 years

$750,000

Savings:

Inventor Tracking

Inventory Management

Centered around the customer

Taiichi Ohno

Toyota

Lean

Performance Improvement

Recommendations

Building a Smarter Manufacturing System
Unilever is a global consumer goods company that specializes in manufacturing and distributing food, cleaning, and personal care products. Well-known Unilever brands include Dove, Axe, Suave, and TRESemmé. Our project focuses on Unilever’s Personal Care business segment, which generates $29 billion per year. We are working with the Logistics team at Unilever to improve inbound shipments to Personal Care factories in Jefferson City, MO, Hammond, IN, Jonesboro, AR, and Raeford, NC. In 2014, Unilever dispatched over 10,000 trucks to deliver raw materials from suppliers to its Personal Care factories. Over 40% of those trucks did not meet Unilever’s benchmark of being at least 85% filled. As a result, Unilever is dispatching more trucks than necessary and wasting time, money, and fuel. Unilever lacks a process to identify opportunities in which multiple truck shipments can be consolidated into single truck shipments. By developing a tool that visualizes all of these opportunities, we can help optimize the usage for each individual shipment, minimizing Unilever’s costs and carbon impact.

In order to improve the use of truck capacity, our team developed a comprehensive methodology. We conducted data analysis with the historical data provided, analyzed Unilever’s current ordering process, and iterated our prototype design to improve on that process. Our final recommendation is to add an additional step to the current process of how material planners order materials for their factories. This additional step involves planners using the tool that we produced to determine when different materials, from different locations, could be ordered in one shipment. Our tool filters out all materials that cannot be shipped together by examining their distances, pallet counts, weights, and volumes. It then highlights all opportunities that planners have for ordering materials together. With this tool, we are increasing the average amount of space used per truck and reducing the total number of trucks shipped. This makes Unilever’s operations leaner by saving them time, money and resources.
UNILEVER INBOUND LOGISTICS
CONSOLIDATING INBOUND SUPPLIER SHIPMENTS

BACKGROUND
Unilever is a global consumer goods company that specializes in manufacturing and distributing food, cleaning, and personal care products. Well-known Unilever brands include Dove, Axe, Suave, and TreSemme. Our project focuses on Unilever’s Personal Care business segment, which generates $29 billion per year.

CURRENT STATE
4 U.S. Personal Care Factories
≈70 Materials suppliers per factory
Raw materials are ordered from supplier
Carts transport the materials
Materials arrive at destination factory

10,304
4,599
Total trucks dispatched in 2014
Partially empty* supply trucks dispatched to all factories in 2014
*less than 85% full

2014 AVERAGE TRUCK SPACE USED
Raeford Factory: 78.1%
85% goal
Raeford, NC was chosen as our scalable model factory because of the high potential for improvement and the lack of extreme variety in its raw materials and final goods.

METHODOLOGY
- Define problem
- Conduct data analysis
- Examine current process
- Develop recommendations
- Test idealized design
- Synthesize results

RECOMMENDATIONS
Goal: Improve truck usage at Raeford Factory to 85% and develop a scalable plan for three other factories

Recommendation - Add step to current ordering process; build combined shipments before placing materials orders

1. Receive materials needed.
2. Map out and combine materials that can fit in the same truck.
   Tool: Excel template that cross references all materials against each other by distance, pallet count, volume, and weight.
3. Place materials orders.
4. Inform carriers of which materials need to be included in particular trucks.
5. Carriers route individual trucks to pick up multiple materials.

