Senior Capstone Projects
Spring 2016

Project A: Quality Improvement through Mistake-Proofing of Countertop Fabrication and Installation

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Description: Reliable Granite and Tile is a family-owned business that fabricates countertops from granite and stone slab in its fabrication shop located in the Bruce Industrial Park in Belgrade, MT. They are a full service company providing design, fabrication and installation services. Shop operations include wet cutting, reinforcement, and polishing.

The company is currently experiencing rework that is costing the company in excess of 10% of sales revenue in labor and materials. Many of the errors seem to stem from the information flow from sales through installation, though some may be the result of production methods. The project team is expected to analyze the current process from templating a new countertop through fabrication and inspection, conduct a root cause analysis of common errors, devise mistake-proofing measures to prevent recurrence of the errors, and assess their effectiveness through analysis and experimentation.

Team Members:

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Project B: Value Stream Improvement of Assembly and Inspection Operations for Commercial Aircraft Part Fabrication

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Description: Boeing's Helena facility fabricates key components for Boeing commercial aircraft. Among the most significant parts for this facility is upper and lower side of body chords, fabricated in left and right pairs. Side of body chords are large parts machined from a titanium casting to high precision, and are critical to aircraft function and safety as they are the main structural pieces that hold the wings on the aircraft body.

Boeing Helena is interested in having a team of industrial engineering students conduct a value stream improvement project for this production system, from the point of receiving the part back from the paint vendor through shipping. The goal of the project is to reduce production lead-time through enhanced material flow, work allocation and levelled pull production. Challenges include a balanced build plan across multiple work centers, accounting for multiple part numbers with differing process flows, optimal process design to enable efficient utilization of resources, and creating a scalable solution for anticipated rate increases. Project scope covers initial analysis of work to determine critical factors (build process, cycle time, process yield, work center layout, build plan, rework loops, etc.), generation and evaluation of design alternatives that accommodate requirements, and delivery of a detailed design of recommended solution(s) along with implementation plan of associated action items needed to fully realize the future state value stream within a 9-month time window.

Note: project requires students who have completed EIND 458 and who are able to travel to Helena several times during the semester. Students will need to complete Boeing's clearance process in order to acquire data from the facility.

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Project C: Integration of Robot Arms in the Computer Integrated Manufacturing Laboratory

Sponsor:

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Description: The Mechanical & Industrial Engineering (M&IE) department has recently procured two new industrial robot arms using student equipment fee allocation funds. One robot is on a Certified Education Robot Trainer cart while the other is stand-alone. The robots come with state-of-the-art robot programming and simulation software. The objective of this project is make the robots functional for the department for educating M&IE students in robotics for industrial applications. Specifically, this project will entail:

- Learning how to program the robots using the available software.
- Integrating the robots with the existing PLC-controlled conveyor system to enable communication between the robots and the PLC, and automated loading and unloading of conveyor pallets among other tasks. This must be done in a way that allows the CERT cart to be deployed easily to a classroom setting, and returned to the lab and seamlessly connected back to the PLC system.
- Development of a Robot Users Guide that documents the system architecture and has startup and other procedures as needed.
- Development of a demonstration program that can be shown to visitors to the department, with accompanying documentation to allow others to run the demonstration.
- Development of laboratory exercises for students to learn robot programming in a hands-on fashion, with accompanying documentation for deployment in Fall 2016.

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Project D: Inventory Management System and Workshop Layout for a Startup NC Machine Manufacturer

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Description:

Pocket NC is a Bozeman startup that designs and manufactures 5-axis desktop CNC milling machines (see: http://www.pocketnc.com). They recently ran a successful Kickstarter campaign, and currently have an order backlog of approximately 100 units, and an even larger number of people interested in pre-ordering units sometime in the near future. They have recently moved their operation from a garage to a commercial shop in preparation to ramp up production, and are in need of some industrial engineering help.

Fabrication of most components is outsourced to other vendors, some of which are local. In the shop, they fabricate several key components on a full-sized CNC mill, assemble the product, test it, and package it for shipping. The current production process involves about 5 hours of machining and 7 hours of assembly labor per unit. The BOM has approximately 350 items, many of which are fasteners.

The objective of the project is to design an inventory management system and workshop layout in order to sustain a production rate that will match the owners' projected demand over their planning horizon. The inventory management system must include a reliable method for replenishment, maintain sufficient stock to avoid halting production, and keep inventory holding costs to a minimum since storage space is limited. The system must also help the owners track internally fabricated parts which require external processing (e.g., anodizing) before final assembly. Ideally, the owners would like to be able to monitor inventory levels in such a way that physical counts are not necessary, and replenishment ordering is exceedingly simple and straightforward. The system should be scalable and easily re-configurable to accommodate increases in demand and product design changes. The project also includes a layout design for the shop that will accommodate material storage needs, facilitate material and personnel flow, and help realize the full potential of the envisioned inventory system.

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Project E: Productivity Improvement of a Small Part Production Process

Contact:
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Description: Autopilot is a local design and manufacturing company started 10 years ago by an MSU graduate. They desire a full value stream assessment of the production process for one of the high volume products they produce for one of their clients (current volume is approximately 300 units per day). The product starts with an extruded aluminum part, which is then machined, tumbled, anodized, laser etched, assembled and packaged. All of the steps are currently completed in-house, except for anodizing. Since Autopilot anticipates future business making products that follow a similar process, they are very interested in enhancements to the current production system that will improve labor productivity because those enhancements could have far-reaching effects.

The scope of the project is expected to include value stream mapping of the existing production process, from receiving to shipping; analysis of the current operation; proposal for a future state value stream design; and detailed proposals of the key changes needed to realize the future state. Proposed changes could range from shop layout and work allocation to inventory management and workstation redesign. The client is also open to capital investments if economically justifiable.

Team Members: