Industrial and Management Systems Engineering
Senior Capstone Projects
Spring 2018

Project A: Workflow Improvement of Pressing Department in Fishing Wader Manufacturing

Sponsor: Simms Fishing Products
177 Garden Drive, Bozeman MT 59718

Description: Simms Fishing Products is a fishing apparel company headquartered in Bozeman, MT. They specialize in GORE-TEX-lined fishing waders that are handmade in their Bozeman facilities and sold world-wide. The wader production process starts with a cutting operation that cuts fabric pieces out of rolls of fabric according to patterns. Subsets of these pieces are pressed together into components, and bundled into rolls that constitute four complete waders. The bundles move on to the sewing department, where the components are sewn together, and straps and buckles attached. From there, the waders move to attachment where the boots are bonded to the wader. After a water test to ensure quality, the waders are dried, packaged and either sent to inventory or mailed to a customer.

Production management sees opportunity in the pressing department for improved workflow and cycle time reduction. This department includes fabric pressing, laser cutting, fabric die clicker, sewing and bar tacker operations. The department has nine full-time employees working two overlapping shifts, and four part-time employees who work evenings, in addition to the area supervisor. The project entails evaluation of the cut parts inventory system, material and operator flow within the department, work sequence, workstation ergonomics and production control for mixed model production of waders. The project team is expected to evaluate options for work area layout and material flow, sequence of operations, management of work-in-process, ergonomic improvement, and quality assurance; then make recommendations that will produce a 25% reduction in cycle time and comparable reduction in operator travel distances.

Project B: Redesign of Food Bank Warehouse

Sponsor: Gallatin Valley Food Bank
602 Bond Street, Bozeman, MT 59715

Description: Gallatin Valley Food Bank is a food resource center serving the Gallatin Valley. It serves the underemployed, low income, and temporarily homeless

households as well as older adults living on fixed incomes, by providing free food staples donated by community members and area businesses. They serve 1,300 households per month on average from their current warehouse, which stores 150,000 pounds (or more) of produce, dairy products and dry goods. Most product is delivered in totes, and some on pallets or skid pallets. All of it must be weighed and sorted before being stocked. Dry goods are stored in pallets (product and dairy, which have a short shelf life, are fast movers and generally do not need to be stored in the warehouse; although there are two walk-in refrigerators where some produce and dairy is stored). Dry goods then move to a backstock area, and then to the store where clients self-pick items according to established policies. Due to growth in demand for services and increases in donations, they also store bulk dry goods in a satellite facility owned by the City of Bozeman.

Food Bank management would like the services of an Industrial and Management Systems Engineering Team to study their current warehousing operations, storage organization and strategy; and devise a material management system that will increase the efficiency of operations and minimize the number of moves of any given good. The key challenges in this project are that the Food Bank does not know what product will arrive at its receiving dock, and their warehouse inventory is seasonal; thus, inventory is highly variable in what product is in stock and in what quantities. The client would like low-cost recommendations on how to improve material management in the near-term as well as a longer-term proposal that could include more significant capital expenditures and/or facility expansion. Recommendations need to be supported by a cost-benefit or other economic analysis. Solutions could encompass warehouse layout, storage design, operations management planning, and standard procedures for key operations.

Project C: Improved Inventory Management for Local Distributor

Sponsor: Birddog Distributing, Inc.
1490 Harper Puckett Rd.
Bozeman, MT 59718

Description: Birddog Distributing is a distributor of decorative and accent lighting, bicycle engine kits and parts, and a line of garden markers. Inventory management of the approximately 2000 items they stock is challenging due to cyclical and fluctuating demand for many of the products, and the long order lead-times for replenishing product from overseas manufacturers.

The goal of this project is to reduce the occurrence of stockouts in the warehouse, because stockouts potentially mean a lost sales opportunity or reduced margins due to expedited shipping costs. The team would be expected to evaluate the current stockout rates; assess the current workflow for replenishing stock, filling customer orders, and updating electronic records; identify potential root causes for the areas of highest stockout

occurrence; and develop and test potential countermeasures to decrease stockout frequency. Possible reasons for stockouts include, but are not limited to: accuracy of computer inventory compared to physical inventory, lags in synchronization between sales channels, discrepancies between forecasted and realized demand, unexpected demand fluctuations, sub-optimized order quantities or safety-stock levels and errors related to data entry. Recommended solutions must be cost effective with a strong return-on-investment for the client, and be user-friendly for the various stakeholders who may be affected.