RAEFORD TRUCK USE IMPROVEMENT

1. Original
2. With consolidation process

Jan 2014
# Trucks on the Road
162
133
% Truck Usage
71%
86%

IMPACT
156,000 Truck miles saved
26,000 Gallons of fuel saved
260 Tons of CO₂ eliminated
$429,000 In yearly truck usage savings

PROJECT TEAM
Black Belt Consulting
Rachel George | Jenny Gu | Alina Musi
Sudhanshu Shankar | Drew Szabo
Project Champion | Brooke Fitzgerald, James Anderson
Faculty Advisor | Dr. Thomas Casi
QUEST Faculty | Kyle King, Dr. Jeffrey Herrmann
Dr. Pamela Armstrong
ASSOCIATE DIRECTOR, QUEST HONORS PROGRAM
CLINICAL ASSOCIATE PROFESSOR OF MANAGEMENT SCIENCE
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Dr. Pamela Armstrong is a Clinical Associate Professor in the Decision, Operations and Information Technologies department at the Smith School. She teaches the introductory QUEST course on design and quality and the QUEST mentors course. Dr. Armstrong also teaches courses in operations management, operations strategy, decision analytics and project management at the Smith School. Her areas of interest include quality, performance excellence, and service operations. Prior to joining the Smith School, Dr. Armstrong ran a management consulting firm that provided operational analysis, strategic planning, and performance management services to federal clients. Before consulting, she served on the faculty at Georgetown University’s McDonough School of Business. Dr. Armstrong has also worked as an engineer at IBM, AT&T Bell Laboratories, and Hughes Aircraft Company. She earned her Ph.D. in Operations and Information Management at the Wharton School of the University of Pennsylvania, her M.S. in Operations Research and Industrial Engineering from the University of California, Berkeley, and her B.S. in Systems Engineering from the University of Arizona.

David Ashley, M.B.A.
EXECUTIVE IN RESIDENCE, QUEST HONORS PROGRAM
ROBERT H. SMITH SCHOOL OF BUSINESS

David Ashley is an adjunct professor and an Executive in Residence at the University of Maryland’s Smith School of Business. He is currently the Human Capital Data Analytics Division Manager at the Department of Homeland Security. In that role, Mr. Ashley manages a division overseeing analytics and reporting of the DHS workforce that includes 230,000 people across the 10 DHS components. Before his current role at DHS, he was a program analyst for the Federal Emergency Management Agency (FEMA) within the Department of Homeland Security where his duties involve developing business models, performance measurement and survey work, and program management and program reviews. Before joining FEMA, Professor Ashley also worked at the Department of Homeland Security, Customs and Border Protection (CBP), the U.S. Small Business Administration (SBA), and the Small Business Development Center at the University of New Mexico. He also served as president of the University of Georgia’s Marketing Research Institute International and he served two terms as president of the Mid-Atlantic Chapter of the Marketing Research Association. Professor Ashley has many publications including a marketing research college textbook published by Kendall Hunt Publishing. He holds an undergraduate degree from the University of North Carolina and a graduate degree from the University of New Mexico.

Dr. Nicole Coomber
UNDERGRADUATE MANAGEMENT MAJOR COORDINATOR, DEPARTMENT OF MANAGEMENT AND ORGANIZATION
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PROJECT ADVISED: ATK

Dr. Nicole M. Coomber completed her PhD in Education Policy and Leadership in May of 2012 at the University of Maryland’s College of Education. She teaches organizational behavior, management consulting, and cross-cultural management, and her research focus is management education and curriculum design. Nicole is currently the undergraduate management major coordinator for the Management & Organization department and serves as affiliated faculty to the QUEST Honors Program. Before joining the faculty at Smith, she worked with the QUEST program as Assistant Director, leading efforts in curriculum and corporate development.
Dr. Thomas M. Corsi

**ACADEMIC DIRECTOR, QUEST HONORS PROGRAM**

**ASSOCIATE PROFESSOR, DEPARTMENT OF MECHANICAL ENGINEERING AND INSTITUTE FOR SYSTEMS RESEARCH**

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**PROJECTS ADVISED: HOWARD COUNTY PUBLIC SCHOOLS, TAMKO**

Dr. Hassan Ibrahim is a Clinical Professor at the Robert H Smith School of Business. Dr. Ibrahim received Doctor of Science (D.Sc.) and Master degree in Engineering Management from The George Washington University. He also has Bachelor degree in Electrical Engineering. Dr. Ibrahim areas of specializations are Project Management, Information Systems development, and Operations Strategy. Dr. Ibrahim's research was published by Harvard Business School and the Production and Inventory Control Journal. Ibrahim served on the Editorial Review Board of the Journal of Operations Management. His primary teaching areas are: Project Management, Information Systems Analysis and Design, Data Communications, and Operations Management. He was nominated for the Outstanding Scholar of the Year Award in the Commonwealth of Virginia in 1996. Dr. Ibrahim is a twice recipient of both the Philip Merrill Award and the prestigious Krowe teaching Excellence Award. He has worked for and consulted with a number of industry leaders including the World Bank, McDonnell Douglas, Phillips Electronics, Hughes Networks Systems, and Siemens Medical Systems.

