Portfolio for
Integrated Program/Project Management and Capstone Experience and Independent Undergraduate and Graduate Industry Projects

Preparing students for management, engineering , and technology practices through engaging in “real world” experiences has been the major focus of my efforts in conducting the **Integrated Program/Project Management and Capstone.**

Capstone experience includes engagement of students in real world projects performed on behalf of real world business and industrial clients. The capstone experience draws upon combinations of all the intended academic knowledge and skill outcomes. It integrates research, proposal development, and design experience based on the knowledge and skills acquired in earlier coursework. The capstone experience also incorporates standards and realistic constraints. To succeed in capstone , students must demonstrate professional competence through the accomplishment of work activities for business and industrial clients. They are required to collaborate as a team to apply their knowledge, think critically, and complete activities.

I also use other opportunities to engage students in business/industry projects. Since spring of 2010, teams of senior level and graduate students have been involved in conducting industry projects as part of individual study courses addressing client needs. **The following pages are the posters for some of the projects that were conducted during my service at North Dakota State University by students under my supervision.** Each poster summarizes project objectives, deliverables, project team members, and other relevant information .

Thanks for visiting this site,

Reza A. Maleki

Updated May 10, 2012

Aluminum Pneumatic Bulker (APB) Piping Supplier Analysis

Project Team Members: Alex Anderson, Mark Hendrickson, Michael Schnepf, Luisa Torres.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

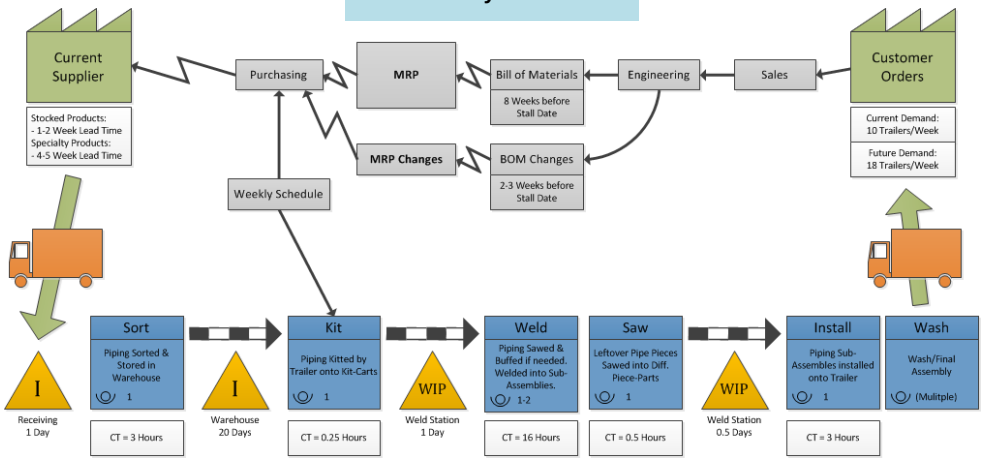
Project Objectives

- Explore opportunities to improve/replace current supplier
- Standardize APB piping through the reduction of design

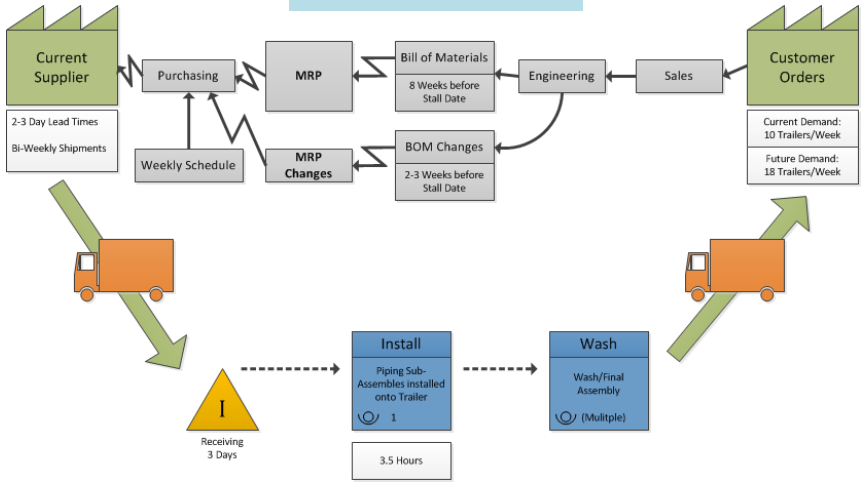
Project Team Deliverables

- Current piping system analysis
- Alternate piping system analysis
- Improvement proposals
- Recommendations based off of economic analysis
- Installation plan
- Recommendations for future projects/improvements

Current System VSM



Proposed System VSM



Recommendation

Alternate Piping Supplier and kitted piping parts

Potential Benefits

- Reduce piping inventory
- Reduce labor hours
- Welding capacity increased by 6 aluminum-welders per year
- Increased trailer throughput
- Decrease in floor space

Yearly Labor Savings	$476,000
Yearly Supplier Cost Increase	($300,000)
Total Savings/Year	$176,000

Reductions

Area	Current	Proposed
Production time	22.75 hours	3.5 hours
Production lead time	23.5 days	3.25 days
Floor space savings	800 sq-ft	400 sq-ft

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

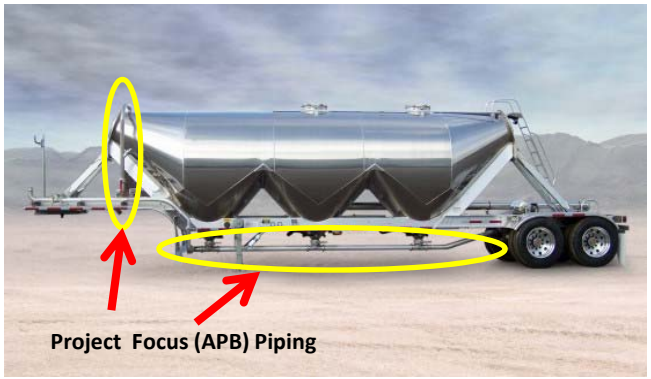
Aluminum Pneumatic Bulker (APB) Piping Supplier Analysis

Project Team Members: Andrew Berglund, Cory Trana, Aayush G. Chhetri, Jason McKeever.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

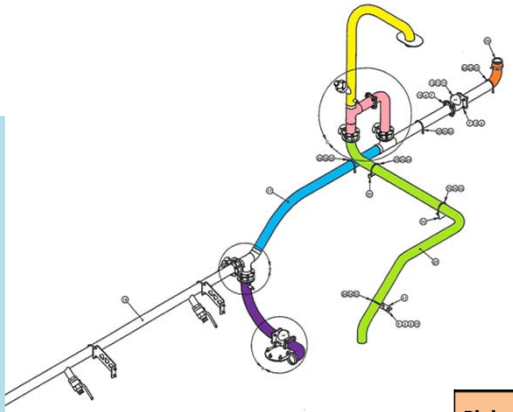


Project Focus (APB) Piping

Project Objective:

The purpose of this project is to study and standardize the APB piping through the reduction of design and specification variations. Also, explore an alternative piping supplier while evaluating their quality and availability benefits compared to current supplier

	Proposals		
Problems	Design Standardization	In-House Pipe Bending	Outsource Pipe Bending and Kitting
Piping Variations	✓		
Supplier Distance		✓	✓
Warehouse Space	✓		✓
Welding/Picking Times		✓	✓
Order Quantities		✓	✓



Programmable Pipe Bender

Deliverables:

- Documentation of current piping design variations.
- Development of standardized piping specifications and alternative piping suppliers.
- Economic analysis of standardized piping specifications and alternative piping suppliers.
- Documentation of economic benefits that may result from implementing proposed suggestions.
- An outline of recommendations for future projects and improvements.

	Economic Impact of Proposals ($)			
	Current Process	Design Standardization	In-House Pipe Bending	Outsourcing
Piping Cost	643	643	190	1,000
Labor Cost	8,092	8,092	8,342	7,675
Cost/Trailer	8,735	8,735	8,532	8,675
Savings/Trailer	-	-	203	60
Annual Saving 10 Trailers/Week	-	-	101,410	29,845
Annual Saving 18 Trailers/Week			182,538	53,721

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Integrated Program/Project Management and Capstone Experience

TRAIL KING industries

IMPROVING WAREHOUSE LAYOUT & MANAGEMENT

Project Team Members: Derek Anderson, Jie Chen, Shawn Kline, Shiyu Li.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

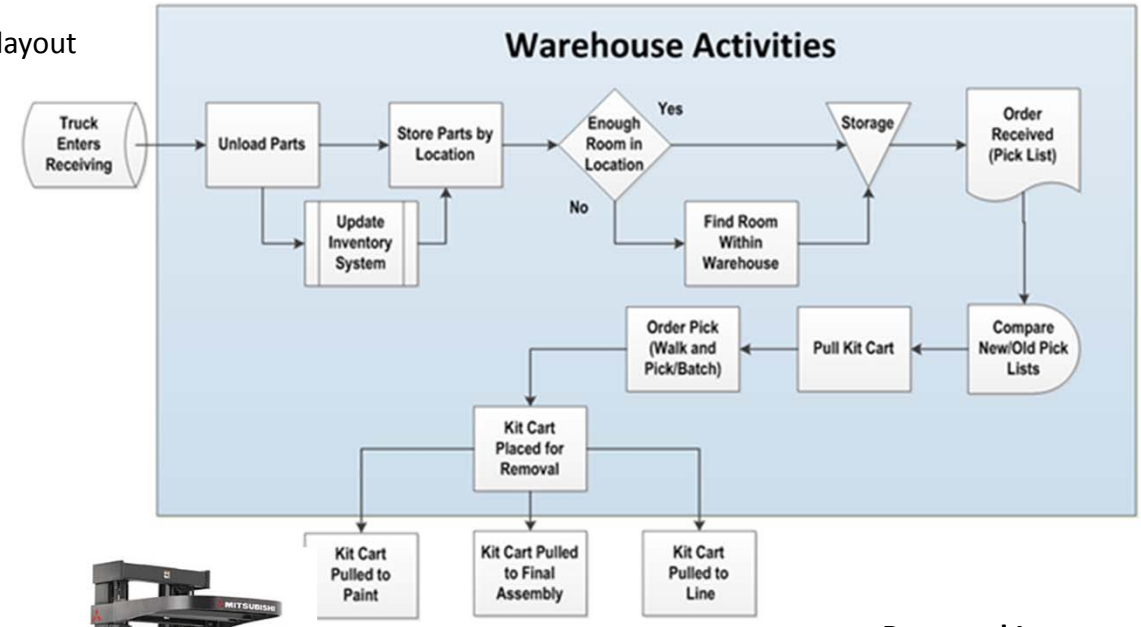
Research Project Objective

The project objective is to improve the utilization of the warehouse space by organizing parts and providing a new layout

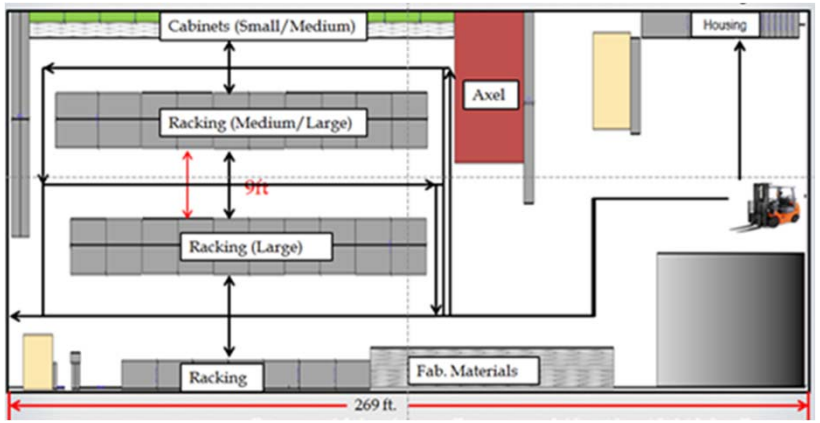
Deliverables

Documentation of current warehouse layout and information flow, economic analysis, Implementation plan, and future project recommendations.

		Solutions			
		New Facility Layout	Improved Shelving units	New Material Handling Equipment	Rearrangement of parts
Problems	Poor Utilization of racking space		★		★
	Storage of Excess inventory	★	★		★
	Inaccurate Location of parts		★		★
	Underutilization of warehouse area	★	★	★	★



Proposed Layout



Potential Benefits

- ❑ Reduced the warehouse footprint (~25%)
- ❑ High racking system utilization
- ❑ Accurate part location easy to pick up
- ❑ Availability to add an additional production line providing potential increased profits of $64,000 per week.

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Integrated Program/Project Management and Capstone Experience

Improving Warehouse Layout and Management

Project Team Members: Yiwei Han, Kyle Kramer, Fangzheng Yuan, Jonathon Thesing.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

Project Objective

Improve the productivity of Trail King's warehouse operations including layout, space utilization, information flow, and material handling

Deliverables

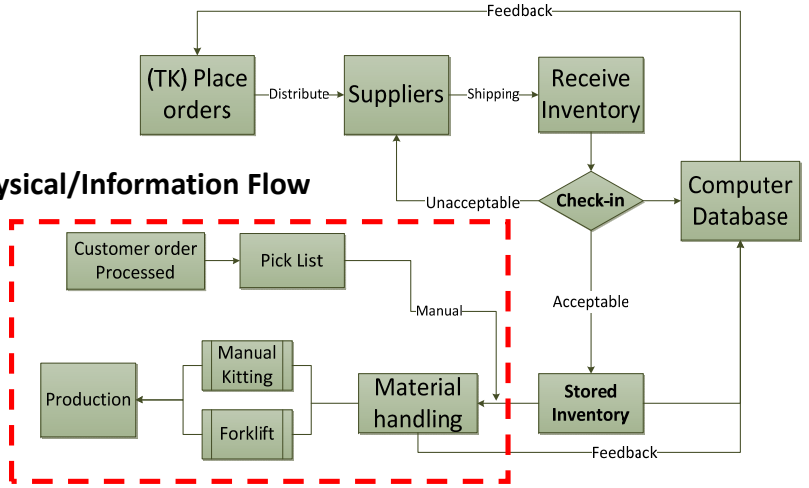
Documentation of:

- **Current warehouse operations**
- **Improved warehouse operations**
- **Cost savings**
- **Recommended procedure for implementation**

Problem/Proposal Matrix

Problems \ Proposals	Condense Storage Space	Narrow Aisle Lift Truck	Increase Rack Height	Combinations of Proposals
1. Material handling	√	√	√	√
2. Inventory Quantities	√			√
3. Storage System	√		√	√
4. Layout Design	√	√	√	√

Physical/Information Flow



Economic Analysis

Proposals	Description	Space Saving (ft^2)	Cost Avoidance
A	• Rearrange inventory and condense racking space • Reduce the total number of racks • Relocate office and dust collectors	1,398	$136,225
B	• Use narrow aisle life truck • Use narrow racking system • Relocate office and dust collectors	1,008	$ 13,025
AB	• Combination of proposal A and proposal B	2,118	$124,025
BC	• Combination of proposal B and proposal C	1,547	$61,665/ $64,036
ABC	• Combination of proposal A, proposal B, and proposal C**	2,488	$152,236/ $154,607
ABC+Dust Collectors + Office Pod	• Combination of Proposals A, B, C and the removal the dust collectors and office pod**	3,238	$81,089/ $83,469

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

TRAIL KING industries

Improving Pipe and Tube Storage and Handling

Project Team Members: Joshua Mangahas, Yongshin Park, David Rokenbrodt, Joseph Wolverton

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

Project Objective

The purpose of this project is to study, analyze, and document the current pipe and tube storage and handling process and develop proposals for improvements.

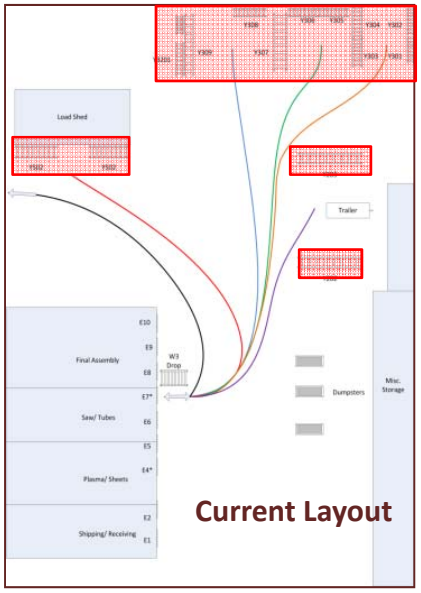
Project Team Deliverables

Documentation of

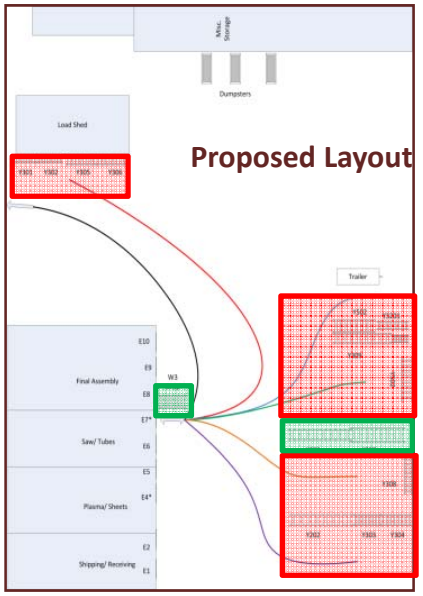
- Current Processes
- Process Improvements
- Labor and Space Savings
- Implementation Plan
- Outline for Future Projects

Multi-directional Forklift

	Move Current Racks	Add Labeling System	Adapt Current Racks	Information Timing	Bar and Tube Cart	Crane Attachment Device	Proposed Outdoor Layout
Space Not Fully Utilized	X		X		X		X
Generalized Stock Location System		X					X
Unprotected Storage			X				
Non-centralized Storage Locations Outside	X		X				X
No Specific Order for Cutting Parts				X			
Information Delay				X			
Hazardous Driving Conditions							X
Inefficient Material Handling Equipment					X	X	



Current Layout



Proposed Layout

Benefits

- Improved space utilization
- Reduce labor time
- Better material handling
- Improved information flow

Total Savings					
Space Savings (ft^2)	Space Savings ($)	Labor Savings / Year (hours)	Labor Savings/ Year($)	Cost to Implement($)	ROI (years)
4,000	400,000	350	9,625	$4,023	0.42

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Improving Pipe and Tube Storage and Handling

Project Team Members: Jared Comegys, K. R.Gayan Jayasinghe, Tyler Samuelson, Jordan Sharp, He'er Xi.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

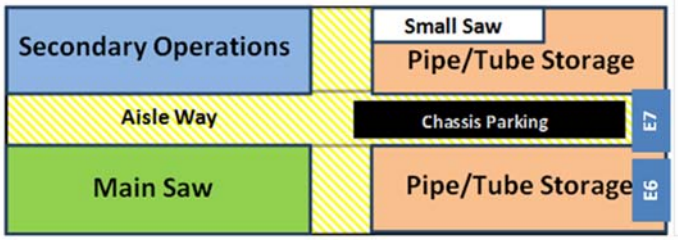
Funding Source: Trail King Industries

Project Objective

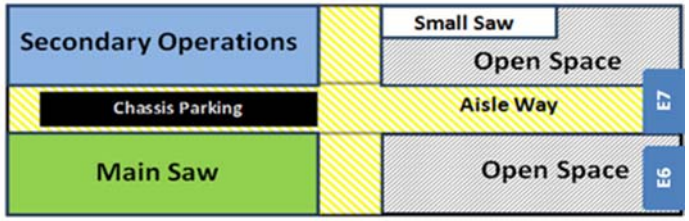
Study, analyze, and document the material handling, information flow, and develop a proposal for improvements.

Project Deliverables

- Understand the current processes
- Recommend ways to improve material handling/storage.
- Demonstrate economic benefits that may occur.
- Outlines procedures for implementing the proposal.



Current Layout



Proposed Layout

		Problems						
		Space Utilization	Handling Material	Material Location	Current Racking System	Lack of Information Flow	Saw Operator Utilization	Mobility
Proposed Idea	Sideloading Forklift	x	x		x		x	x
	Covered Shed	x		x				
	Cantilever Racks	x	x	x	x			x
	Material Handler		x		x	x	x	

Potential Benefits

- More floor space in the plant
- Reduce material damage
- Faster loading and delivering time
- More condensed storage and space utilization
- Reduce time waiting for material
- Increase saw operator utilization

Economic Analysis	
Initial Costs	$142,397
Annual Costs	$31,000
Annual Savings	$79,750
Payback Period	**2.92 yrs.**

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Paint System Throughput Improvement

Project Team Members: Andrew Dittus, Guangjing You, Rajat Pahwa, Sam Reinhardt.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

PROJECT OBJECTIVE

The purpose of this project is to study, analyze and provide documentation to improve the overall efficiency of the paint system.