Project D: Efficiency Study of WIC Program Office

Sponsor: Gallatin City-County Health Department
215 W. Mendenhall
Bozeman, MT 59715

Description: The Women, Infants and Children (WIC) program is a federally funded support system for pregnant women and children up to five years of age who need financial assistance. The program provides health and nutrition education, health screenings, breastfeeding support and food vouchers for qualified women and families.

Locally, the program is administered by the Gallatin City-County Health Department. WIC program staff certify potential participants, conduct follow-up interviews, and provide educational programming. The main office in Bozeman operates five days per week. The MSU and Belgrade offices are open one day per week. Staff visit West Yellowstone approximately once per quarter. The staff of two full-time and two part-time certifiers, one counselor and an aid serve approximately 900 family units at any given time. Presently, the WIC program has a strategic goal to implement efficiency and quality improvements to their appointment systems and internal processes to increase WIC participation, improve services to clients and reduce staff stress. The program requests the services of an Industrial and Management Systems Engineering design team to build upon ongoing improvement efforts by conducting a current state assessment of existing processes and systems, devising improved ways of working, and conducting a trial intervention to test the team's recommendations.

The primary metrics of interest are the third-next-available appointment for new clients (currently at 27 days, target is 10 days to comply with federal requirements) and staff time required for certification appointments.

Project E: Revised Layout of Backpack Design and Manufacturing Operations

Sponsor: Mystery Ranch Backpacks
1750 Evergreen Park
Bozeman, MT 59715

Description: Mystery Ranch designs and manufactures packs and load carriage systems for military, hunting, fire-fighting and mountaineering customers. They currently lease ¾ of a 40,000ft² building which houses product development; prototyping and production operations; and marketing, purchasing and administrative offices. The company is considering purchasing the whole building and expanding into the additional 10,000 ft² of space because of current and future need for additional office and design/development space. In addition, they currently rent about 6,000 ft^2 of warehouse space in a separate, nearby building that the company would like to bring into the main building should a purchase be made.

Management would like to consider how to best use the acquired space, which could entail significant layout changes for the entire building. Due to multiple building additions in the past and the constraint imposed by the railroad line that runs next the property, oddly shaped spaces add to the challenge of creating an efficient layout. Management is open to ideas generated by the student team, subject to constraints; and is particularly interested in a feasibility and cost analysis of different options to help determine whether to purchase the building. The project would also inform decisions on how to manage the 30,000 ft² space they currently occupy based on the recommendations of utilizing the 10,000 ft² next door.

Goals: optimize flow of product and enhance communication between departments. Make the best use of the space, possibly including remodel recommendations.

Project F: Batch Optimization of Electro-Optic Assemblies for High Power Solid-State Lasers

Sponsor: Quantel USA
Bozeman, MT 59715

Description: Quantel USA manufactures high power solid-state lasers for industrial, medical, scientific and defense/security applications in Bozeman, Montana. Due to the nature of these markets their products

are built-to-order in a high-mix / low-volume manufacturing environment. The company strives for commonality in components in both design and build whenever possible in order to realize economies of production and logistics. But to fully utilize this commonality of lower-level subassemblies, production control needs to optimize build quantities to minimize waste by balancing the added labor for production setup with the added costs of non-moving inventory while accounting for constraints such as inventory space availability. The existing ERP software cascades material needs through the bill of materials hierarchies and combines orders for different end units, but it does not provide guidance on the size and timing of work order releases to the floor.

The overall goal of the project is to reduce labor costs by optimizing batch sizes and build processes for electro-optic (EO) assemblies. This project will likely include data collection to supplement client-supplied process information and processing times, analysis of historical data and manufacturing constraints for EO assemblies, and batch-size optimization.

The primary output of this project will be a tool that a production scheduler can use to determine optimum batch sizes for building EO assemblies based upon predetermined constraints. The team is expected to verify the tool's effectiveness, perhaps through computer simulation and/or economic analysis.

Project H: CIM Lab Enhancement through Computer Simulation and Machine Vision

Sponsor: Mechanical and Industrial Engineering Dept.
Montana State University

Description: The M&IE department will be purchasing a machine vision system for the robot cart in the Computer Integrated Manufacturing (CIM) Lab. Potential exists to learn machine vision as it applies to robot tasks, develop a demonstration of it, and develop and user test a laboratory experience for use in EIND 371.

Also, CIM Lab management would like to explore the possibility of a virtual simulation of the PLC-controlled conveyor for use in student labs. The team would research the potential of existing software owned by the department (such as Automation Studio and Technomatix), and then develop a simulation model of the conveyor system that can be programmed virtually in ladder logic.

Review the existing Robot laboratory exercises and documentation, propose improvements; and if approved, implement (and potentially user test) them.

Learn about automation safety technology as provided by Pilz. Install and test hardware. Develop documentation.