Dr. Thomas M. Corsi joined the Robert H. Smith School of Business in 1976 as a Professor of Logistics and Transportation. He served as Chairperson of the Logistics and Transportation Group from 1986 through 1994. During that time, the Group received recognition from the Transportation Journal as the most prolific faculty group in the nation based on published research in the field. He is an associate editor of the Logistics and Transportation Review and the Journal of Business Logistics and serves on the editorial review board of the Transportation Journal and the International Journal of Physical Distribution and Logistics Management. He has authored more than 100 articles on logistics and transportation, and he has co-authored four books. He has consulted for such organizations as the Interstate Commerce Commission, the Maryland State Department of Transportation, the National Science Foundation, and the United States Department of Transportation.

**DR. JEFFREY HERRMANN**

**ACADEMIC DIRECTOR, QUEST HONORS PROGRAM**

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**A. JAMES CLARK SCHOOL OF ENGINEERING**

**PROJECTS ADVISED: HOWARD COUNTY PUBLIC SCHOOLS, TAMKO**

Dr. Jeffrey Herrmann is an Associate Professor at the University of Maryland, where he holds a joint appointment with the Department of Mechanical Engineering and the Institute for Systems Research. Dr. Herrmann earned his B.S. in Applied Mathematics from Georgia Institute of Technology. As a National Science Foundation Graduate Research Fellow from 1990 to 1993, he received his Ph.D. in industrial and systems engineering from the University of Florida. His dissertation investigated production scheduling problems motivated by semiconductor manufacturing. He held a post-doctoral research position in the Institute for Systems Research from 1993 to 1995. His current research interests include operations research for homeland security and emergency preparedness, production scheduling, and improving decision-making processes.

Dr. Hassan Ibrahim

**CLINICAL PROFESSOR, DEPARTMENT OF DECISIONS, OPERATIONS, AND INFORMATION TECHNOLOGIES**

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**PROJECTS ADVISED: BD**

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QUEST FACULTY AND LEADERSHIP

KYLIE GOODELL KING, M.A.
PROGRAM DIRECTOR, QUEST HONORS PROGRAM

Kylie King is QUEST’s Program Director and a co-instructor for BMGT/ENES 490H. Kylie teaches a related course, Defining Consulting and Innovation Projects, where she works with students to identify QUEST clients and outline capstone projects. She also leads a course about design and innovation in Silicon Valley. In addition to teaching, Kylie manages QUEST’s program operations, including learning outcomes assessment, program marketing, and alumni relations. Kylie is currently pursuing a Ph.D. in Quantitative Methodology in Maryland’s College of Education. Her research interests include evaluating admission metrics and outcomes of high-achieving student programs. Previously, Kylie served as an assistant director and graduate assistant with QUEST while earning her MA in higher education at the University of Maryland. Before joining QUEST, she received a BS in industrial and systems engineering from North Carolina State University and worked as an Industrial Engineer in the Tyco Electronics Leadership Development Program.

JESSICA MACKLIN, M.A.
PROGRAM COORDINATOR, QUEST HONORS PROGRAM

Jessica Macklin is the Program Coordinator for the QUEST Honors Program. She coordinates the program’s daily operations, leads QUEST’s recruitment and admissions efforts, plans and executes QUEST conferences and orientation, and advises QUEST’s student organizations. Jessica received her BA in Psychology from the University of Maryland, College Park and her MA in Higher and Postsecondary Education from Teachers College, Columbia University. Jessica is an active member of the Teachers College National Research Team on College Educational Quality. Prior to joining QUEST, Jessica was the Graduate Assistant in Columbia University’s Office of Student Engagement.