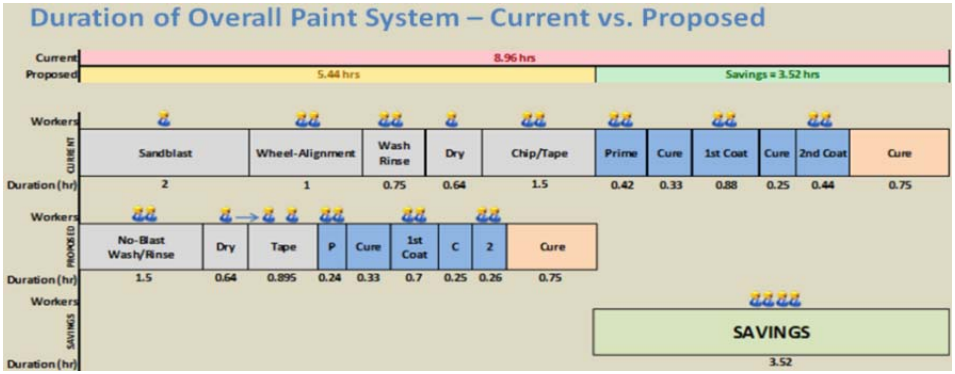
PROJECT DELIVERABLES

- **Documentation of the current system**
- **Documentation pertaining to research of paint system options**
- **Documentation of proposals with improvements to the paint system**
- **Documentation of cost and time savings Documentation outlining steps for implementing proposals**
- **An outline of recommendations for future improvements and projects**

	Problems \ Solutions	Eliminate Sandblast	Relocate Wheel Alignment	Install Hose Booms	Eliminate Current Wash Chemicals on Steel Trailers	Implement Madison Chemical No-Blast Technology	Install a Second Wash/Rinse	Welders Do Their Own Chipping	3M Dirt Trap Protection System	LPI LP5 3-Axis Mast Lift	Standardize 4 Main Colors	Install New Shelving	Utilization of Paint Pumps	Standardization
Prep	SandBlast	X				X								X
	Workers Climb Ladders	X				X								X
	Poor Lighting in Sandblast	X				X								X
	Location of the Wheel Alignment	X	X											X
	Hoses on the Floor				X		X							X
	Drip-Dry Rinse after Wash			X			X							X
	Chipping is done by Anyone							X						X
Paint	Workers Climb Ladders									X				X
	Lack of cleanliness in Paint Booth			X					X					X
	Lack of Paint Pump Utilization												X	X
	Lots of Colors to Choose From										X			X
	Lack of cleanliness in Paint Kitchen											X		X

	Current	Proposed	Difference
Trailers/Year	522	1,721	1,199
Materials Cost/Year	$49,543	$709,052	$659,509
Labor /Year	$177,866	$363,836	$185,970
Add. Worker Costs/Year	$0	$169,128	$169,128
Avg Profit/Trailer	$8,000	$8,000	0
Revenue/Year	$4,176,000	$13,768,000	$9,592,000
Profit/Year	**$3,948,591**	**$12,525,984**	**$8,577,393**

Potential Profits Resulting from Increased Throughput



Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Paint System Throughput Improvement

Project Team Members: Melissa Bartholomay, Duanjian Feng, Alex Hawkins, Eric Nelson.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

Project Objective:

Study and analyze the current paint system then develop proposals that will increase the paint system's throughput without major capital expenses

Deliverables:

Documentation of

- ❑ Current processes
- ❑ Layouts
- ❑ Proposals
- ❑ Cost savings of proposals
- ❑ Implementation plans
- ❑ Recommendation for future projects

Paint System Area		Problems
Prep	Pre-Wash	Poor method for removing weld splatter
	Masking	Poor method for masking trailer hubs
		Parts hanging process is inefficient
Paint		Poor lighting/ long paint inspection
		Low end solvent used to clean paint lines
General		Workers drifting into other areas

Proposal	Cost	Yearly Time Savings (hours)	Yearly Labor Savings	Payback Period (years)	Throughput Increase per week
Pneumatic Chipping Tool	$45	146	$4,010	0.011	1 trailer
Standardized Paint Rack	$3,185	176	$4,840	0.66	1 trailer
Bag Hub Masking	$1,500	390	$10,700	0.14	4 trailers
Inspection Lighting	$380	87.5	$2,406	0.15	1 trailer
Cost Avoidance and Throughput Increase Resulting from Standardize Work Schedule			$1,815,000		17

Summary of Economic Analysis

Summary of Recommendations
☐ Better Tools for Removing Splatter
☐ Standardized Cart Configuration
☐ Better Method for Masking Hubs
☐ Improve Lighting in Paint Booth
☐ New Solvent for Paint Lines
☐ Standardized Work Schedule

Potential Benefits:

- ❑ Ergonomically sound working methods
- ❑ Time and labor savings
- ❑ Increased throughput
- ❑ Reduced material handling
- ❑ Higher quality paint job
- ❑ Organized job assignment and schedule

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Analysis of Proposals for Dedicated Production Centers

Project Team Members: Devin A. Kasper, Akash Satija, Jingfeng Tan, Joe Zimmerman.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

PROJECT OBJECTIVE

The purpose of this project is to study, analyze and document proposals which can more efficiently utilize plant floor space through the implementation of target production centers in coordination with the Mitchell, South Dakota plant.

TEAM DELIVERABLES

Documentation of current production system, target products identification, economic benefits, steps for implementation

Production Shifting		
	West Fargo	Mitchell
I-Beams	← Produced	
Axles	← Assembled	
Tires	Mounted →	

Comparison of Reutilization Alternatives			
Free up Axle assembly & I-Beam production areas		Free up axle assembly area & install weld stations	
Advantages	Low overhead	Advantages	Increases production & profit
	Large cost avoidance		Short payback period
Disadvantages	No additional production	Disadvantages	High overhead
	Requires future reutilization		Line rebalancing & bottlenecks

Potential Benefits from Freeing-up Axle Area and Installing Weld Stations in the I-Beam Area.

- Increases production & Profit
- Freed-up Floor Space
- $32,000/week increased profit
- 3 weeks Payback Period

Number of Shipments, I-Beam vs. Axle Bi-Weekly Demand

I-Beams								
0	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7
1	2.7	3.0	3.3	3.6	3.8	4.1	4.4	4.7
2	2.7	3.0	3.3	3.6	3.8	4.2	4.5	4.8
3	2.7	3.0	3.3	3.6	3.8	4.2	4.5	4.8
4	2.8	3.1	3.3	3.6	3.9	4.2	4.5	4.8
5	2.8	3.1	3.4	3.7	3.9	4.3	4.6	4.8
6	2.8	3.1	3.4	3.7	3.9	4.3	4.6	4.9
7	2.8	3.1	3.4	3.7	4.0	4.3	4.6	4.9
8	2.9	3.2	3.5	3.8	4.0	4.3	4.6	4.9
9	2.9	3.2	3.5	3.8	4.0	4.4	4.7	5.0
10	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0
11	3.0	3.3	3.6	3.8	4.1	4.4	4.7	5.0
12	3.0	3.3	3.6	3.9	4.1	4.5	4.8	5.1
13	3.0	3.3	3.6	3.9	4.1	4.5	4.8	5.1
14	3.1	3.3	3.6	3.9	4.2	4.5	4.8	5.1
15	3.1	3.4	3.7	4.0	4.2	4.6	4.8	5.1
16	3.1	3.4	3.7	4.0	4.2	4.6	4.9	5.2
17	3.1	3.4	3.7	4.0	4.3	4.6	4.9	5.2
18	3.2	3.5	3.8	4.1	4.3	4.6	4.9	5.2
19	3.2	3.5	3.8	4.1	4.3	4.7	5.0	5.3
20	3.2	3.5	3.8	4.1	4.3	4.7	5.0	5.3
21	3.3	3.6	3.8	4.1	4.4	4.7	5.0	5.3
22	3.3	3.6	3.9	4.2	4.4	4.8	5.0	5.3
23	3.3	3.6	3.9	4.2	4.4	4.8	5.1	5.4
24	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4
25	3.4	3.7	4.0	4.3	4.5	4.8	5.1	5.4
26	3.4	3.7	4.0	4.3	4.5	4.9	5.2	5.5
27	3.4	3.7	4.0	4.3	4.5	4.9	5.2	5.5
28	3.5	3.8	4.0	4.3	4.6	4.9	5.2	5.5
29	3.5	3.8	4.1	4.4	4.6	5.0	5.3	5.5
30	3.5	3.8	4.1	4.4	4.6	5.0	5.3	5.6
	90	100	110	120	128	140	150	160
	Axles							

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

TRAIL KING industries

Analysis of Proposals for Dedicated Production Centers

Project Team Members: Justin Bahm, Tyler Johnson, Hanzhe Li, Christian Mocchi.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

PROJECT OBJECTIVE:

Analyze the costs and benefits associated with dedicating the production of target components

DELIVERABLES:

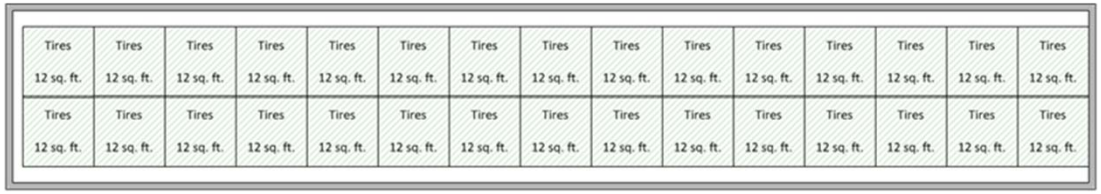
Documentation of:

- ❑ Current layout and processes
- ❑ Identification of target components
- ❑ Proposed layout reflecting utilization of production centers
- ❑ Proposed transportation methods
- ❑ Economic analysis
- ❑ Implementation plan
- ❑ Recommendations for future improvements

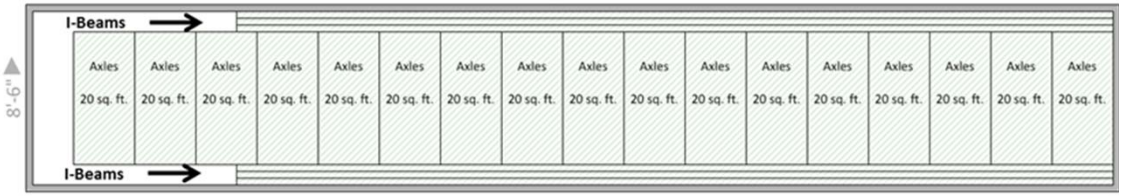
RECOMMENDATIONS

- ❑ Expand APB production – West Fargo
- ❑ Aluminum machining center – West Fargo
- ❑ Small steel part production – Mitchell
- ❑ Reduce shipping costs by using suppliers
- ❑ Outsource axle assembly

West Fargo's Shipment to Mitchell Plant



Mitchell Facility's Shipment to West Fargo Facility



Item	Fixed Benefit (Cost) ($)	Annual Benefit (Cost) ($)
Labor Reduction - Axles	-	8,800
Labor Reduction - I-Beams	-	34,375
Shipping - Material Handling	-	(5,500)
Shipping - Fixtures	(11,400)	-
Transportation*	(150,000)	(130,375)
Shipping Cost Avoidance	-	255,200
Shipping Components to Mitchell	-	(50,000)
Equipment Removal	(25,000)	-
Total	**(186,400)**	**112,500**
Space Saved	**3875 ft²**	

* Estimated 60,000 miles/year

Payback period: $\frac{\textit{Total Fixed Cost}}{\textit{Annual Savings}} = \frac{186{,}400}{112{,}500} \approx 1.7$ years

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Improving In-House Belt Manufacturing and Analysis for Outsourcing

Project Team Members: Tucker Richardson, Hanxiao Tian, Patrick Whelan, Aaron Woytcke.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries

Project Objective

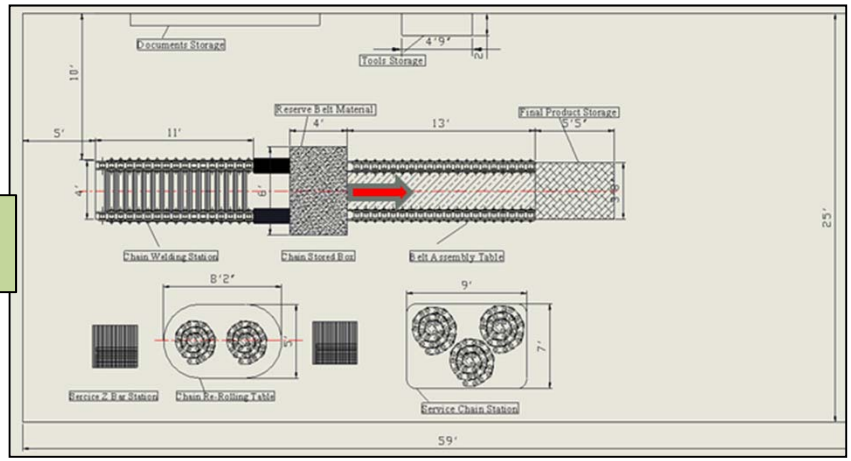
Develop proposals that can help with improved belt manufacturing including processes and layouts. This project also includes studies of potential outsourcing of belt manufacturing.

Project Team Deliverables: Documentation of:

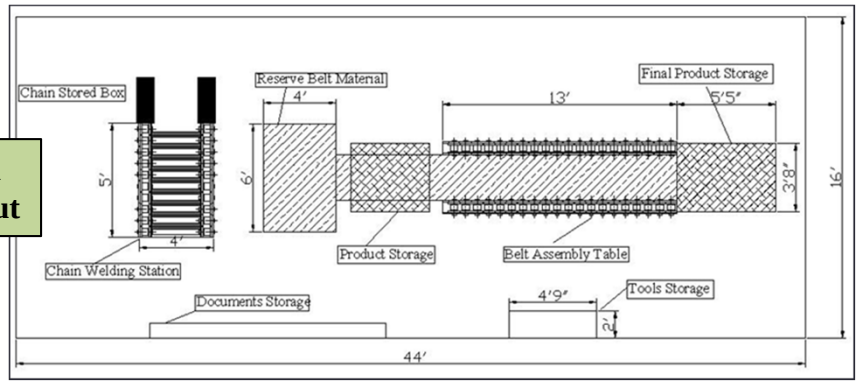
- current processes and layout
- proposals for improved process and layout
- outsourcing potential
- economic analysis
- Implementation of new processes and layouts

Problems \ Solutions	Shorter Chain Table	Adjustable Chain Table	Pre-Punched Z-bars	Z-bar Rack	Table Separation	Eliminate Extra Fixtures	New Drill Fixture
Manual Chain Rolling					X	X	
Multiple Fixtures Transportation		X				X	
Z-bar Stack				X			
Fixed Chain Width		X				X	
Unreliable Drills			X				X
Secondary Manual Countersinks							X
Need for Metal Drilling			X				X
Excessive Walking for Welders	X	X		X		X	

Current Layout



Proposed New Layout



Benefits Summary	
Time Saved/Belt	38.21 min
Savings per year	$15,417.30
Payback Period	2.59 Years
Potential Throughput Increase	> 100%
Space Saved	665 Sq. Ft. (45%)

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

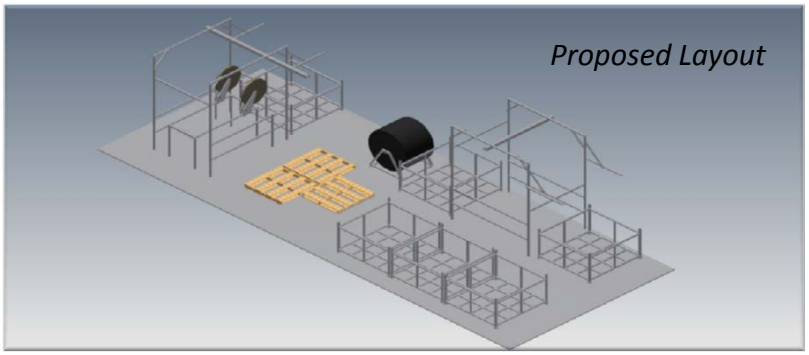
Improving In-House Belt Manufacturing and Analysis for Outsourcing

Project Team Members: Thomas Schantz, Ryan Tapper, Kathryn Whelan, Yang Yang.

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Trail King Industries



Project Objectives

- Improve processes and equipment
- Analyze feasibility of outsourcing

Team Deliverables

- Documentation of current process
- Economic analysis
- Recommendations
- Implementation Plan
- Future Recommendations

	Time Per Belt (hr.)	Avg. $ Per Belt	Total $ Per Yr.
Current Process	4.24	$350	$53,533
Proposed Process	2.63	$217	$33,188
Savings	**1.61**	**$133**	**$20,345**

$$Payback\ period = \frac{Initial\ Cost}{Yearly\ Savings} = \frac{\$30{,}447}{\$20{,}345} \cong 1.5\ years$$

Solutions \ Problems	Inadequate Equipment	Inadequate Layout	Material Flow	Ergonomics
Resdesign of Belt/Chain Fixtures	X			
New Work-Cell Layout		X	X	
In-house Logistics Improvements	X		X	
Adjustable Equipment	X	X		X

Summary of Potential Benefits

- Reduced footprint by 31%
- Decreased process time by 1.61 hr./belt
- Improved ergonomics
- Decreased material movement

Spring Semester 2012

Integrated Program/Project Management and Capstone Experience

Analysis and Selection of Food Packaging and Seasoning Equipment

Project Team Members: Vaibhav Biradar..

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

Funding Source: Giant Snacks

Project Research Objective

To develop proposals that can help with improved throughput of the packaging equipment used in the facility.

Deliverables

- Documentation and analysis of current processes including information flow, facility layout, and processes lead times.
- Documentation of requirements for improving the throughput of packaging equipment.
- Documentation of economic benefits.

Productivity Improvement of Packaging Machine

- Extra weighing bucket can reduce the cleaning and washing time.
- Industrial washer can reduce washing time and help to increase production.
- Improved production planning can increase the production rate.
- Various combinations of linear and main feed parameters (amplitude and time) may help to increase efficiency and hence productivity.
- Upfront calculation of packaging time can help with better scheduling and improved throughput.
- Reducing setup time will increase the production rate.
- Continuous supply of seeds can increase machine utilization and improve productivity.

Three (3) Major Opportunities for Productivity Improvement

- Extra packaging machine buckets for select machines.
- New Industrial washer and dryer.
- New production planning to reduce setup time.

	New Buckets	Industrial Parts washer	New Production Schedule
Initial Investment	$23,000	$5,200	$1,572
Operating Cost	0	0	0
Production Hours (per week per machine)			
AS IS Production Hours	80	80	80
Actual Production Hours	68	68	68
Improved Production Hours	74	74	72
Increase in Production Hours	6	6	6
% increase Production Hours	8%	8%	8%
Labor Hours (per week per machine)			
AS IS Labor Hours	160	160	160
Improved Labor Hours	160	148	154
Labor Hours Saving	0	12	12
% labor Hours Saving	0%	8%	8%
$ Labor Savings (per week)	0	$720	720
Production (per week single machine)			
Average Production per Minute	40	40	40
Increase in Production	14,400	14,400	14,400
Profit Margin	$0.10	$0.10	$0.10
Profit due to INCRESED Production	$1,440.00	$1,440.00	$1,440.00
Benefit per Week	$2,880	$4,320	$2,160
Payback Period (weeks)	7.99	1.20	0.73

Summer Session 2011

Individual Study Design Research Project

Improving Allocation of SKUs to Distribution Centers

Project Team Members: Vaibhav Biradar..

Faculty Advisor and Consultant: Reza Maleki

Department: Industrial and Manufacturing Engineering

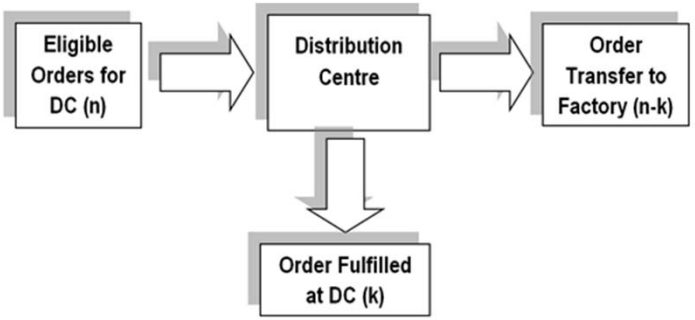
Funding Source: Giant Snacks

Research Project Objective

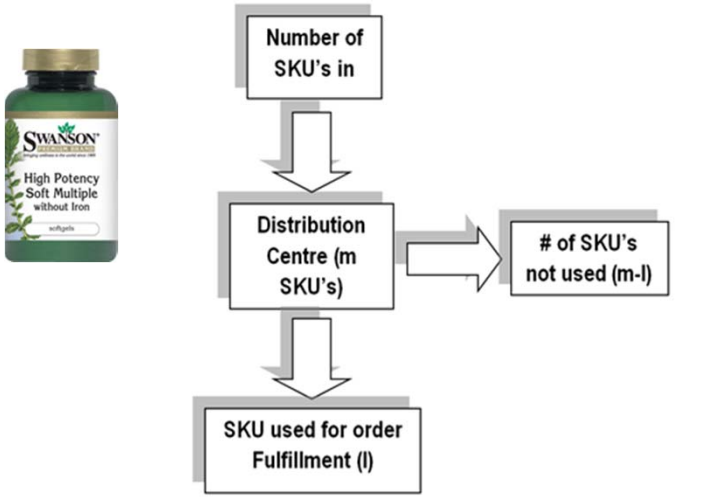
The purpose of this project is to assist with developing proposals for allocating the SKUs to Harrisburg and Sparks centers so they can achieve the SHP's goal of meeting the target percentage for processing and shipping "complete" orders to customers in their regions.