DR. MICHAEL OHADI
PROFESSOR, MECHANICAL ENGINEERING DEPARTMENT
A. JAMES CLARK SCHOOL OF ENGINEERING
PROJECT ADVISED: LUTRON

Dr. Michael Ohadi is a professor of mechanical engineering, co-founder of the Center for Environmental Energy Engineering, and Director of the Smart and Small Thermal Systems Laboratory at the University of Maryland, College Park. He received his Ph.D. in mechanical engineering from the University of Minnesota in 1986. His areas of research include heat/mass transfer enhancement; advanced energy systems, and building energy audit/control/modeling. He is a fellow member of both ASME and ASHRAE. He is the inventor/co-inventor of eight issued U.S. patents and has published more than 200 refereed technical publications, and is the recipient of numerous awards in recognition of his work.
Dr. James Purtilo
Associate Professor, Computer Science Department
College of Computer, Mathematical, and Natural Sciences
Project Advised: Bloomberg

Dr. James Purtilo specializes in software development and product assurance, and his research is currently funded by the Office of Naval Research on a cyber security systems project. With prior support from the National Science Foundation, Department of Defense Advanced Research Projects Agency and various corporate sources, Purtilo has studied and published on topics of software producibility, formal methods, rapid prototyping and testing. Purtilo has served on the Defense Biometric Support Team (an advisory group to the Office of the Secretary of Defense), is a member of the Arrhythmia and Cardiology Imaging Group at the UM Medical Center in Baltimore, and has consulted with the Division of Civil Rights within the Department of Justice. At the University of Maryland, he has served as the Associate Dean for Undergraduate Education in the College of Computer, Mathematical and Physical Sciences, chaired the undergraduate Computer Science program and directed the Master's of Software Engineering Program. He received his Ph.D. in Computer Science from the University of Illinois at Urbana in 1986.

Dr. J. Gerald Suarez
Professor of Practice in Systems Thinking
Design Fellow, Center for Leadership, Innovation, and Change
Senior Executive Coach
Robert H. Smith School of Business

Dr. J. Gerald Suarez is a premier educator, speaker and consultant in the fields of Organizational Design, Systems Thinking and Total Quality Management. He joined Smith in 2005 as Executive Director of the multidisciplinary Quality Enhancement Systems and Teams (QUEST) Honors program. Dr. Suarez currently teaches the required QUEST class on “Systems Thinking for Managerial Decisions.” Additionally, he teaches at the corporate, executive MBA, custom EMBA, international, and undergraduate levels. From 2008 to 2010 Dr. Suarez served as Associate Dean of External Strategy, leading the offices of marketing communications, recruitment and career services. Prior to joining the Smith School, he served under two administrations in the White House as the Director of Presidential Quality. Dr. Suarez holds a master’s degree and a Ph.D. in Industrial-Organizational Psychology from the University of Puerto Rico.
NOTABLE PAST PROJECTS

2014: THE QUEST—TULKOFF FOODS AND T.W. GARNER PROJECT
PROJECT: DEER REPELLENT FROM WASTE PRODUCT

YONI KOZLOWSKI
KENNY LOPEZ
MARK NATHANSON
ISA OPORTO
GRACE ZHANG

PROJECT SUMMARY

Our team worked with two clients in the food industry, both of which primarily produce condiments. Tulkoff Food Products Inc., based in Baltimore, Maryland, is recognized as one of the nation's largest food manufacturers of horseradish products. T.W. Garner Food Company, located in Winston-Salem, North Carolina, is known for manufacturing a diverse portfolio of food products, including Texas Pete hot sauce. Our two clients currently spend $36,000 a year to remove a combined 500 tons of byproduct waste and are interested in repurposing the waste to turn this cost into a profit. Our clients have hypothesized that their byproduct wastes could be effective as deer repellents. We were tasked with conducting further research to test this hypothesis. This consisted of field-testing the byproducts to measure their effectiveness as deer repellents and an industry analysis to determine whether there was a meaningful market for deer repellents.