Deliverables

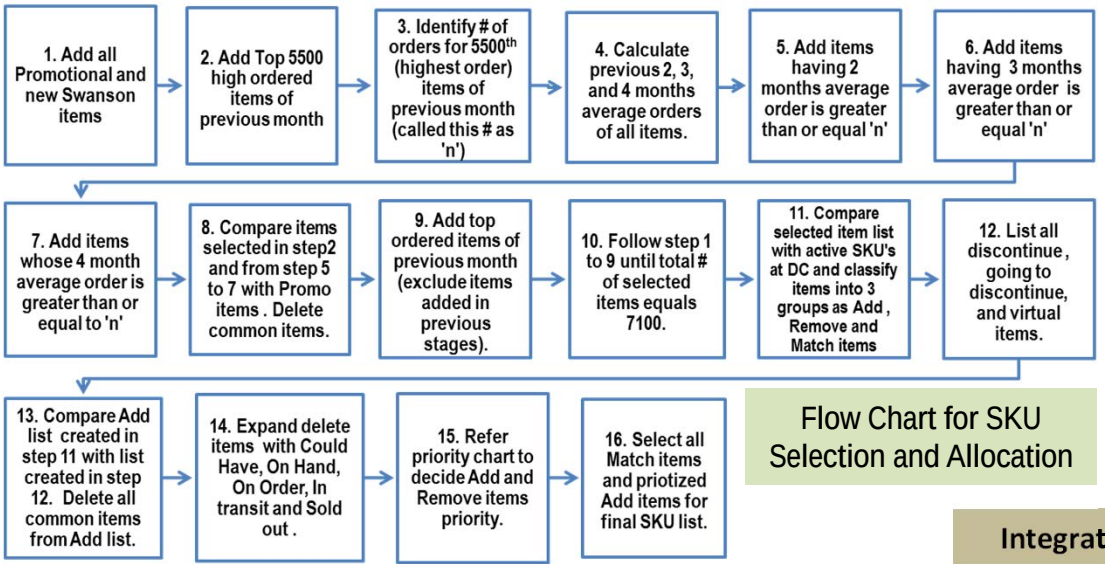
- ❑ Documentation and analysis of current orders from customers that are targeted to be served by the Harrisburg and Sparks "centers."
- ❑ Documentation and analysis of SKUs allocated to the centers.
- ❑ Documentation of proposals that can help with improved allocation of SKUs to the centers.



Flow chart for order fulfillment by Eligible Distribution



Flow chart for Number of SKU used in Eligible Distribution Centre



Flow Chart for SKU Selection and Allocation

Fall Semester 2011

Integrated Program/Project Management and Capstone Experience

Process Emission Analysis

Project Team Members: Kirsten Kelly, Chance Krom, Tom Swenson , Jianchao Xiao

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

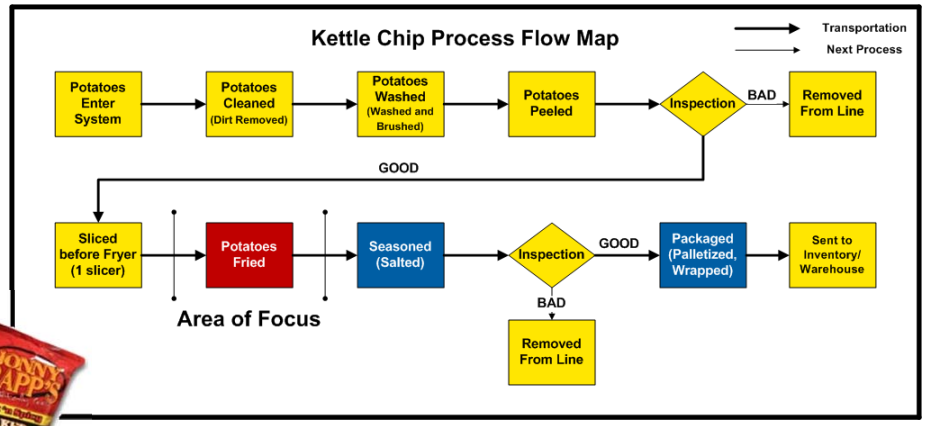
Funding Source: Barrel O' Fun

Research Project Objective

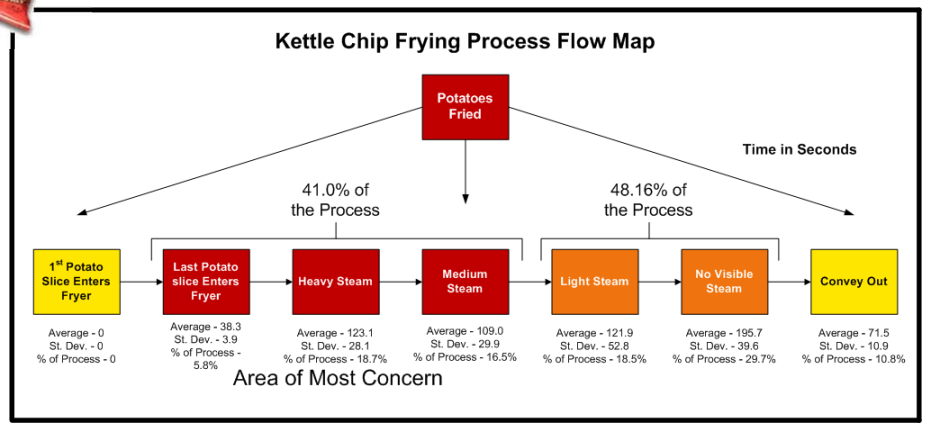
The purpose of this project is to study, document, and analyze the facility's frying process emissions, as well as calculate the current emission levels for a typical day of production

Deliverables

- Documentation of:
  - Research on Clean Air Act and MPCA Standards and Regulations
  - Frying Processes That Use Oil (Flow Charts)
  - Traditional Potato Chips
  - Tortilla Corn Chips
  - Kettle-Cooked Potato Chips
  - Calculations of Current Emission Levels
- Recommendation for Acquiring Air Permit



Flow Charts of Kettle-Cooked Frying Processes



Project Activities

- Researched Particulate Matter Emissions PM-10 & 2.5 for Frying Process.
- Documented the Barrel O' Funs Frying Processes and Estimated a Typical Day of Emissions
- Analyzed Other Filtration Systems to Reduce Emissions in Future
  - Scrubbers
  - Mist-Eliminators
  - Impingement Devices

Pollutant	Total Facility PTE* Thresholds (tons per year)	
	Federal	State
PM10	100	25
PM2.5	100	100

Federal and Minnesota Pollution Control Agency's Potential to Emit (PTE) Threshold for a Facility

Project Results

The results show that Barrel O' Fun's meets state and federal requirements for process emission.

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

Packaging Line Layout and Labor Analysis

Project Team Members: Reece Bunnell, Patrick Jenkins, Matthew Lanoue, Cuiyuan Lu, Simon Deng

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Barrel O' Fun

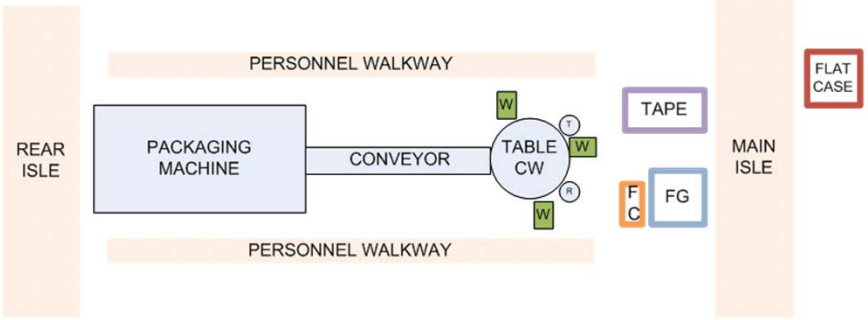
Project Objectives:

- Observe and document current layout and labor practices
- Establish packaging and layout standards

Project Deliverables:

- Documentation of current system
- Proposal of improvements
- Economic analysis

		Solutions		
		Time Standards Matrix	Standardized Layout	Set-up Reduction Team
Opportunities	Standardization of Packaging Rates	✓		
	Production Scheduling Optimization	✓		
	Packaging System Layout		✓	
	Minimization of Packaging Donwtimes			✓



Proposed Standardized Layout

Proposed Standardized Machine Output Rates (Bags/Min)

3 Workers	Bag Size (weight in ounces)													
Bags per Case	1	1.5	2	2.13	5	5.3	7	8	9	10	11	13	14	16
8	100	100	100	100	70	70	60	60	50	50	50	45	40	40
9	100	100	100	100	70	70	60	60	50	50	50	45	40	40
10	100	100	100	100	70	70	60	60	50	50	50	45	45	40
12	100	100	100	100	70	70	60	60	50	50	50	45	45	40
14	110	110	110	110	75	75	65	65	55	55	55	50	50	45
15	110	110	110	110	75	75	65	65	55	55	55	50	50	45
24	110	110	110	110	80	80	70	70	60	60	60	50	50	45
60	110	110	110	110	80	80	70	70	60	60	60	50	50	45
72	110	110	110	110	80	80	70	70	60	60	60	50	50	45

Proposed Profit of Packaging System Production ($/min)

Line Workers Bags/Min	Bag Weight (oz.)	Bags/Case	lbs/min	Profit/Min 2008	2009	2010
80	1.5	60	7.50	$ 12.60	$ 13.28	$ 13.50
50	5	14	15.63	$ 26.25	$ 27.66	$ 28.13
40	7	12	17.50	$ 29.40	$ 30.98	$ 31.50
40	8	10	20.00	$ 33.60	$ 35.40	$ 36.00
35	9	12	19.69	$ 33.08	$ 34.85	$ 35.44
35	10	12	21.88	$ 36.75	$ 38.72	$ 39.38
35	11	12	24.06	$ 40.43	$ 42.59	$ 43.31
30	13	12	24.38	$ 40.95	$ 43.14	$ 43.88
25	14	8	21.88	$ 36.75	$ 38.72	$ 39.38
25	16	9	25.00	$ 42.00	$ 44.25	$ 45.00
			Sum	$ 331.80	$ 349.58	$ 355.50

Potential Benefits:

- More consistent and predictable packaging rates
- Improved production planning
- Increase in throughput

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

Improve Seasoning Line Capacity Through Setup Reduction

Project Team Members: Andrew Lembcke, Xing Zhuang, Shuang Shi, Andy Ryan

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Barrel O' Fun

Project Objectives:

- Study, document and analyze current setup procedures
- Improve Seasoning line capacity

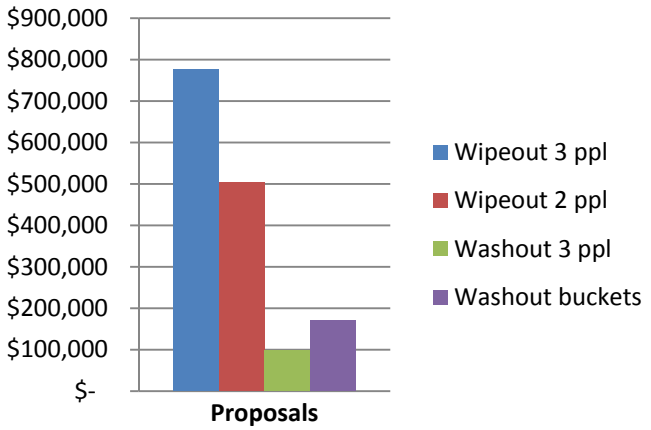
Team Deliverables:

- Documentation of current setup procedures
- Documentation of proposed setup procedures
- Documentation of cost savings
- Recommendations for future projects and improvements

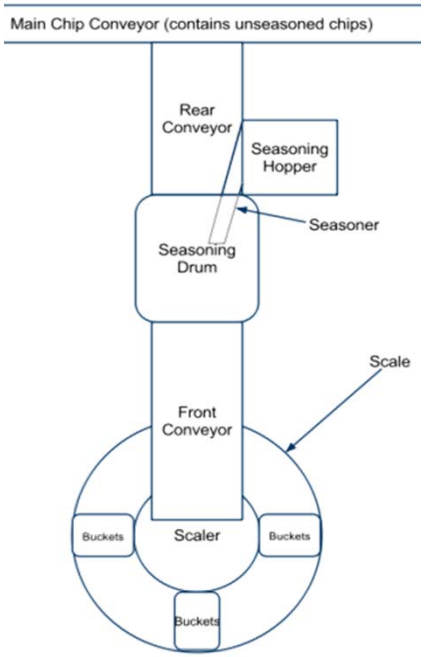
Project Activities:

Researched and developed improved setup processes

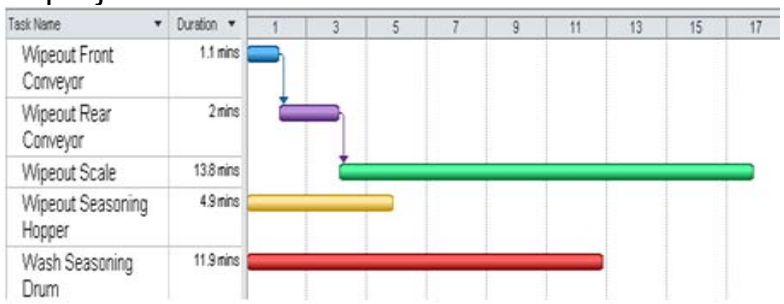
Potential Profit Gain



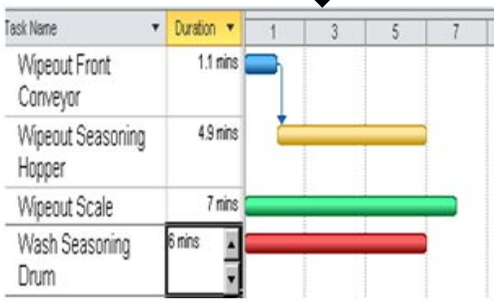
Seasoning Line Layout:



Current Wipeout Times:



Proposed Wipeout Times:



Project Benefits:

- Capacity increase for traditional and kettle chip seasoning lines
- Potential Profit gain
- Labor savings
- Improved utilization of resources

Original Critical Path Time(minutes)	17.00
New Critical Path Time(minutes)	7.00
Time Savings(minutes)	10.00
% of Time Saved (minutes)	59%

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

Tugger Cart Logistics

Project Team Members: Prabesh Joshi, Yaquan Wang, Jason McDonald, Felicity Lunden, Kyle Rolfsrud

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Case New Holland

Project Objective:

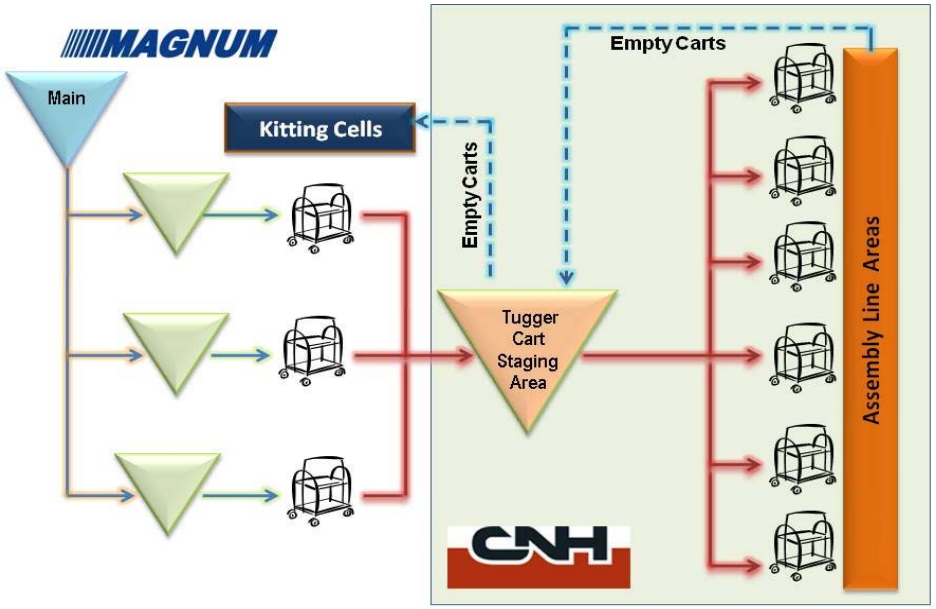
The purpose of this project is to study, analyze, and document proposals for improved tugger cart logistic

Deliverables:

- Document current tugger cart flow
- Identify problems in the system
- Document proposals to improve tugger cart logistic
- Document economic benefits
- Outline recommendations for future projects and i

Proposals:

- Implement CNH Labor Scheduling at Mangum
- Implement Inventory Tracking System
- Staging Area Organization
- Follow designated CNH Routes
- Universal Cart Connection



Economic Analysis

	Proposal #1	Proposal #2	Proposal #3	Proposal #4	Proposal #5
Profit	NA	NA	$ 15,714	$ 2,946.30	$ 11,460
Cost	NA	$ 5,080.88	NA	$ 450	$ 0
Total	NA	$-5,080.88	$15,714	$ 2,496.30	$ 11,460

Potential Benefits:

- Better employee utilization
- Better communication
- More room in the staging area
- More reliable cart connections
- Large amounts of time and money saved

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

Boeing 777F Roller Tray Assembly Line Design

Project Team Members: Marcus Bruhn, Lindsey Hermanson, Katie Roesler, Rob Strand, Chris Winning

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Goodrich

Project Objectives

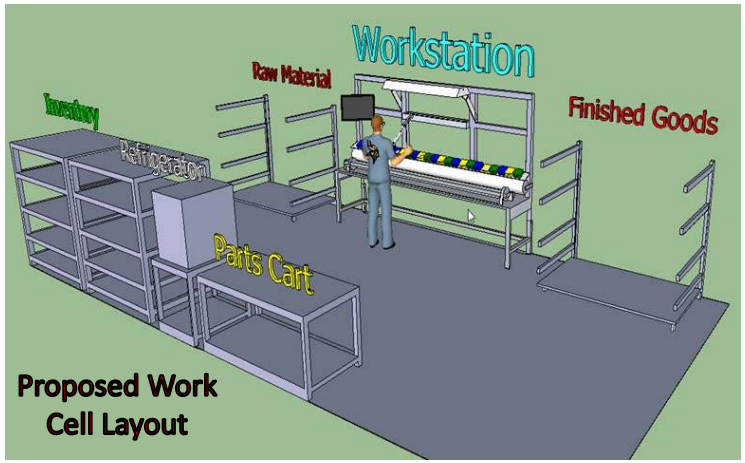
Develop an assembly line that:

- ❑ **Supports TAKT Time**
- ❑ **Increases Labor Efficiency**
- ❑ **Improves Ergonomics**
- ❑ **Provides Visual Controls that Highlight Production Issue**

Team Deliverables

Documentation of:

- ❑ **Current Assembly Line**
- ❑ **Proposed Solutions**
- ❑ **Cost and Time Savings from Proposed Solutions**
- ❑ **Implementation Plan**
- ❑ **Recommendations**

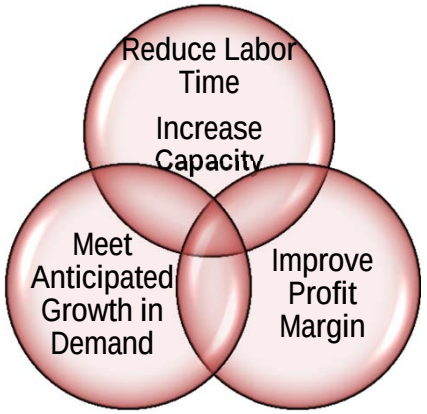


Proposed Work Cell Layout

Proposed Solutions

1. **Electronic Display for IP/SWIs**
2. **Ergonomic Tool Arm**
3. **Improved Work Cell Layout**
4. **Improved Workstation Design**
5. **Component Placement Display**
6. **Sealant Application**
7. **Cycle Time Reduction**

System Metrics	Current	Proposal #1	Proposal #2	Proposal #2 Rev 1
Throughput/Day	10	18-20	16-18	23-26
WIP Cart	Yes	No	Yes	Yes
# of Workstations	2	1	2	2
Square Feet Consumed	400	245.5	400	400
# of Workers	1	1	1	2
Labor Cost/Day	$172.80	$172.80	$172.80	$345.60
Revenue/Day	$20K	$36K-$40K	$32K-$36K	$46K-$52K



Project Benefits

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

GOODRICH

Paint Line Analysis

Project Team Members: Jeff Schmaltz, Lars Peterson, Zach Bullinger, Conor Herron, Baird Cuppy

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Goodrich

Project Objective:

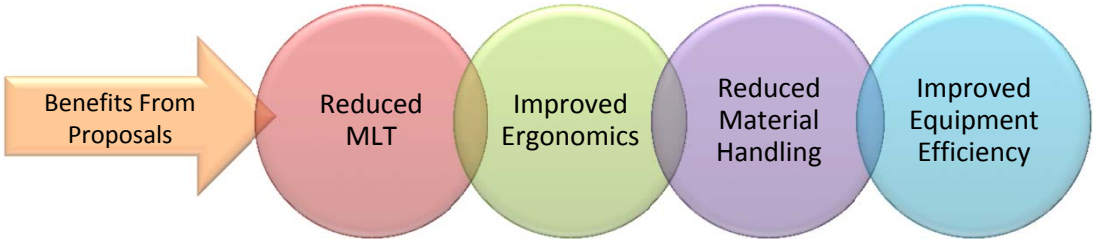
Improve the efficiency and use of the paint line

Deliverables:

- Document current paint line operations
- Document researched paint system options
- Recommend proposals to improve the paint line
- Document potential economic benefits from proposals
- Develop a phased installation plan
- Recommended future projects and improvements

Proposals:

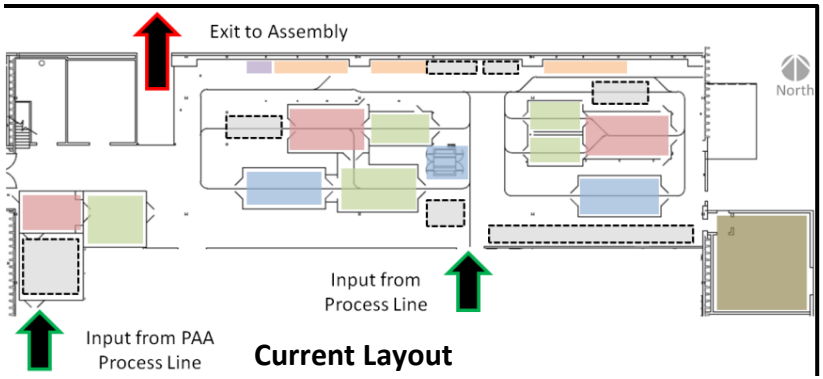
- Redesigned Facility Layout
- New Curing Ovens
- Color Coded PAA Paint Booth
- Ergonomic Material Handling Carts
- New Ergonomic Work Stations
- Color Coded Prep Work Instruction
- Multi Axis Tape Dispensers



Process	Current/ Proposed	Mfg. Lead Time (hr/batch.)	Savings	
			Hours	Percentage
1	Current	7.17	0.99	14%
	Proposed	6.18		
2	Current	20.37	3.36	16%
	Proposed	17.01		
3	Current	43.28	3.87	9%
	Proposed	39.41		
4	Current	55.49	7.44	13%
	Proposed	48.05		
		Average	3.92	13%

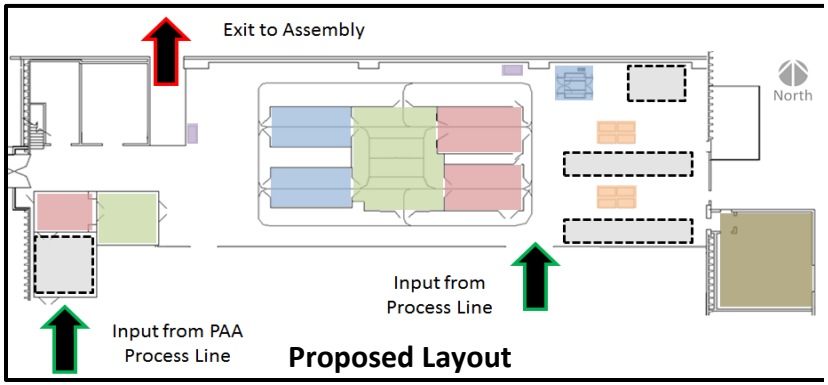
Material Handling Savings	
Travel Distance Saved	15,816,120 ft.
Time Saved	2,746 hrs.
Annual Savings	$ 123,563.44

Economic Analysis Summary	
Initial Investment	$ 422,737.50
Annual Savings	$ 200,771.68
Payback Period	2.11
ROR	46.80%



Current Layout

KEY
Prep Station
Paint Booth
Flash Off
Curing Ovens
Remove Prep
Material Storage
Staging/Storage



Proposed Layout

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

NDSU
Student Health Service

Patient Throughput Improvements

Project Team Members: Ryan Adams, Cooper Anderson, Kayla Bergee, Evan Buchholz, Jacob Makuei

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

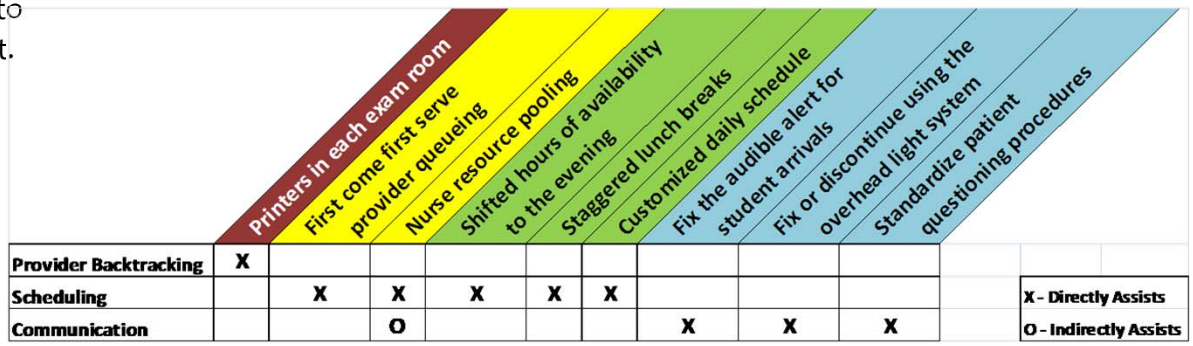
Funding Source: NDSU Student Health Service

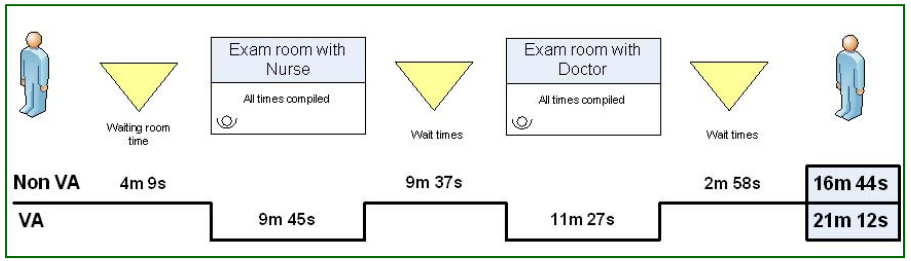
Project Objective: Analyze and document services to discover opportunities for improvement in throughput.

Project Deliverables:

Documentation of:

- ✓ current practices and proposals for information and patient flow
- ✓ benefits analysis from implementation of the proposed suggestions
- ✓ recommendations for future projects and improvement





Recommendation	Patients/Day	Patients/ Year	$Daily Value	$Yearly Value
Current Schedule	66	11,404	$5,478	$944,108
Purchase Printers	+12	+1,632	+$996	+$135,456
Nurse Pooling	+9	+1,465	+$747	+$128,484
Nurse and Provider Pooling	+24	+4,179	+$1,992	+$342,624
Staggered Lunch	+2	+410	+$166	+$28,607
Shifted 9-6	+4	+691	+$333	+$57,214
New Daily Schedule	+8	+1,338	+$665	+$114,428
Standardize patient questioning procedure	Improved throughput			
Audible Alert	Improved throughput			
Fix or Discontinue use of expansion overhead light system	Improved throughput			

Recommendation Benefits:

- ✓ Reducing provider backtracking could allow for up to three more patients/provider/day
- ✓ First come first serve queuing in simulation helped to show benefits of pooled resources
- ✓ Better communication through questioning procedures and notification systems will reduce miscommunication occurrences and wait times
- ✓ Final recommendation allows for 87 patients per day or 22 patients per provider per day

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

The Development and Documentation of an ESD Control Program

Project Team Members: Cory Kiemele, Matt Roberts, Laura Vaske, Yachao Wang

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

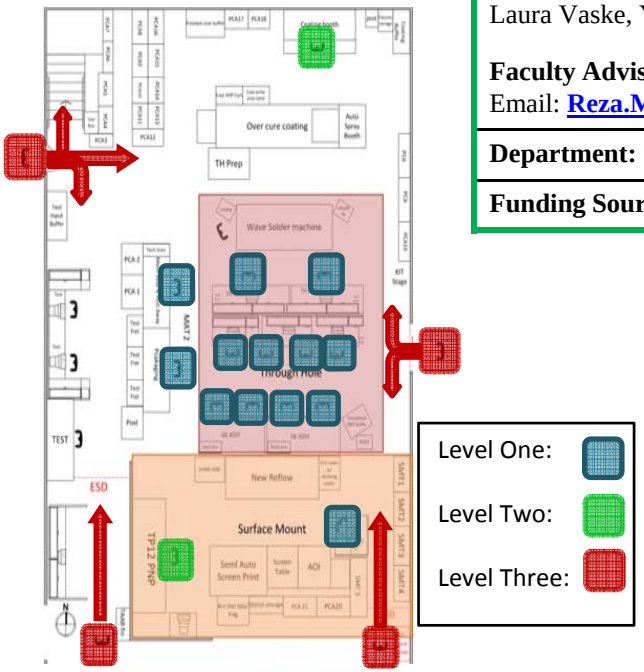
Department: Industrial and Manufacturing Engineering

Funding Source: SJE Rhombus

Project Objective: Construct an ESD control program so SJE Rhombus can meet certification requirements according to the ANSI/ESD S20.20 standard.

Deliverables

- ❑ Document current operations highlighting major ESD concern areas
- ❑ Construct ESD control program
- ❑ Create manuals/slideshows used to train Personnel
- ❑ Provide an outline of recommendations



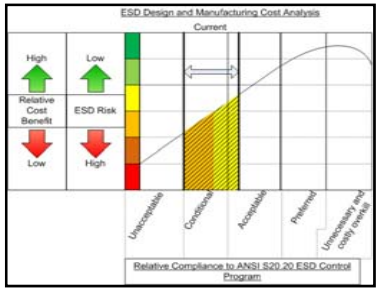
Level One: Full ESD Protection (Heel and Wrist Strap with Smocks)
Level Two: Moderate ESD Protection (Heel Strap and Smock)
Level Three: Slight ESD Protection (Smock)

Overview of ESD Control Program Document	
Introduction	• Purpose • Scope • Responsibiities • Applicable Documents • Definitions
ESD Control Program Plan	• Basic Control Standards • General Guidelines
Training Plan	• Training Requirements • What is Covered in Training • How Often Training is Required
EPA Requirements	• ANSI Technical Requirements • Testing of Grounding Equipment • Workstation Requirements
Compliance Verification	• Requirements for resistance of surfaces • Test Procedure • Test frequency • Who is responsible for testing

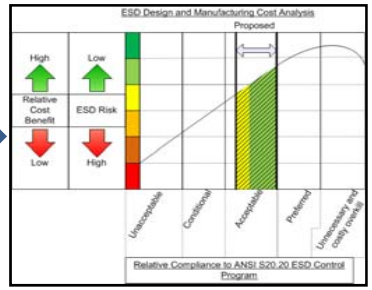
Weighted Recommendations Table

		Recommendations Scale (1-10)									
		Personal Preocedures (log book)	Well Marked EPA	Smocks/Heel-Wrist Straps	Drop Chains	Disspative Surface Mat	ESD Packaging Requirements	Ionized Fans	Conductive Floor Paint	Conductive Vinyl Tile	Humidity Control
General Evaluating Criteria	WEIGHT										
Cost	3	10	10	9	10	9	10	7	7	1	1
Resulting ESD Control	2	9	8	9	4	5	5	8	9	9	10
Estimated Installation Time	1.5	10	9	9	9	9	9	6	5	6	1
Expected Life	1.25	7	7	4	9	8	2	7	7	9	10
Ease of Implementation	1.25	10	9	9	9	8	9	6	2	3	1
Maintenance	1	9	7	9	9	8	9	7	7	9	8
TOTAL WEIGHT	10										
		87	84	83	79	76	69	65	54	46	
		CALCULATED RANKED WEIGHT									

Current ESD Compliance



Proposed ESD Compliance



Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

TECTON PRODUCTS LLC

APEX Warehousing and Distribution Center Design

Project Team Members: Nadeesha Bellana, Weichao Chen, Ashit Datta, Tyler Hahn, Katie Sable

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Tecton Products

Project Objective

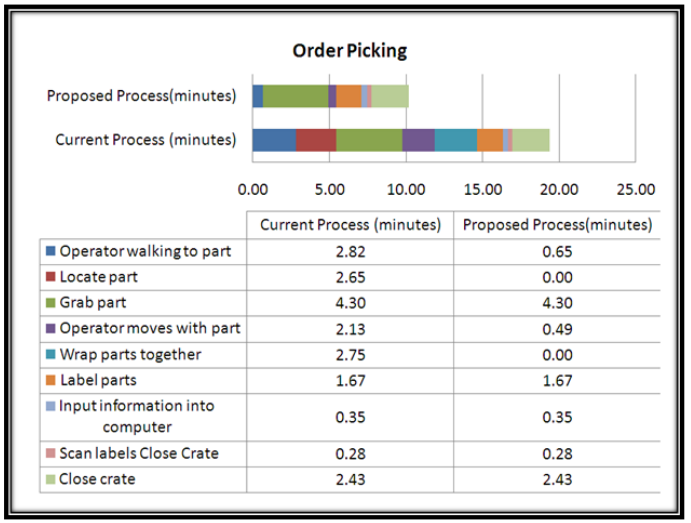
The purpose of this project is to study, analyze, and document proposals which can help Tecton with improved manufacturing, warehousing and distribution of APEX siding systems.

Project Team Deliverables

Documentation of…

- Current warehouse layout and practices
- Current process for assembling marketing kits
- Proposed improvements
- Proposed cost savings
- An outline of recommendations for future project

APEX Siding



	Current Process (minutes)	Proposed Process(minutes)
Operator walking to part	2.82	0.65
Locate part	2.65	0.00
Grab part	4.30	4.30
Operator moves with part	2.13	0.49
Wrap parts together	2.75	0.00
Label parts	1.67	1.67
Input information into computer	0.35	0.35
Scan labels Close Crate	0.28	0.28
Close crate	2.43	2.43

Recommendations

Opportunities		New Warehouse Layout	Racking System	Redesign Workstation	New Mfg. Process
Warehouse Layout	Excessive material handling	✓	✓	✓	✓
	Less than optimal space utilization	✓	✓	✓	✓
	Improper racking system		✓		
Marketing Kits	Multiple workstations	✓		✓	
	Lack of fluidity	✓	✓	✓	✓
	Excessive operator travel	✓	✓	✓	✓

	Total Saved		
	Distance (ft)	Space(Sq ft)	Time (Min)
Warehouse Layout	1583 (77%)	590.58 (12%)	9.2/Order (48%)
Marketing Kits	370 (84%)	242.3 (45%)	1.28/Kit (29%)

Racking Systems			
	Current	Cantilever Racks	Pallet Racks
Ease of Picking	3	2	1
Material Handling	3	2	1
Foot Print (Sq.Ft.)	1185	1755	2048
Cost	–	$56,681.64	$22,953.45

Benefits

- Reduced material handling
- Better space utilization
- Balanced manufacturing processes
- Reduced manufacturing lead time
- Reduced order picking time

Spring Semester 2011

Integrated Program/Project Management and Capstone Experience

Analysis of Dynamometer Process and Scheduling

Project Team Members: Vaibhav Biradar, Jay Kothman, Michael Mathers, Waylon Thomas.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

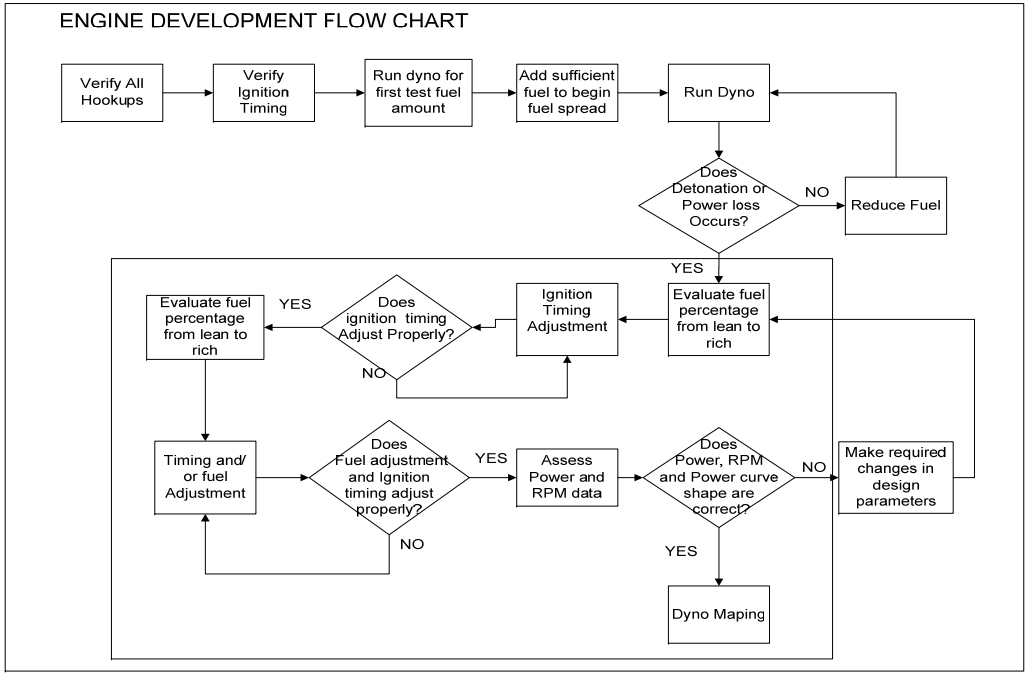
Funding Source: Arctic Cat

Research Project Objective

- Analyze the current dynamometer and testing resources to develop a testing schedule for the demand for the next four years.
- Analyze the current development procedure and recommend changes that would allow for more testing or earlier completion dates.

Project Team Deliverables

- Documentation and analysis of current setup processes including information flow, facility and work force utilization, and test lead time.
- Documentation of proposals for improving engine dynamometer facility utilization.
- Documentation of economic benefits that may result from implementing proposed suggestions.



Resource Needed for Dyno Cells (Solution 2, Snowmobile Group Dyno Status)			
Dyno No.	Equipment Needed	Capital Cost	Operating Cost /Year
Dyno 1	Data acquisation Software	$144,500	
	New Dyno	$53,675	
	Dyno Base	$8,000	
	Dyno Shaft	$4,500	
	Fuel System Upgrade	$2,200	
	New Operator	$0	$50,000
Dyno 2	Data acquisation Software	$144,500	
	New Dyno Base	$8,000	
	Dyno Shaft	$4,500	
	New Dyno	$53,675	
	Emission Tester Cells 1&2	$60,000	
Dyno 3	Data acquisation Software	$151,000	
	New Operator	$0	$50,000
Dyno 4	Emission Tester Cells 3&4	$210,000	
	Total	**$844,550**	**$100,000**

	Percentage of Utilization						
		100%	90%	80%	70%	60%	50%
No. of hours/ Day	8	2.13	2.37	2.67	3.05	3.56	4.27
	10	1.71	1.90	2.13	2.44	2.85	3.42
	12	1.42	1.58	1.78	2.03	2.37	2.85
	14	1.22	1.36	1.52	1.74	2.03	2.44
	16	1.07	1.19	1.33	1.52	1.78	2.13

Spring Semester 2010

Individual Study Design Research Project

SHIPPING FACILITY LAYOUT AND IMPROVEMENTS

Project Team Members: Benjamin Flotterud, John Koehler, Brandon Vold.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Phoenix International

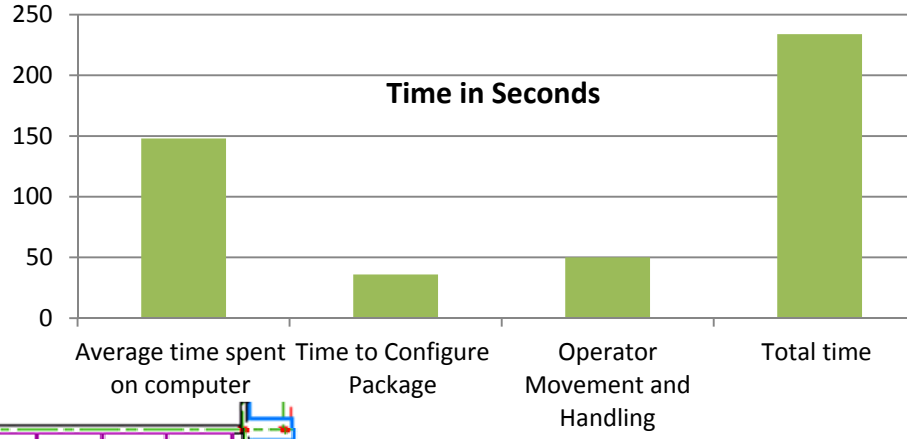
Research Project Objective:

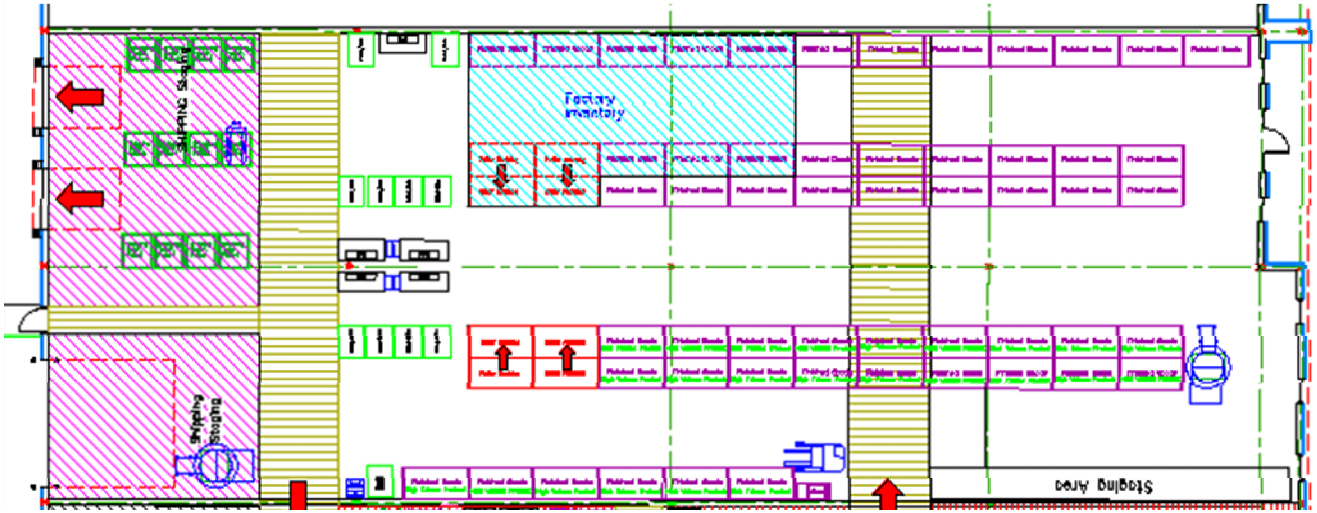
The objective of this project is to develop a new layout for the shipping area that can help with improved operational efficiencies for production, storage and inventory management, and shipping.

Team Deliverables:

Documentation of the following:

- ❑ Current production, inventory management, and shipping practices.
- ❑ Current facility layout.
- ❑ Proposals for improving production, inventory management, and shipping practices
- ❑ Improved layout alternatives
- ❑ Estimated shipping labor requirements.
- ❑ Economic analysis of proposals





Benefits:

The proposals can help with:

- ❑ Minimize labor required to ship product
- ❑ Adequate storage capacity during peak seasons
- ❑ Maintain a safe working environment
- ❑ Minimize capital expense
- ❑ Provides for First-In-First-Out inventory movements

Spring Semester 2010

Individual Study Design Research Project

Setup Reduction For Engine Emission Testing

Project Team Members: Jared Wagner, Phillip Loy, Joe Marcella, Michael Sayler.

Faculty Advisor and Consultant: Reza Maleki, Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Arctic Cat

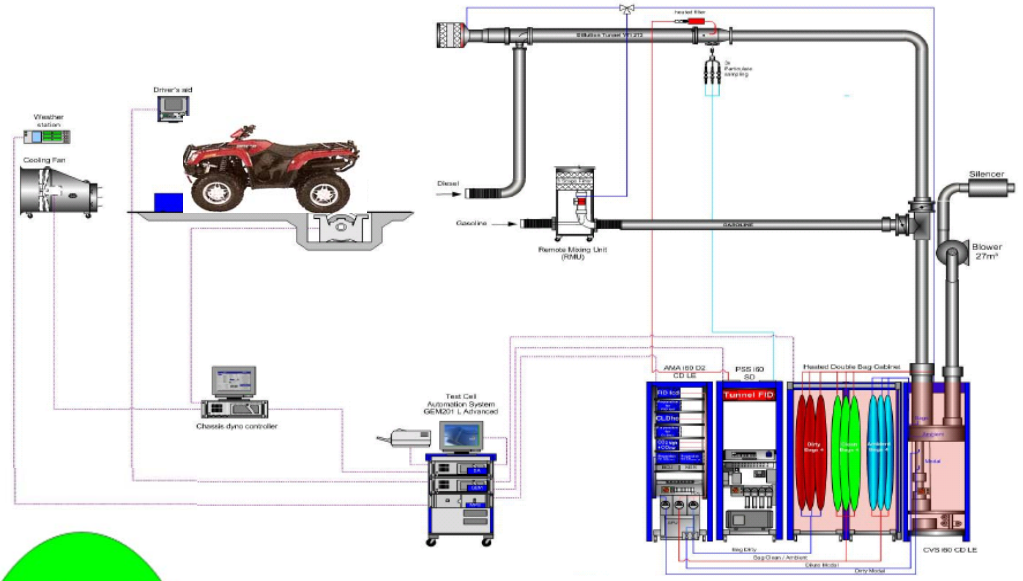
Research Project Objectives

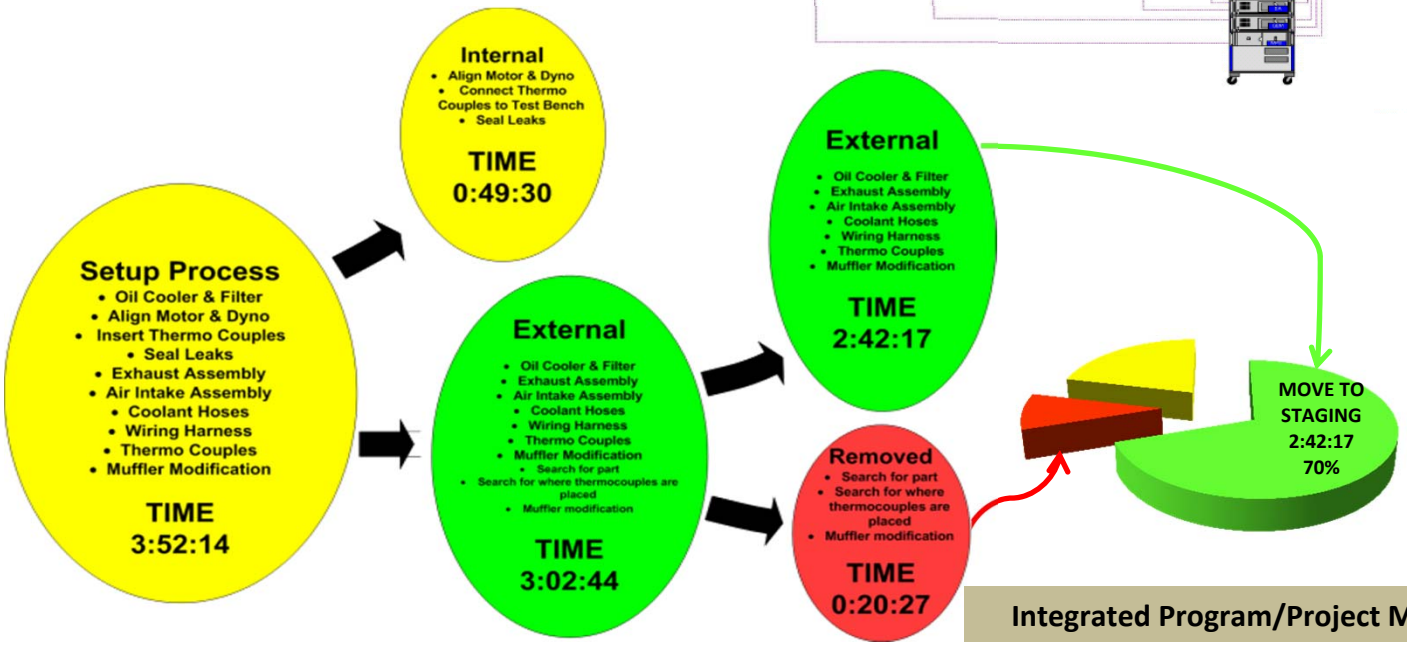
1) To study, analyze, and document proposals which can help improve the Emissions Testing Facility Utilization.
2) Research will be done to identify required equipment for Chassis Testing.

Team Deliverables

Documentation of:

1) Current testing processes.
2) Proposals for improved testing processes.
3) Specifications and Requirements of chassis testing equipment.
4) Economic benefits.
5) An outline of recommendations for future projects and improvements.





Project Benefits

1) Proposed recommendations can help Arctic Cat to better utilize the Emissions Test Facility.
2) Recommended Test equipment will allow Arctic Cat to continue and meet the future EPA emission regulations.

Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Engine Emissions Testing Facility Layout

Research Project Objective

- Analyze the current engine emission testing facility.
- Develop proposals to include chassis testing.

Project Team Deliverables

Documentation of:

- The current emission testing facility layout and procedures.
- Equipment, capacity, and space requirements.
- Proposals to accommodate both current and chassis testing.
- Recommendations for future projects and improvements.

Project Team Members: Peter Nelson, Robert Berg, Neil Viola.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

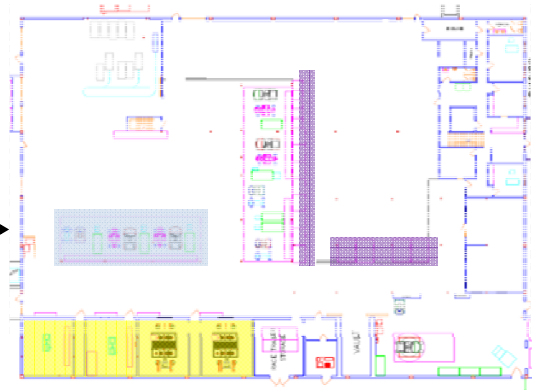
Funding Source: Arctic Cat

Functional Areas	Projected ft²	Alternative A	Alternative B
Engine Dynamometer Cell	494	494	1000
Storage	668	0	668
Setup	446	450	800
Support Systems	378	378	378
Engine Receiving	n/a	n/a	n/a
Field Test	n/a	n/a	n/a
Chassis Dynamometer Cell	828	828	1000
Total	2814	2150	3492

Summary of Benefits

- Reduce the number of engine testing cells from four to two.
- Have additional setup area to accommodate external setups.
- Create two chassis dynamometer cells to meet EPA requirements.
- Allow for shared resources with other departmental groups.
- Have sufficient storage with secure access.

Recommendation Criteria	Weight	Alternative A		Alternative B	
		Rating	Weighted	Rating	Weighted
Support Chassis Test	17	4	68	5	85
Effectiveness Setup Area	12	3	36	5	60
Sufficient Storage System	13	1	13	5	65
Updated Support Systems	17	5	85	5	85
Closeness of Engine Receiving	5	5	25	3	15
Closeness of Field Test	7	5	35	3	21
Possibility of Shared Resources	12	1	12	5	60
Ease/Cost of Implementation	13	1	13	4	52
Work Environment	5	3	15	4	20
	100		302		463



Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Johnston Fargo Culvert, Inc.

Project Team Members: Scott McCamy, Matt Antony, Chris Bingea.

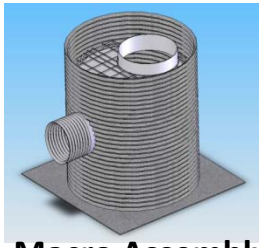
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Johnston Fargo Culvert, Inc.

Research Project Objectives

The purpose of this project is to study, analyze, and propose new methods for improving the fabrication of the Manhole-Assembly.



Macro Assembly

Project Deliverables

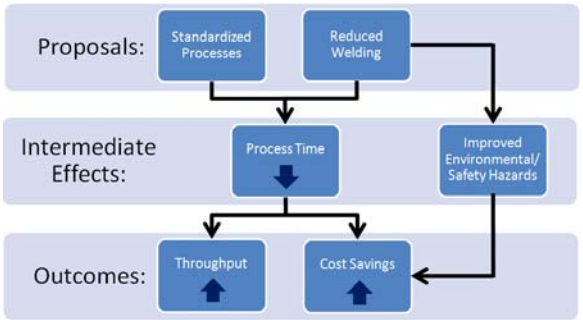
- **Documentation of current production processes**
- **Recommendations for improving fabrication processes**
- **Economic Analysis**
- **Recommendations for future projects and improvements.**

Problems	Cutting Templates	CNC Rebar Forming	Spin Forming	Alternative Water Sealing	Standardized Work Instructions	Reduced # of Fastening Nuts	Water Jet Cutting
Excessive Welding	◎		◎	◎	◎	◎	◎
Excessive Cutting	◎	◎		◎	◎	◎	◎
Time-consuming Forming		◎	◎	◎	◎		◎
Inconsistent Process	◎	◎	◎	◎	◎		◎
Environmental Hazards	◎	◎	◎	◎	◎	◎	◎

Economic Analysis

Proposals	Initial Cost ($)	Recurring Cost ($)	Time Savings of Total Time (%)	Labor Savings ($/Assembly)	Payback Units (# of Assemblies)	Improve Environmental/Safety Factors?
Cutting Templates	$63	-	8%	$14	5	Yes
CNC Rebar Forming	-	$17.60	8%	$23	Immediate	Yes
Spin Forming	-	$10.20	4%	-$3.70	N/A	Yes
Alternative Water Sealing	$260	$11.25	42%	$58.00	4	Yes
Standardized Work Methods	$90	-	86%	$600	Immediate	Yes
Reduce Number of Fasteners	0	$0.00	1%	$2	Immediate	Yes
Water-jet Cutting	$330,000	$25.00	12%	-$5.50	N/A	Yes

Potential Benefits



Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Johnston Fargo Culvert, Inc.

Corrugated Steel Pipe (CSP) Joint System

Project Team Members: Matthew Bishoff, Brandon Scherber, Christopher Nilson.

Faculty Advisor and Consultant: Reza Maleki, Email: Reza.Maleki@ndsu.edu.

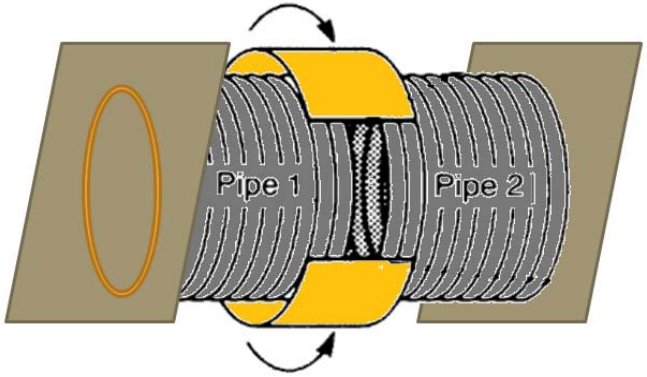
Department: Industrial and Manufacturing Engineering

Funding Source: Johnston Fargo Culvert, Inc.

Research Project Objective: The objective of this project is to test and document the performance of various gaskets for a watertight CSP coupling system.

Deliverables:

- Documentation reflecting research and testing of the CSP joint system
- Documentation of recommendation for improving CSP joint system
- Recommendations for future projects and improvements



Project Work and Research Activities

CSP Joint System
- Band Design
- Gasket

Testing
- Development of Apparatus
- Testing, Data Collection, Analysis

Recommendations
- Band Design
- Gasket
- Cost Analysis
- Future Projects

Test Results and Recommendations

Various Bands and Gaskets were tested, but all failed to meet proposed standards. Based on tests performed and literature reviewed, a CSP Joint System Recommendation Matrix was developed.

CSP Joint System Recommendation Matrix

			Band Design											
S	Superior		Profile					Clamp			Structure			
?	Questionable		Annular	Semi Annular	Flat	Hat	Universal	Band Angle	Lug Angle	Bar and Strap	1 Piece	2 Piece		
P	Poor											Piano Hinge	Loose	
I	Incompatible													
Gaskets	Profile	O-ring	?	S	P	I	I	?	S	S	?	S	S	
		Sleeve	S	S	P	I	?	?	S	S	S	S	S	
		Strip	S	I	P	S	S	?	S	S	P	S	S	
		Wrap	S	S	P	I	?	?	S	S	?	S	S	
	Installation	In Corrugation	S	S	P	I	S	?	S	S	S	S	S	
		Around Pipe	S	S	P	I	S	?	S	S	S	S	S	
		Applied	I	I	I	S	I	?	S	S	S	S	S	
	Material	Rubber	S	S	S	S	S	?	S	S	S	S	S	
		Foam	P	P	P	P	P	?	S	S	S	S	S	
		Mastic	I	I	I	S	I	?	S	S	?	S	S	

Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Laminated Residential Garage Panel Assembly Line Analysis

MIDLAND GARAGE DOOR MFG. CO.
WEST FARGO, ND OMAHA, NE CHASKA, MN
www.midlandgaragedoor.com

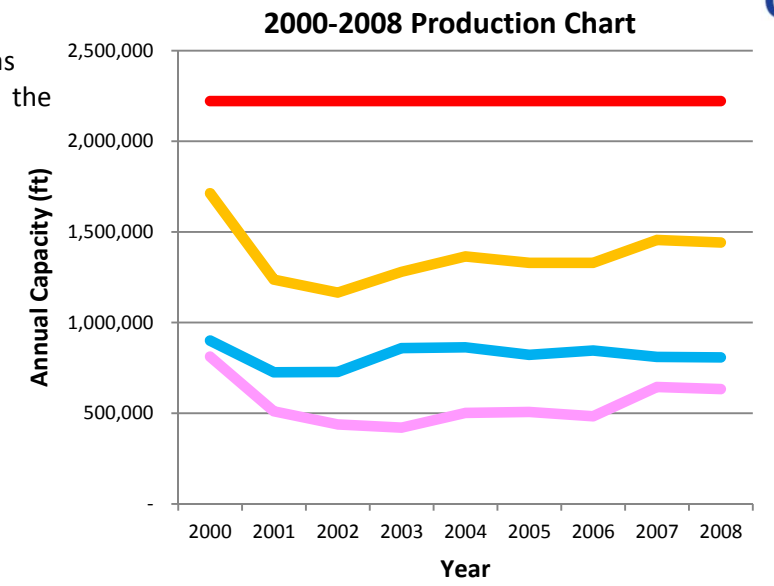
Research Project Objective

Determine if the current residential laminated door panel assembly line has the capacity and capability to produce the commercial laminated door panels

Project Deliverables

Documentation of:

- Residential line capability and capacity
- Residential and Commercial Door demand
- Proposal for modifications to Residential Line
- Economic analysis
- Future project recommendations



Project Team Members: Kevin Ronsberg, Kim Lammers, Erika Hedger, Adam Hilzendager

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Midland Garage Door Manufacturing

Modification		Cost
End Style Machine		
1 Change	$	40,000
2 Changes	$	50,000
3 Changes	$	60,000
Change Overs	$	20,000
Screw Station	$	50,000

Commercial Panel Dimensions

Length (ft)	Thick. (in)	Percentage	Cost	Commercial Feet/Year	Labor Time Savings/ Year (hrs)	Labor Savings/ Year ($)	Payback Period (yrs)
≤18	≤2	46%	$ 90,000	291,434	778	24,894	3.6
≤18	≤3	75%	$ 100,000	475,164	1,268	40,588	2.5
≤40	≤2	53%	$ 120,000	335,783	896	28,682	4.2
≤40	≤3	100%	$ 130,000	633,552	1,691	54,117	2.4

Potential Benefits

The proposed modifications will allow Midland to produce commercial door panels on the current residential assembly line. The modifications can help with cost savings as well meeting some growth in demand.

Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Facility Layout Analysis and Improvements

MIDLAND GARAGE DOOR MFG. CO.

RESEARCH PROJECT OBJECTIVE

To develop proposals for improving layout which will provide more efficient flow of product, reduced WIP, and improved manufacturing lead time.