CONTRIBUTIONS AND RECOMMENDATIONS

To determine whether our client byproducts were feasible deer repellents, we conducted field-testing using the byproducts as repellents. First, we chemically extracted the active ingredient from each by-product. We coated deer feed with the extract and set up test sites in a residential area known for significant deer browsing. Deer visit times and feed consumption at each repellent site were analyzed using recorded video footage. Both repellents performed as effectively as the leading commercial repellent (Liquid Fence) in deterring deer browsing. Meaningful feed consumption was found only at the test site with no repellent added. These test results demonstrated the feasibility of using both byproducts as deer repellents. Thus, we recommend that our clients pursue commercialization of their byproducts. In addition, market research indicated that there is an unmet need for deer repellents. Moving forward, we suggest that our clients conduct further field-testing to optimize repellent concentrations and delivery methods. We estimate a 3 to 5 million dollar annual revenue from our clients' expected repellent production.
Spectrum Foods is a poultry, meat, and food service distributor founded in 1989. Located in Landover, MD, the company mainly services average-to-low cost ethnic grocery stores, restaurants, and wholesalers in the Mid-Atlantic region. In recent years, Spectrum Foods has experienced exponential growth and generated upwards of $70 million in sales. Spectrum’s differentiating factors are flexibility, convenience, and an overall customer-oriented approach to business operations. Our client was looking to assess opportunities to optimize the capacity of their current warehouse. Our team’s primary goal has been to explore and determine the most feasible and effective methods for maximizing storage capacity and minimizing holding costs, both in the short- and long-term. Allowing for an increase in capacity would strategically position our client for future growth opportunities. Moreover, it would allow Spectrum Foods to reduce its internal and external holding costs, take on additional business, and lay the foundation for future expansion.

To position our client for continued growth, our team recommends the elimination of unprofitable items, the reduction of excess inventory levels, and the implementation of a racking system. Specifically, we recommend eliminating approximately 90% of the product offerings with monthly sales of under 5 cases per month and/or that generate under $50 per month in profits. In addition, we have compared each item’s average inventory holdings to an optimal level for that item, based on demand and variation in demand, and recommend a reduction in inventory levels for 62 product offerings. Lastly, our team has designed a racking system for the dry goods space of the warehouse which will add an additional 32 pallet spaces by early 2014. These three strategies together would result in a total annual opportunity cost savings of nearly $700,000.
NOTABLE PAST PROJECTS

2013: THE QUEST—UNILEVER PROJECT
PROJECT: OPTIMIZING OUTBOUND SHIPMENT PROCESS

MACKENZIE COOPER
ERIC HAMEL
ADITYA SRIDHAR
AARON TUCKER

PROJECT SUMMARY

Unilever is a British-Dutch multinational corporation behind many of the world’s most widely acknowledged consumer product brands collectively used by over 2 billion people daily. Among the extensive range of Unilever’s food brands, the Baltimore Spreads and Dressings Site is one of three facilities that manufactures popular spreads including Country Crock, Promise, and I Can’t Believe It’s Not Butter for distribution across the United States. Since the closure of a similar facility in Atlanta, Unilever Baltimore’s demand has increased by 40% from shipping 700 to 1000 pallets daily. Outbound shipment turnover time has consequently increased by 15% to 135 minutes. Due to limited warehouse capacity, additional inventory is interfering with inbound and outbound flow of goods which is detrimental to on-time delivery. In order to successfully meet demand, accommodate increased shipments, and boost dock schedule compliance, our team is tasked with reducing the average outbound shipment turnover time to 90 minutes.