PROJECT DELIVERABLES include documentation of:

- Current layout and production methods
- Improved layout
- Economic analysis

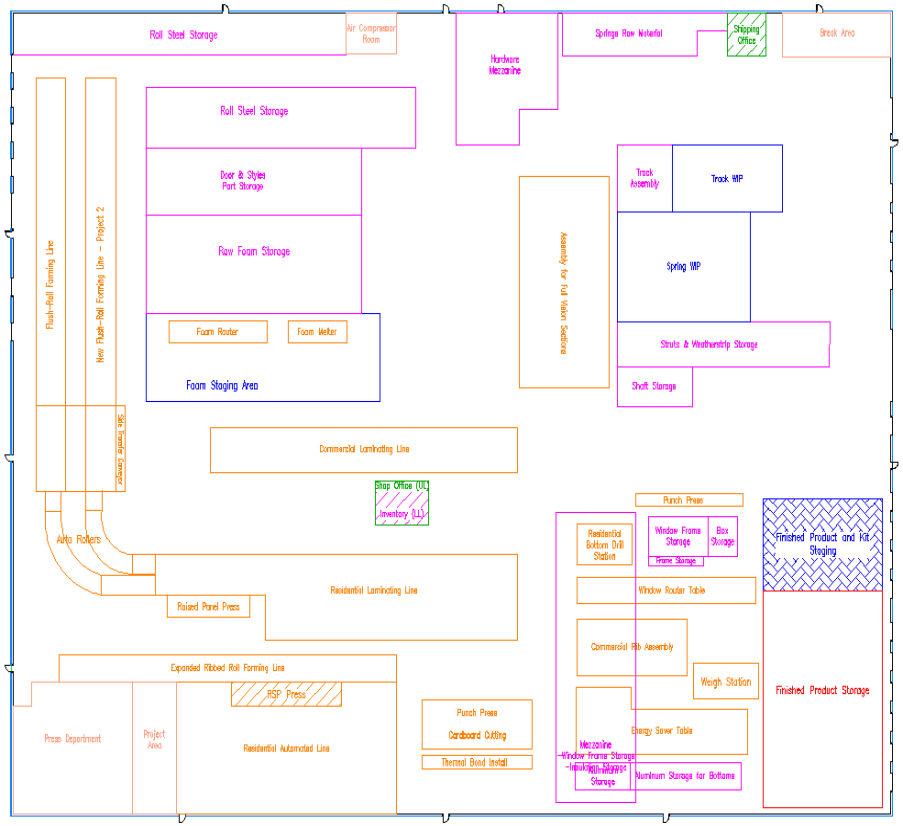
Project Team Members: Kurt Semanko, Jacob Chan, Ray Berry, Sean Osowski

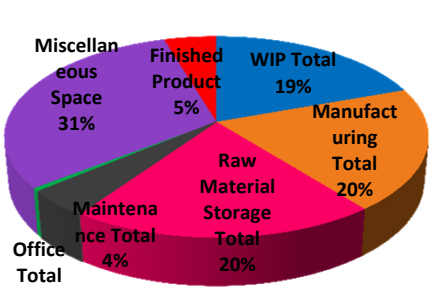
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

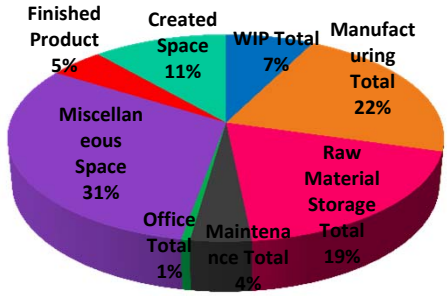
Funding Source: Midland Garage Door Manufacturing Company

Proposed Layout





Current Space Allocation



Proposed Space Allocation

Potential Benefits

Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Neal's Industrial Painting

Facility Layout and Process Improvements

Project Team Members: Jenna Ludwig, Paul Gieseke, Luke Johnson, Anthony Ross, Chris Opland.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Neal's Industrial Painting

Research Project Objective

The purpose of this project is to study, document, analyze, and propose improvements for the facility layout and process systems.

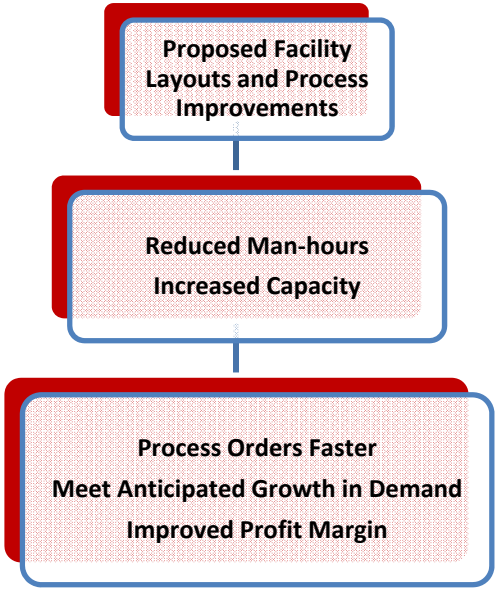
Deliverables

- Documentation of:
  - Current facility layout and coating systems processes
  - Proposal for improvements
  - Analysis of the required space to meet the current and anticipated growth in demand
  - Economic impact of the proposed recommendations
  - Proposals for future projects

Alternative Layouts	Monorail	Small Utility Oven	Large Utility Oven	Wet Booth Monorail Compatible	Small Powder Booth	Improved Vacuum	Equipment Movement	Expansion	Continuous Oven	Removal of wall	Vinyl Covering	Total Cost
	500K	54K	225K	22K	22K	5K	18K	360K	285K	5K	4K	
1		x			x	x	x			x	x	108,000
2	x			x	x	x	x		x	x	x	861,000
3	x		x	x	x	x	x	x	x	x	x	1,446,000

	Capacity Increase					Pay Back Period (years)		
	Current Labor	Additional Labor	Labor Reduction	Profit Margin	Capital Expenditure	10%	20%	30%
Alternate 1	56%	97%	0%	32%	108K	2.75	1.90	1.60
Alternate 2	96%	245%	20%	37%	861K	7.20	5.10	4.20
Alternate 3	96%	245%	20%	37%	1,446K	9.30	6.60	5.40

Potential Benefits



Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

DUST COLLECTION SYSTEM DESIGN

Project Team Members: Dayne Efta, James Dravitz, Thomas Steckler, George Auen.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Northern Contours

Research Project Objective

The purpose of this project is to document, analyze, and propose improvements to the current dust collection system.

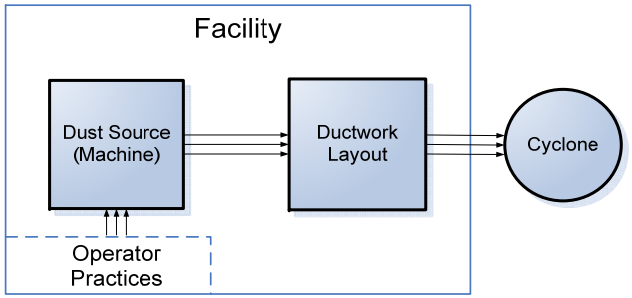
Project Team Deliverables

- Documentation of current processes and evaluation of dust collection system
- Proposals that can help with effective collection and containment of dust
- Economic analysis
- Recommendations for future projects and improvements

Areas of Impact	Problems	Move return air	Bridge gaps with door brush seal	Remove cooling fans	Limit use of compressed air at workstations	Responsible operation/cleanup	Utilize workstation suction tools	Utilize lumber carts	Multiple suction locations at source	Reduce material removal rate	Use denser brushes to block dust spray	Reduce amount of compressed air at source	Implement downdraft prototype	Seal all gaps in ductwork	Install blast gates and pipe plugs	New pipe layout	Increase motor capacity
		Recommendations															
Facility	Return air	1														4	-
	Cooling fans			2													
	Gaps between different rooms in facility		5														
Operator Practices	Compressed air																
	a. Clean off finished part/sacrificial board				-	5	5										
	b. Clean operators themselves				-	5	5										
	Leaving doors open																
	Stacking finished products							5									
	Cutting scrap material					5	5										
Dust Source (Machine)	Poor tool housing design																
	a. Compressed air shoots at rotating tool								5			5					
	b. Insufficient suction								5	3		3	5		5		4
	Material removal rate									5	3						
	Brushes do not block spray of dust								4		5	5	5				
Dust Collection System: Ductwork Layout	Gaps in ductwork - unsealed holes													5			
	Pipes constantly consuming air velocity													5	5		
	No way to balance air in system													5	5		
Cyclone																5	
															5	5	4

Not Feasible
Feasible - No Cost/Low Cost
Feasible - Requires Investment

1 to 5	Solution Impact Rating: 1 - Least 5 - Significant
-	Negative Impact
	Indirectly Hinders Dust Contamination



Potential Benefits

The recommendations shown in the above chart (labeled "feasible") can help reduce the spread of dust and reduce the number of defects caused by dust. Some recommendations can help reduce operational expenses as well

Spring Semester 2009

Integrated Program/Project Management and Capstone Experience

Facility Layout Analysis and Improvements

Designed for you. aldevron

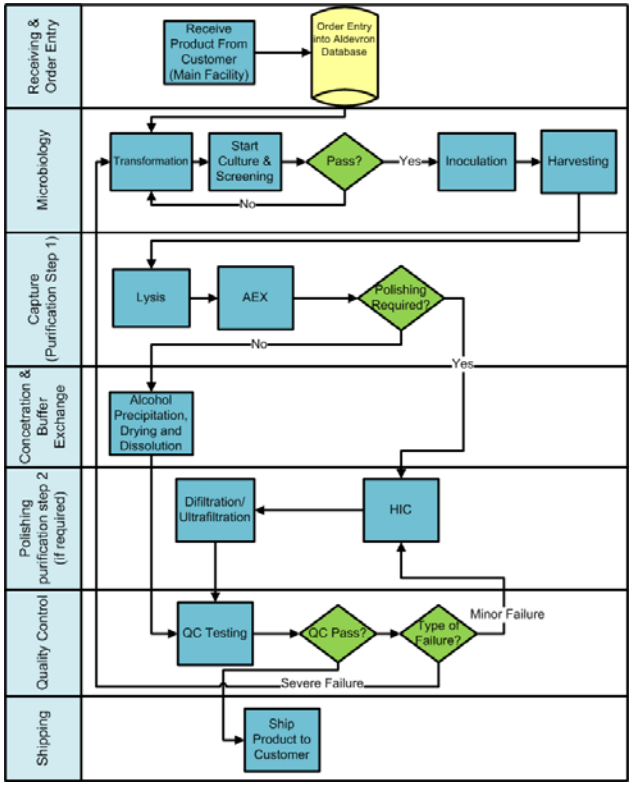
Research Project Objective

Study, analyze, and Document proposals which can help with improving layout to reduce manufacturing lead time within the Fastlane building

Project Deliverables

- Documentation of:
  - Current production processes including layout, product, and process flow
  - Improved facility layout
  - Economic benefits from implementing proposed suggestions
- Recommendations for future projects and improvements

Macro Process Flow



Recommendations

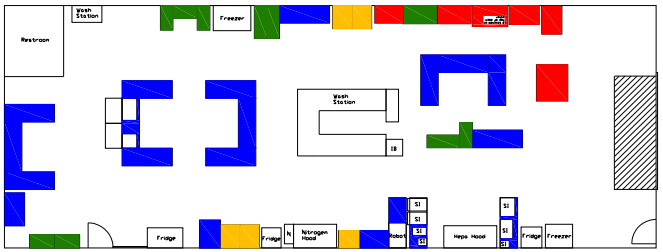
- Revise Layout
  - Process relocation
  - Improved wash station
  - Additional equipment
- New scheduling practices

Project Team Members: Brad Buck, Tony Noga, Ashley Kringle, Jordan Debilzen.

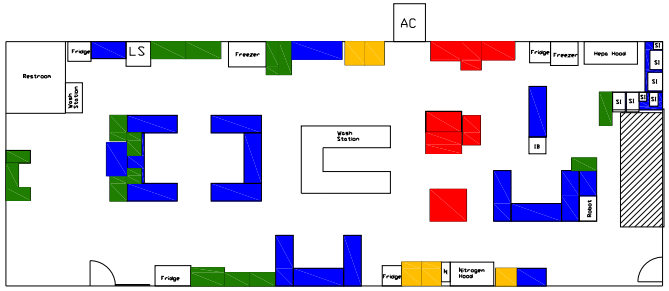
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Aldevron



Current Fastlane Layout



Proposed Fastlane Layout

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

New Facility Layout Design

Project Team Members: Jeff Comegys, Doug Peterson, Chris Rivard, Dheeraja Kaja

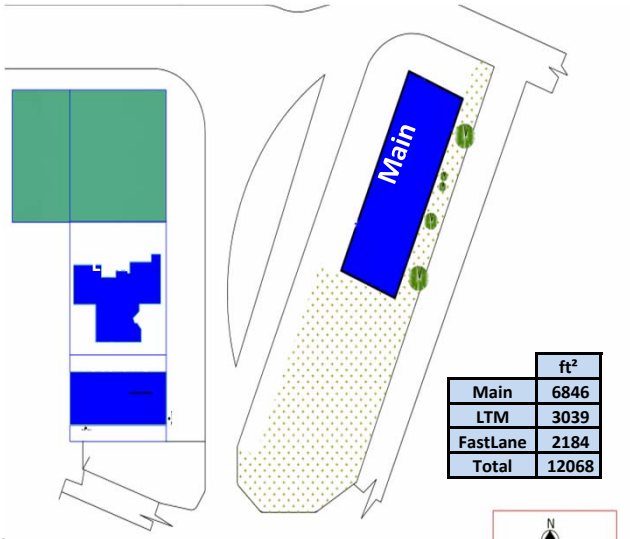
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Aldevron

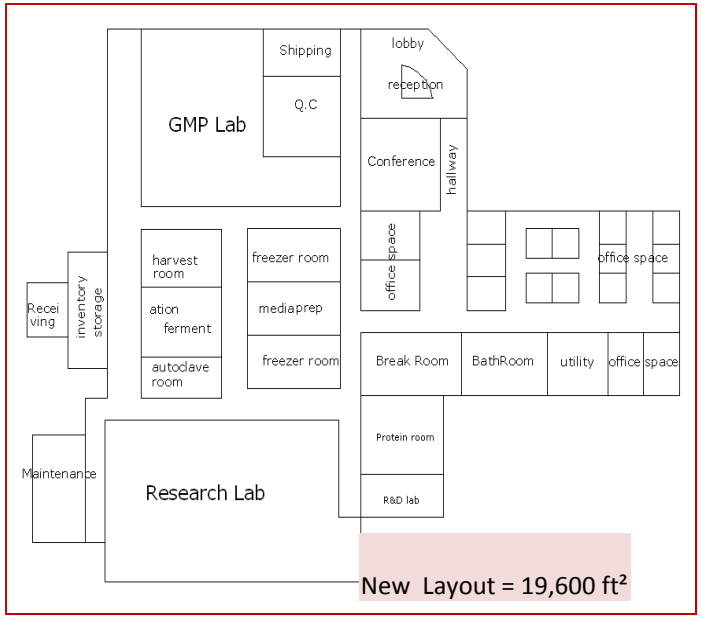
RESEARCH PROJECT OBJECTIVE:
To develop a proposal for a new facility layout capable of accommodating future growth in production and expansion of research and development activities.

PROJECT TEAM DELIVERABLES:
- Documentation of the current layout and processes
- Documentation for a new facility layout
- Estimation of building costs
- Recommendations for future projects



	ft²
Main	6846
LTM	3039
FastLane	2184
Total	12068

Current Facility Layout



Proposed Facility Layout

Space Analysis

	Facility Categories	Current Square Feet	Adjusted Square Feet	100% Increase In Production
1	Support	1728	1782	2256
2	Lab Support	1455	1813	2645
3	GMP Lab	1293	1293	2000
4	Research Grade Lab	3375	3709	4810
5	Receiving	0	150	150
6	Shipping	121	200	300
7	Storage	225	375	470
8	Maintenance	636	766	800
9	QC	426	475	500
10	Office	1523	2250	2500
	Total: *Hallways Not Included	10782	12813	19511

PROJECT BENEFITS:
- New facility layout that accommodates future growth
- Improved product flow
- Reduced risk of contamination
- Improved communication

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

Facility Layout Improvements

Project Team Members: Jesse Johnson, Woo Kim, Yasaman Kazemi, Robert Wessel

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: BTD Manufacturing, Inc.

Research Project Objective:

The purpose of this project is to develop a proposal for an improved facility layout, which will reduce manufacturing lead time, lower work in process inventories and lower material handling.

Project Team Deliverables:

Documentation of…

- Current layout, including flow of products and work in process inventories
- Improved layout, including flow of products and work in process inventories
- Cost savings that may result from implementing proposed suggestions
- Recommendations for future projects and improvements

Recommendations:

Relocate machines which will improve the problem areas that BTD clients defined

	WIP	External Handling	Internal Handling	Lead Time
Move Press Brake to Plant 1	X	x		x
Press Brake, Spot Weld, Hand Weld Cell	x	x	x	x
Move Two Hand Welders to Plant 1	x	x		x
Laser, Press Brake and Hand Weld Cell	x		x	x

Benefits:

- Reducing manufacturing lead time resulting in higher productivity
- Elimination of WIP will result in lower inventory carrying cost
- Decreasing travel distance will reduce material handling costs

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

Warehouse Operations Analysis

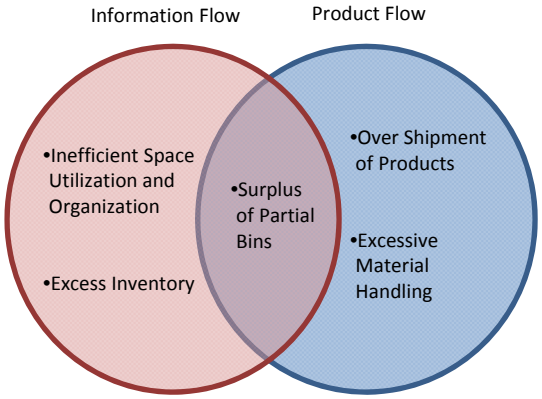
Research Project Objective

Study, analyze and improve the utilization of the warehouse space and operations.

Project Team Deliverables

- **Analysis of current warehouse** layout and processes
- Documentation of **proposed recommendations**
- Documentation of **economic benefits** resulting from implementation of proposed recommendations
- Recommendations for **future projects and improvement**

Problem Identification



Project Team Members: Andrew Larson, Scott Engberg, Andrea Hopf, Matt Olson.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: BTD Manufacturing, Inc.

Recommendations

5S

- Reduce amount of cross-traffic
- Save 1,600+ square feet
- Organize east and south walls

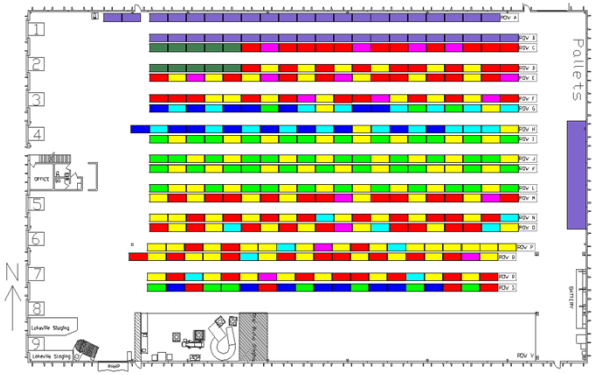
Kanban

- Set order date requirement for customer
- Pull reports based on firm order date
- Send orders to production of what is not in warehouse

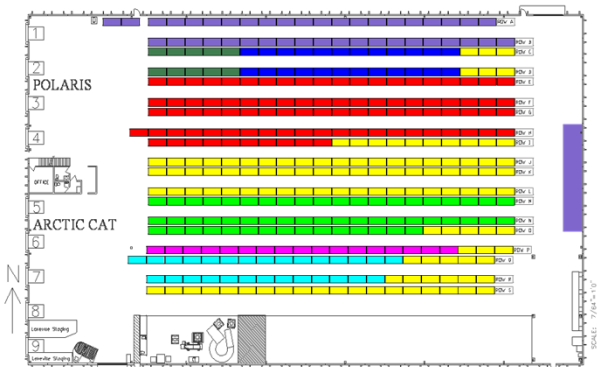
Shelf Standardization

- Group customers' parts in common areas
- High-volume parts closest to shipping docks
- Specific spot for partial bins

Current Product Placement



Proposed Product Placement



Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

CONTAINER LOGISTICS

Project Team Members: Jon Reimche, Brett Winkelman, Gretchen Meiser.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Case New Holland

Research Project Objective:

The purpose of this project is to analyze and document the current logistics of the returnable racks used at the CNH Fargo plant. Through this analysis recommendations will be made to improve tracking methods for the racks.

Team Deliverables:

Documentation of the following:

- Current information flow
- Physical rack flow
- Current physical rack count
- Possible improvements for tracking system
- Economic analysis of recommendations
- Recommendations for Future projects

Benefits:

- Streamlined system with better communication
- Reduction in lost racks
- CNH reimbursed for lost racks
- Substantial cost avoidance

Problems

Recommendations	Losing Racks	Poor Communication	Lack of Liability	Inadequate Number of Racks Available	Difficulty Locating Racks	Difficulty Identifying Racks	Inaccurate count of Rack Inventory	Lack of Rack Financial Management	Shipping Incorrect Rack
Improve CSCN	X	X		X	X		X	X	X
Liability Contract	X		X						
Tracking Technology	X	X	X		X	X	X	X	X

All recommendations contribute to better management and tracking of the returnable racks

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

SIOUX MANUFACTURING CORPORATION

Improving Inventory Management and Warehousing Operations

Project Team Members: Dave Holloway, Nate Granquist, Mike Hedlund, Dave Stenseth.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Sioux Manufacturing Corporation

RESEARCH PROJECT OBJECTIVE:

The purpose of this project is to study, analyze and improve warehouse locations and reduce inventory management difficulties

PROJECT TEAM DELIVERABLES

Based on extensive observation and research, the following documents were provided to the client:

- Current warehouse practices, information, & process flow
- Proposed improvements
- Proposed cost savings
- An outline of recommendations for future projects

RECOMMENDATIONS

- New warehouse ID inventory locations
- Corresponding warehouse names within ERP
- Cellularize workstation to decrease travel
- Enhance barcode system

PROJECT BENEFITS

- Making the physical production facility match the ERP system will result in ease of tracking inventory
- Reduction in search area will considerably reduce time spent searching for inventory
- Relocating the Epoxy/Sanding workstation will result in reduced travel distances

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

SK Food Specialty Processing

Improving Packaging and Warehousing Operations

Project Team Members: Nate Bruns, Joshua Brantner, Tom Cinnamon, Jennifer Vad.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: SK Food Specialty Processing

Research Project Objective

The purpose of this project is to develop a proposal for the improvement of packaging and warehousing operations; included in this will be the layout, inventory tracking, material handling practices, and ergonomics

Deliverables

- Documentation of the current processes
- Documentation of the proposal for improvements
- Documentation of the economic analysis
- An outline of recommendations for future projects and improvements

New racking system allowing more efficient access to all products

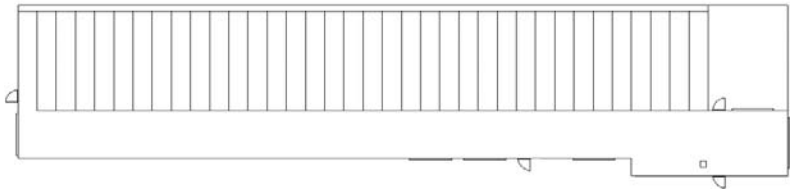
Super Sack Frame and Scissor lift to assist with packaging

Problems Identification

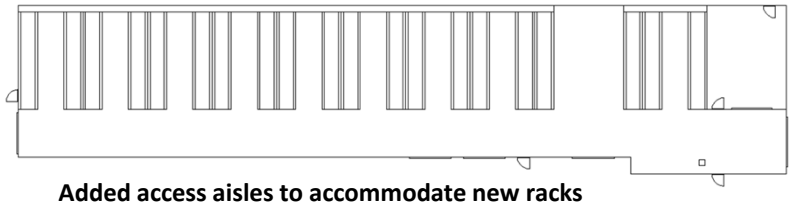
- Inefficient Packaging
- Difficulties tracking inventory
- Poor utilization of warehouse

Very Narrow-Aisle Turret Truck

Current Layout



Recommended Layout



Added access aisles to accommodate new racks

Recommendations

- Purchase and install a Super Sack frame and filler and scissor lift table
- Implement a bar coding system to improve the inventory tracking
- Purchase and install a new racking system, allowing more efficient access to all products
- A new layout is recommended to utilize the new racking system

Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

IMPROVING WAREHOUSING AND MANUFACTURING OPERATIONS

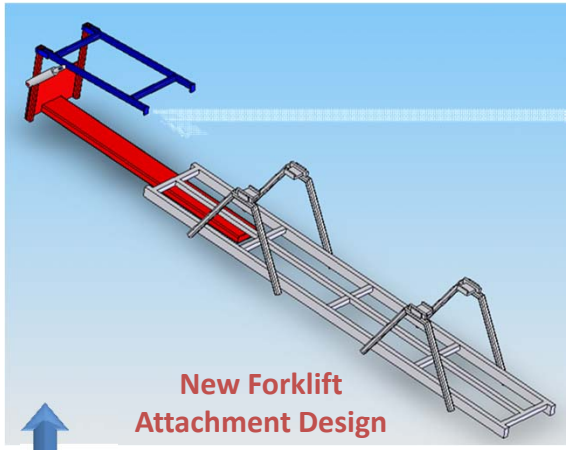
VINYLITE® WINDOWS

Research Project Objective

The purpose of this project is to study, analyze and improve the raw material warehousing practices, inventory management, and the pre-assembly operations in order to decrease work in process and material handling."

Team Deliverables

- Documentation of current processes
- Improve warehousing and pre-assembly operations
- Economic analysis of proposed solutions
- Recommendations for future projects



New Forklift Attachment Design

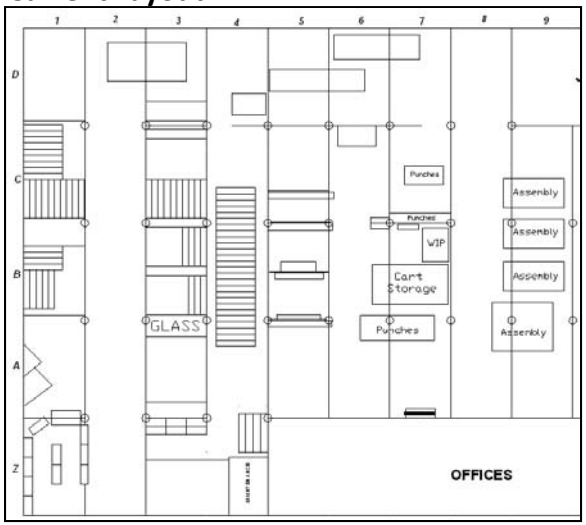
Project Team Members: Lance Straabe, Nathan Noble, Jared Baldwin, Joey Marvig.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Vinylite Windows

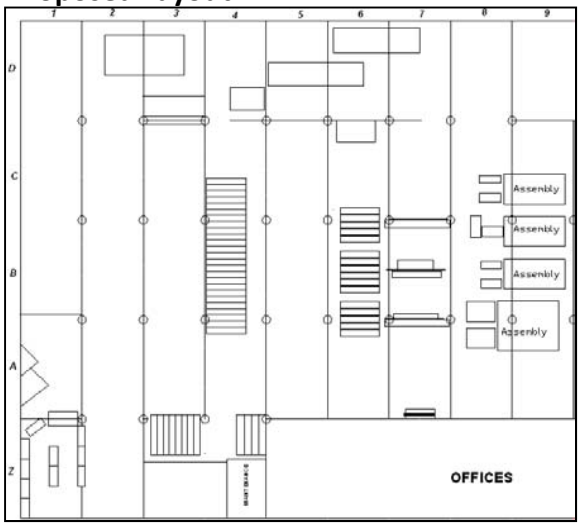
Current Layout



Recommendations / Benefits

- **New Warehouse Layout**
  - Decrease Handling
  - Visible Workplace
- **Material Movement Cart**
  - Decrease Handling
- **Forklift Attachment**
  - Decrease Handling
- **New Manufacturing Layout**
  - Reduce WIP
  - Reduce MLT

Proposed Layout



Spring Semester 2008

Integrated Program/Project Management and Capstone Experience

bobcat® Anti-Corrosive System Design

Research Project Objectives

Research and document the design of an anti-corrosive system for hydraulic cylinder components that offers safety and economic advantages over the current painting methods while meeting the production requirements

Project Team Members: Sean Bittle, Chase Kelner, Cynthia DeAustin, Anthony Schwan.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

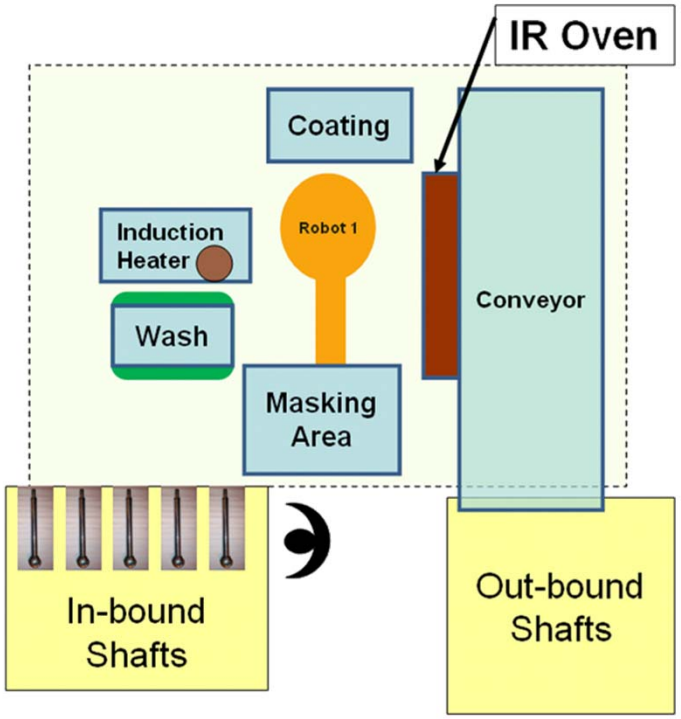
Funding Source: Bobcat

Project Team Deliverables

- Documentation of the current systems that relate to the project
- Documentation of researched alternatives of anti-corrosive methods, and application systems
- Documentation of recommendations for a new, more robust anti-corrosive system
- Documentation of cost and time savings that may result from implementing proposed suggestions.
- An outline of recommendations for future projects and improvements

Problems Identified

- Fully assembled cylinders are powder coated
- Internal seals exposed to high heat
- Expensive seal warranties due to excessive heat
- Bore hole manually cleaned



Proposed System Design

Proposed Process

- Shafts coated in parallel with cylinder tubes
- Hydraulic cylinder assembled after coating processes
- Seals no longer exposed to heat

Potential Benefits

- Purchase less expensive seals
- Reduce warranty costs
- Decrease masking costs
- Pay back period of 1.61 years

Hydraulic Test Bench Design

Project Team Members: Mark Henning, Joseph Haman, Jack Lubka, Kristopher Braaten.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

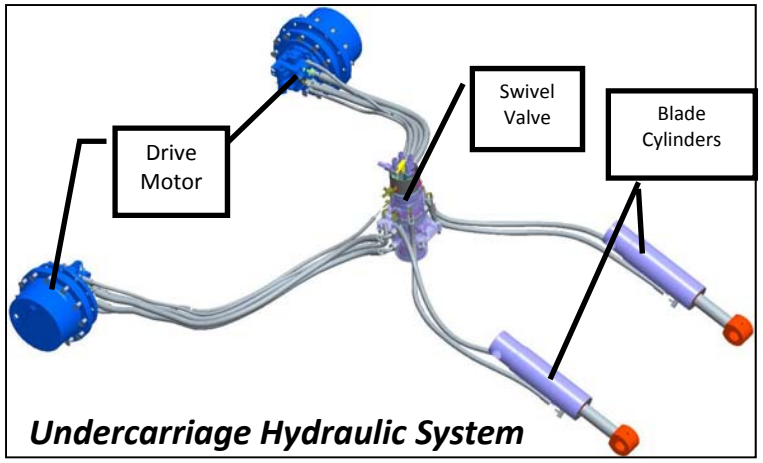
Funding Source: Bobcat

Research Project Objectives

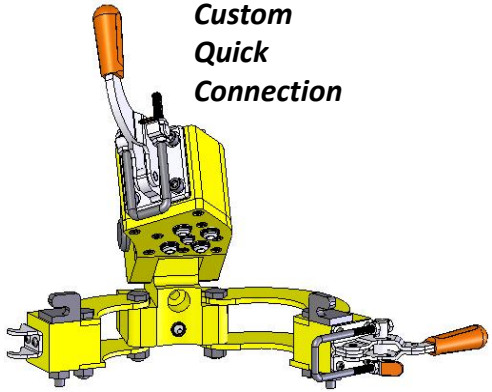
Design a test bench to verify the quality and functionality of a fully assembled undercarriage hydraulic system for a 430 / 435 excavator. The system needs to identify any leaks, verify component functionality and specifications in less than 5 minutes.

Project Deliverables

- Documentation of Current Assembly and Testing Procedure
- Research Alternative Methods
- Recommendations for Improved Assembly
- Recommendations for Test Bench
- Recommendations for Future Improvements



Undercarriage Hydraulic System

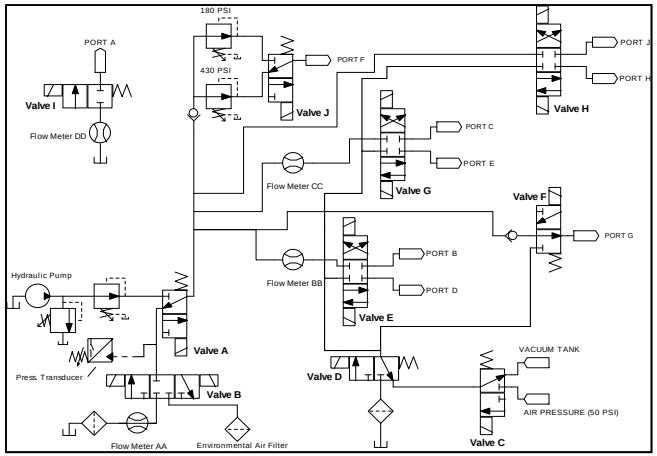


Custom Quick Connection

Potential Benefits

- Proposed assembly procedure will help improve quality of hydraulic system and decrease costs.
- The proposed testing procedure will help confirm that the machine is indeed a quality product.

Proposed Hydraulic Circuit



Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

Manufacturing Lead Time Improvements

Project Team Members: Melissa Brown, Ivan Anheluk, Damon Anderson, Jean Ostrom-Blonigen, Laura Sagness.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

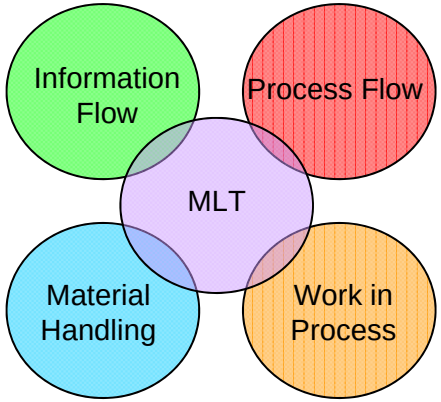
Department: Industrial and Manufacturing Engineering

Funding Source: Rapat Industries

Research Project Objective

The Purpose of this Project is to Document the Current Production Processes and Information Flow and to Develop Proposals to Help Improve the Productivity of the Resources.

Causes of Excessive MLT



Throughput Improvement

		Critical Areas Addressed			
		Information Flow	Process Flow	Material Handling	WIP
Areas Impacting MLT	Information Flow	Improvement	Improvement		
	Process Flow	Improvement	Improvement	Improvement	Reduction
	Material Handling	Reduction	Reduction	Reduction	Reduction
	WIP	Reduction	Reduction		Reduction
	Safety		Improvement	Improvement	Improvement
	Labor	Reduction	Reduction		Reduction
	Space Utilization		Improvement		Improvement
	Excessive Operator Movement	Reduction	Reduction	Reduction	Reduction
	Shop Floor Organization	Improvement	Improvement	Improvement	Improvement
	Material Availability	Improvement		Improvement	
	Process Operation Control	Improvement	Improvement		Improvement
	Project Management	Improvement	Improvement		Improvement
	Process Time	Improvement	Improvement	Improvement	
	Individual Impact On MLT	- 4 Days	- 7 Days	- 4 Days	- 24 Days
	Total Impact On MLT (Current MLT: 53.23 Days)	- 39 Days			

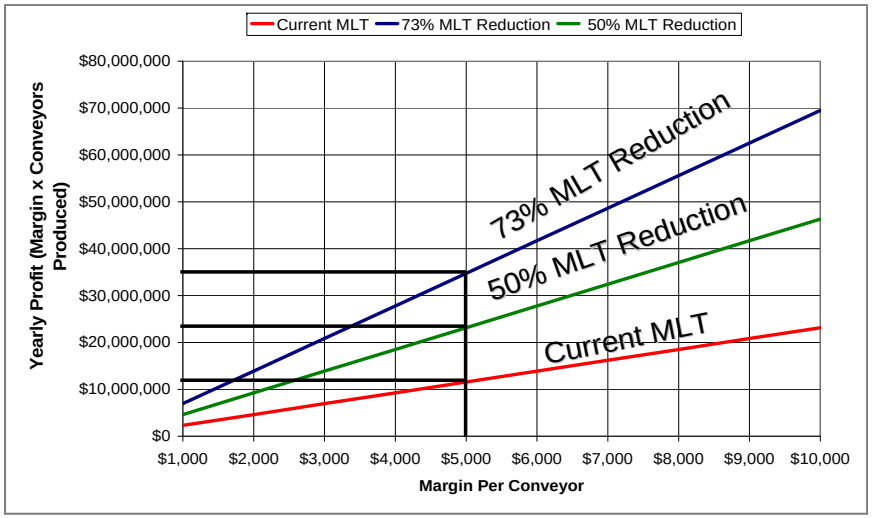
Current MLT =53.23 days Potential MLT = 14.23 days
Potential Decrease in MLT = 73 %

Team Deliverables

- Documentation of current system, production processes and Information Flow
- Documentation of recommendations for improved production processes and Information Flow
- Documentation of associated Cost and time Savings
- Documentation of Future Recommendations

Recommendations

- Schedule/Hire a Material Handler
- Implement Staging Areas
- Routings Sheets
- Implement Scheduling Methods
- Utilize ERP System
- Companywide Training



Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

RAPAT CORPORATION

Paint System Design

Project Team Members: Emily Walstead, Cameron Wahl , Ryan Steinert, Jason Melcher .

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

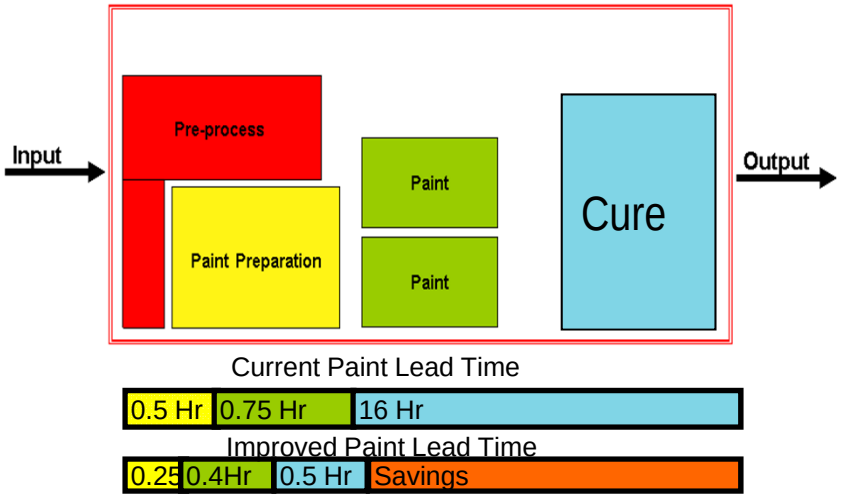
Funding Source: Rapat Industries

Research Project Objectives

Develop a document that reflects research and identification of a paint system that can adequately address the current and future needs of the Rapat Corporation.

Team Deliverables

- Document Current Paint System
- Research Paint System Options
- Recommend Improved Paint Systems
- Document Cost and Time Savings
- Recommend Future Projects



RECOMMENDATIONS / BENEFITS

Three Proposals Pertaining To Capital Investment

- Cure Oven – Reduces Curing Time
- Powder Coat Booth – Improve Ventilation & Quality
- Chemical Wash System- Speeds Up Preperation Time

Purchase Hose Spools

- Decrease painter travel Distance
- Increase time available to paint

Parking Lot Spots for Fabricated Material

- Decrease Material Handler Time
- This includes looking for and moving parts

Utilize Both Booths In Between Paint Coats

- Increase Painter Utilization By 20%

Utilize 2nd Employee to Paint when Available

- Increase Throughput

Economic Analysis				
Costs		**Savings**		
Annual Utilities	Equipment Cost	Coating	Quality	Time
$12,000	$179,931	$70,241	$8,303	$14,000
Total	**$191,931**	**Total**	$92,544	
Simple Payback Period **2.23 Years**				

Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

Facility Expansion Plan

Project Team Members: Bryan Gefroh,, Brooke Pulkrabek, Jason Materi, Megan Aaseth, Carah Barrett, Amanda Girodat.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

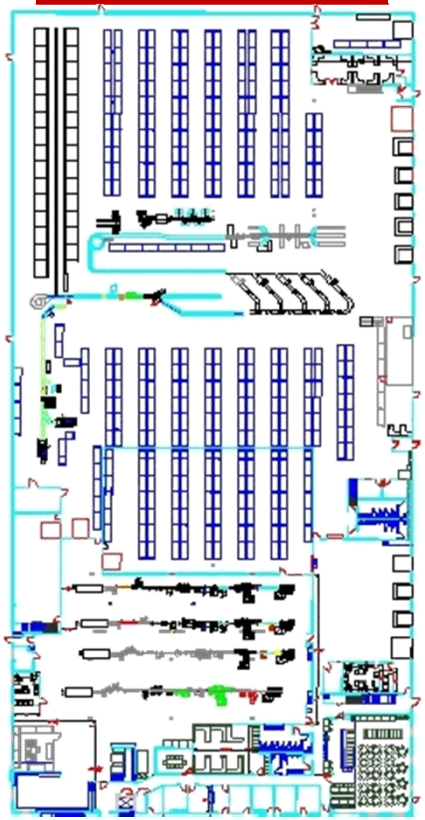
Department: Industrial and Manufacturing Engineering

Funding Source: Swanson Health Products

Research Project Objective

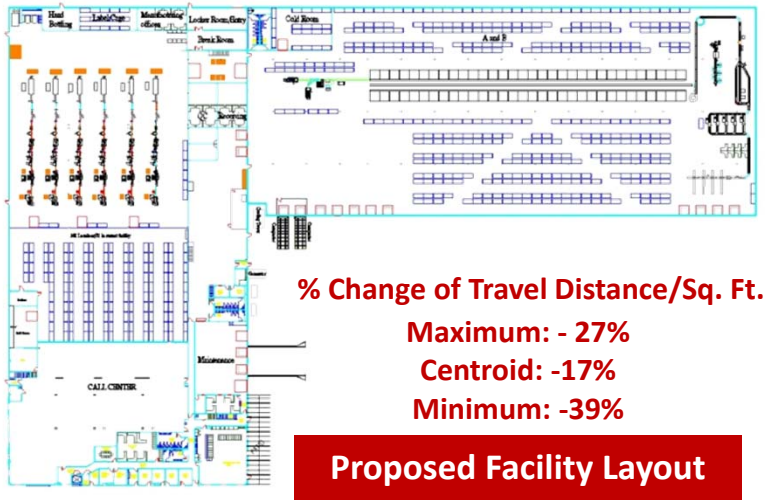
- Study, analyze, and document the requirements of manufacturing, order fulfillment, material handling, and storage/warehousing for the purpose of developing alternative layouts that can be used for the facility's planned expansion.
- Integral to this project is the development of a plan that facilitates the move into the expanded facility.