CONTRIBUTIONS AND RECOMMENDATIONS

Through statistical analysis of loading durations and process mapping, our team concluded that shipments containing orders that request fewer cases than provided on a full pallet inflate average loading time by 50 minutes. We determined that individual partial pallet orders take three times longer to load than full pallet orders. Because partial pallets are consolidated in a reserved area of the warehouse through a process called Pick Line, we recommend that a partial order staging process occur so that loading partial orders entails the same process as full orders. In accordance with in-depth interview feedback from loaders and implementation trials, Pick Line 2.0 requires 4 additional casepickers and 2 additional forklift operator to stage all partial orders two shifts prior to truck arrival. Coordinated with our proposed rollout plan, stock replenishment process by prioritized SKUs, and implementation of 5S standards in a specified casepicking warehouse area, Unilever Baltimore would experience a 36% reduction in average shipment loading duration to 85 minutes. By freeing the dock schedule for an estimated 9 more trucks per day, this site can generate an additional $62 million in net sales within one year.
Revenue growth for companies can occur in two ways; organically, through product or service sales, and inorganically, through mergers & acquisitions (M&A) transactions. In M&A transactions, corporate valuation models are essential tools that help the involved parties make informed decisions. These models evaluate and predict the financial well-being of an entity that would result from a merger or acquisition. Current valuation techniques at ATK require the creation of a new model for each deal, and extensive training for them to be used effectively. This inefficient process can delay important decisions and create unnecessary workloads. In our project, we have created an intuitive model that integrates standardized information to output unique valuation metrics and summarizes important information for enhanced decision-making.

Contributions and Recommendations

We have developed a Microsoft Excel-based valuation model that analyzes financial information from the Bloomberg database. Following the input of standardized financial statements, which is as simple as copying and pasting information from Bloomberg, the model then integrates the information into prepared financial statements and valuation methods. Our model includes a comprehensive instructions page for new users and is color-coded for intuitiveness. We have also included an output page that graphically summarizes desired information using intuitive graphical tools and tables that can easily be copied into presentations for further discussion. Our model will allow our client to make more informed decisions about mergers & acquisition transactions in a faster and more effective manner.
NOTABLE PAST PROJECTS

2012: THE QUEST—TULKOFF FOODS PROJECT
PROJECT: PRODUCTION SCHEDULING

BECCA BROWN
SHIRLEY QIN
DAVID ROSEN
NEAL YAFFE
NICK YARAGHI

PROJECT SUMMARY

Tulkoff Food Products Inc. is a food manufacturing company, specializing in horseradish and garlic based sauces. Tulkoff Food Products Inc. serves a wide range of customers through the packing, retail, food service, and industrial markets. Tulkoff Food Products presented the need for an increase in output per unit time (efficiency) of their production process. Specifically, the team was asked to look into the production scheduling process as a possible source for increased efficiency. For one of their manufacturing lines, the team worked to formulate a scheduling algorithm that would decrease the amount of overall changeovers, maximize run sizes, and ultimately accomplish the goal of increasing efficiency. Through situational research, statistical analysis, and trial runs, we were able to formulate a plan for improvement and move Tulkoff Food Products in the direction of increased efficiency for the future.

CONTRIBUTIONS AND RECOMMENDATIONS

Based on research, the team discovered that Tulkoff Food Products currently produces 47% of their maximum theoretical output. The team also found that the average number of daily changeovers was extremely high. From this data, the team was able to analyze the high moving SKUs that were responsible for 75% of overall production. This information led the team to develop an algorithm that would allow Tulkoff Food Products to focus on creating days in which the High Moving SKUS would be produced with greater run sizes, leading to a decrease in overall changeovers. The algorithm suggests two days a week that are dedicated to high moving SKUS. Also, the implementation of forward thinking in scheduling allows Tulkoff Food Inc. to use current open inventory capacity to allow for more efficient scheduling and use of the production lines.
PROJECT SPONSORS

The companies below have made significant contributions to our students as they completed their capstone learning projects. In addition to financial contributions, these sponsors have given enormous amounts of time and thought leadership to our student teams.
QUEST would like to thank and acknowledge all of the individuals, committees, and organizations who have contributed to this event.

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Kelley McKutchin

**RIGGS ALUMNI CENTER**

Cassandra Klemish

**CATERING**

The Chef’s Table

**DESSERT**

Baked By Yael

**PHOTOGRAPHY**

Lisa Helfert

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