Current Facility Layout



Project Deliverables

- Documentation of processes & material flow
- Develop a layout that utilizes the facility expansion and accommodates alternative equipment and systems
- Benefit analysis of proposed solutions
- Move plan which minimizes downtime
- Recommendations for future projects & improvements



% Change of Travel Distance/Sq. Ft.
Maximum: - 27%
Centroid: -17%
Minimum: -39%

Proposed Facility Layout

Benefits of Proposed Layout

- Material flow reduces material handling and is critical to an efficient layout
- Flexibility is necessary to accommodate future growth
- A meticulous move plan is necessary to accomplishing a move of this magnitude

Move Plan Summary

- Cost of move plan will be $97,685.50
- Does not include the cost of any temporary systems or rental equipment
- 7-day move plan for order fulfillment
- 3-day move plan for manufacturing

Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

Order Picking Improvements

Project Team Members: Aki Yanagi, Shaun Phipps, Kelsey Foldesi, Laura English.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

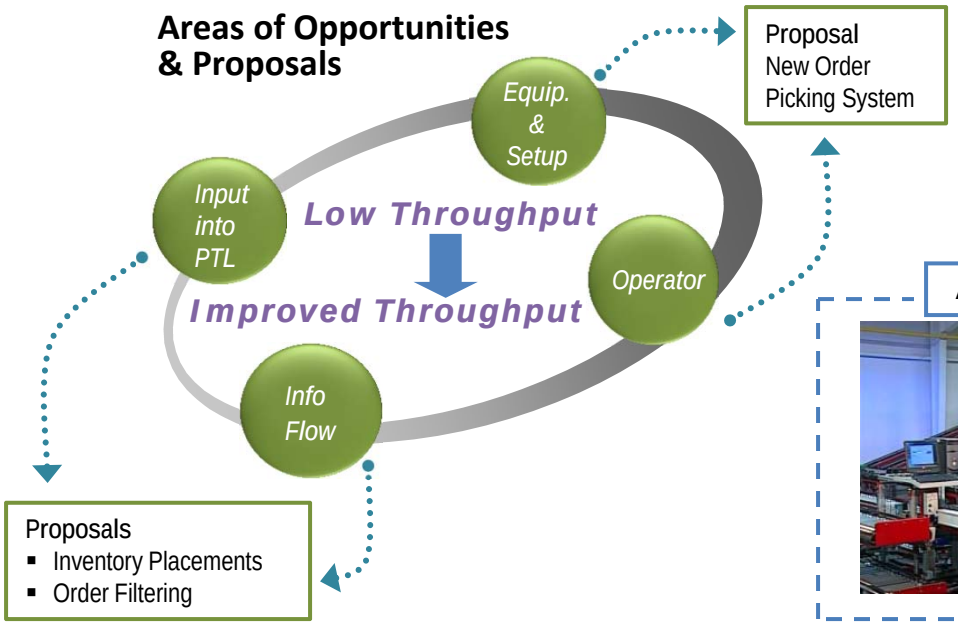
Funding Source: Swanson Health Products

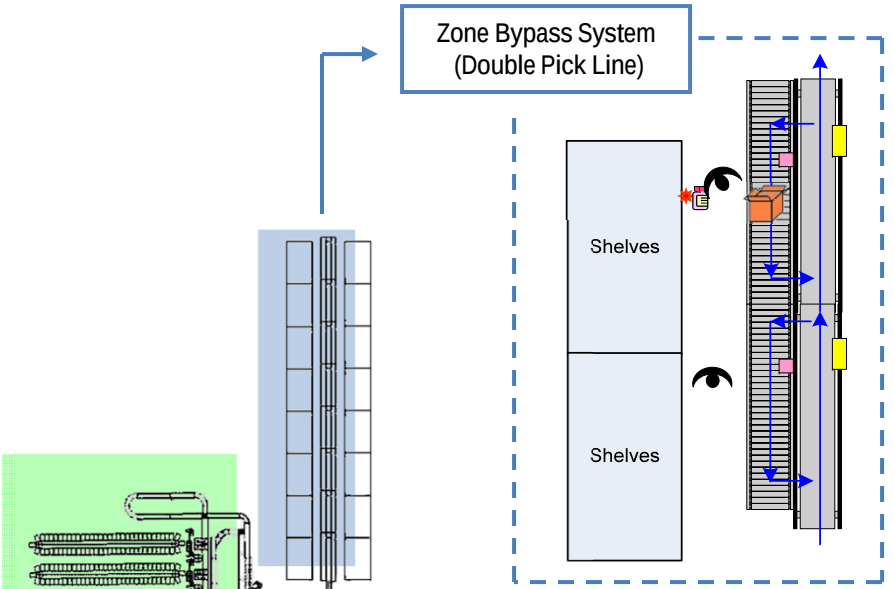
Research Project Objective

The purpose of this project is to analyze and develop proposals that can help to improve the order picking throughput at Swanson Health Products.

Deliverables

- Documentation of current order picking process.
- Documentation of proposals for improved throughput.
- Cost/benefit analysis for proposed improvements.
- Outline of the opportunities for future projects.





Benefits

- Throughput increase: 11000 → 18000 orders/day
- Balanced workload among zones
- Reduced manual handling of boxes

Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

Wil-Rich
Material Handling Analysis and Improvements

Project Team Members: John Kline, Eric Wieland, Jeremy Hjelseth, Adam Gumke.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Wil-Rich

Research Project Objective

The purpose of this project is to study, analyze, and develop proposals to improve the material storage and handling, as well as material delivery schedule to the fabrication shop.

Project Team Deliverables

- Documentation of current raw material and
- information flow processes
- Analysis of current processes
- Proposed improvements for processes
- Economic analysis reflecting potential benefits of
- proposed recommendations

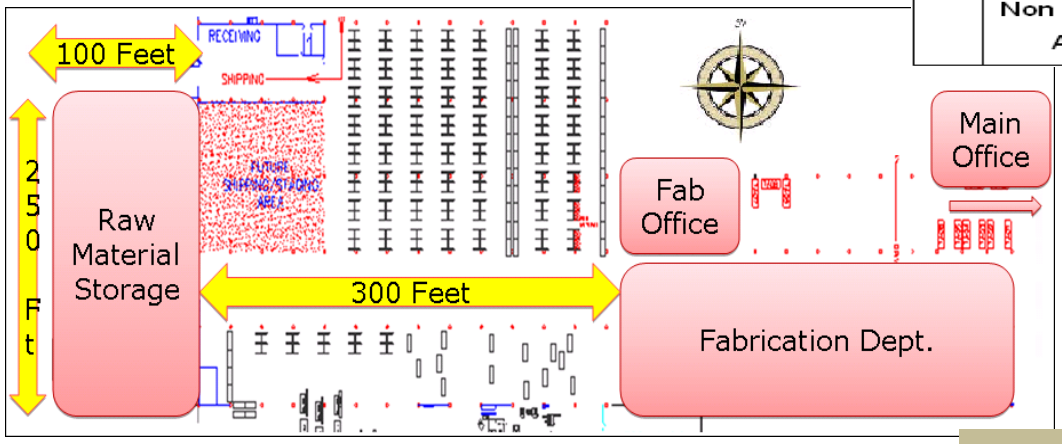
Recommendation

- Optimize Batch Picking Model
- Streamline Information Flow
- Combine current Work Order and Pick Slip into Traveler
- Incorporate Planning Board
- Proactive Scheduling

Improvement Breakdown

Information Flow	Proactive Scheduling	• Visually see trends and patterns of machine usage
		• Planning board will allow forward thinking and scheduling
		• Planning board will allow travelers to be ranked by priority
		• Hot orders easily inserted in planning board when necessary
	Combination	• Work order combined with pick slip
		• Elimination of the pick slips
		• Paper work reduced by 22%
		• Combine traveler orders to eliminate redundant trips
	Non Value Added Activities	• Reduce amount of retrievals by Material Handler
		• Creation of work order and pick slip is now one step of creating a traveler
		• Only one document needed for data entry

Current Facility Layout



Potential Economic Annual Savings

- **Distance: 288.06 Miles**
- **Time: 17,250 Minutes**
- **Dollars: 18,488.92**

Spring Semester 2007

Integrated Program/Project Management and Capstone Experience

Wil-Rich, LLC
Paint System Analysis and Improvements

Project Team Members: Eric Vasko, Chris Dalland, Stu Black.

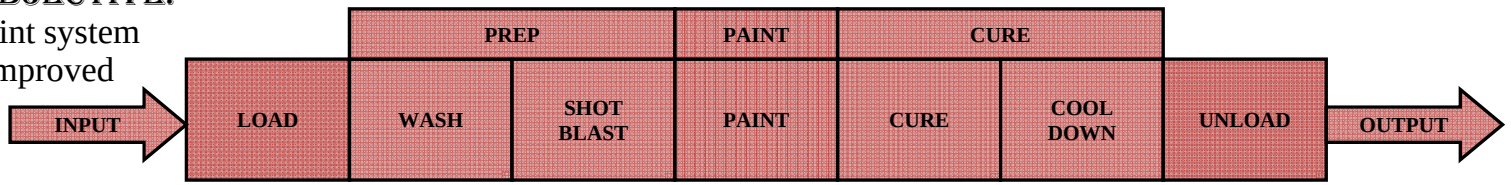
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Wil-Rich

RESEARCH PROJECT OBJECTIVE:

To study and analyze the paint system and develop proposals for improved throughput



PROJECT DELIVERABLES:

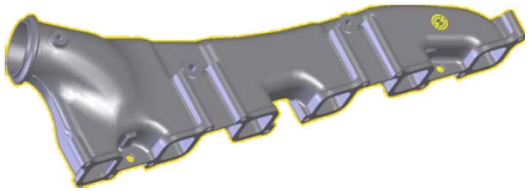
- Documentation of current paint line processes
- Documentation of proposals for improved paint line processes
- Documentation of economic analysis showing the impact of proposed improvements
- An outline of recommendations for future projects and improvements

		Potential Recommendation Benefits			
Painting Facility Sub-system Analysis	Processes	Reduce Rework	Decrease Line Shutdowns	Increase Throughput	Improve 5S
	Input	X		X	X
	Load				X
	Wash				
	Shot Blast	X	X	X	X
	Paint		X		
	Cure		X	X	
	Cool Down				
	Unload		X	X	X
	Output	X		X	X

PROPOSAL SUMMARY AND BENEFITS:

- Identified areas of improvement throughout the paint system
- Developed proposals for increasing system utilization and reducing part rework
- Developed proposals for increased cleanliness and safety throughout the paint system

Production Cell Analysis and Redesign



Project Team Members: Jacob Schnabel, Steve Martineau, Phil Wolf, Chelsea Buck, Sam Jacobson.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Dee, Incorporated

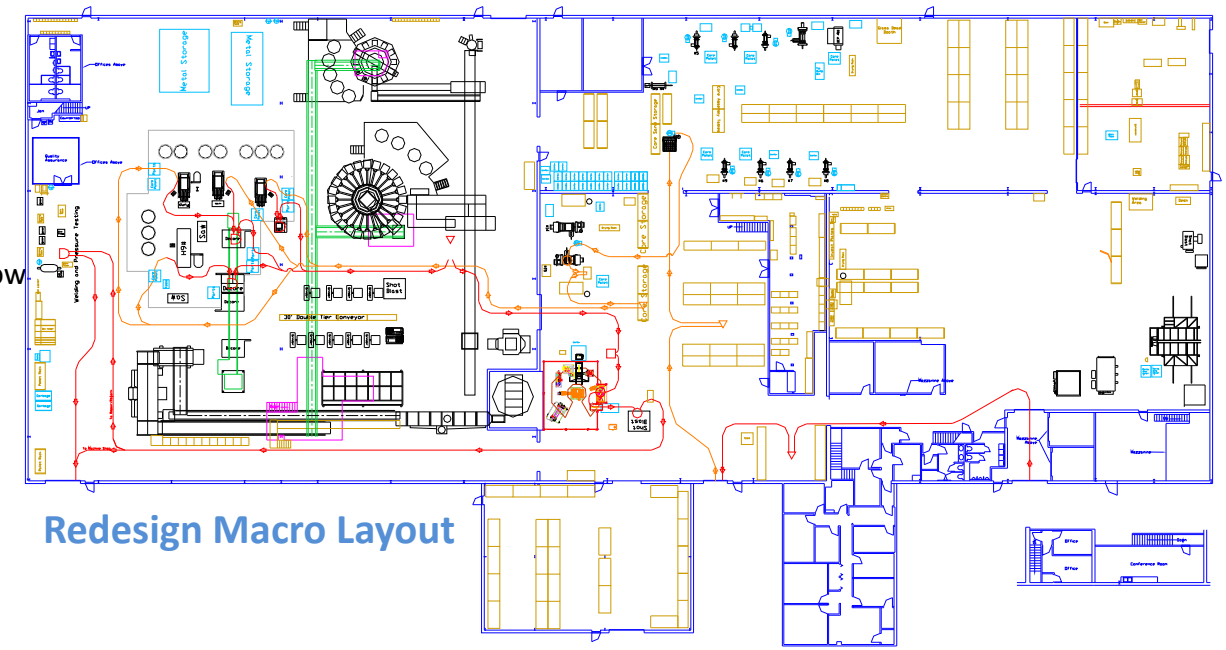
Research Project Objective

The purpose of this project is to study, analyze and improve the production line for the DD133A intake manifold including the layout, manufacturing processes, and material handling

Project Team Deliverables

Documentation of:

- Current layout and manufacturing process flow
- Proposed improvements for layout and process flow
- Cost and time savings from improvements
- Recommendations for future improvements



Redesign Macro Layout

Bottlenecks

- Permanent Mold
- Robot
- Machine Cell

Areas of Improvement

- Reduce Work in Process (WIP)
- Reduce Lead Time
- Increase Throughput
- Reduce Travel Distance for Parts
- Reduce Material Handling
- Move Inspection 'Up the Line'
- Soft Costs
- -Building Insurance
- -Overhead Costs

	Travel Distance (feet)	
	Without Rework	**With Rework**
Current	3,948	6,452
Proposed	3,375	3,826
% Changes	14.5	40.70

Project Benefits

- Reduced material handling
- Significantly decreased WIP
- Increased throughput
- Decreased optimal lead time

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

Fargo Tank & Steel
Decreasing Manufacturing Lead Time

Project Team Members: Ben Horejsi, Chad Consoer, Phil Siek, Santiago Garza, Jeremy Korczak.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

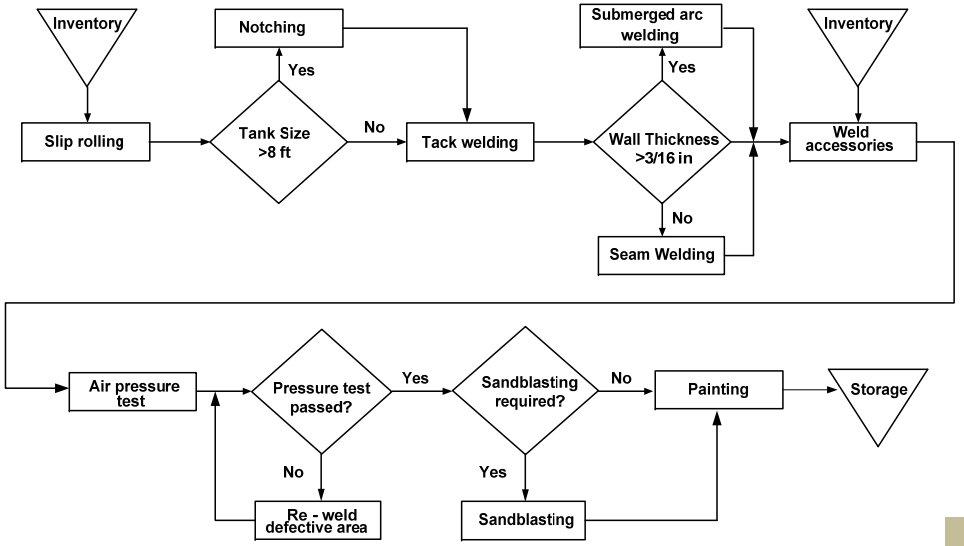
Funding Source: Fargo Tank & Steel

Research Project Objective

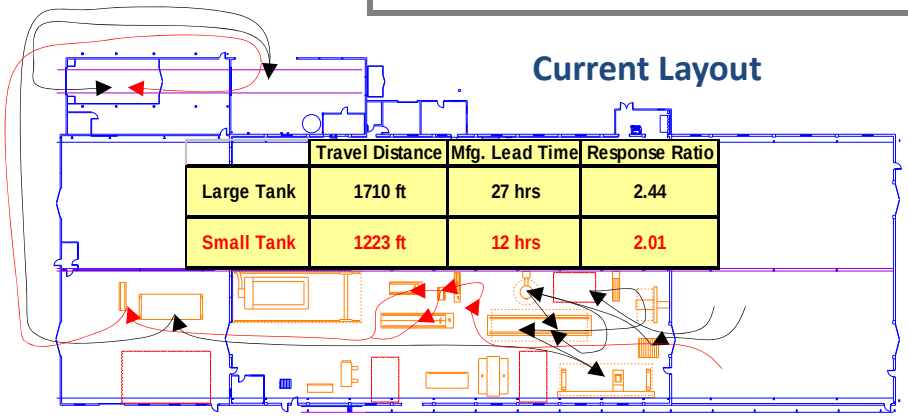
To document current layout and manufacturing processes, identify problems and make recommendations to decrease manufacturing lead time and increase throughput of tanks

Project Deliverables

- Documentation of:
- Current manufacturing processes, layout and flow of tanks
- Recommendations for to improving:
  - Manufacturing processes
  - Layout
  - Work in process inventory
- Cost and time savings for proposed improvements

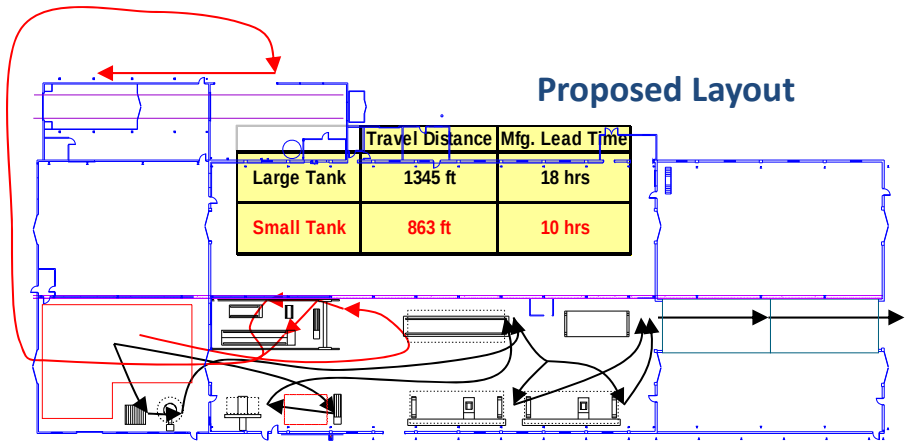


Current Layout



	Travel Distance	Mfg. Lead Time	Response Ratio
Large Tank	1710 ft	27 hrs	2.44
Small Tank	1223 ft	12 hrs	2.01

Proposed Layout



	Travel Distance	Mfg. Lead Time
Large Tank	1345 ft	18 hrs
Small Tank	863 ft	10 hrs

Benefits

Decreasing lead time will enable increased throughput
Reconfiguration of the layout will enable better tank flow

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

Fargo Tank & Steel Co.

Office Needs Analysis & Redesign

Project Team Members: Colby Grupa, Amy VanderLinden, Emily Tarr, Tom Mohagen, JT Rhode.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Fargo Tank & Steel

Research Project Objective

The purpose of this project is to develop proposals for improving the current office layout that will effectively utilize the space and meet the anticipated staff growth.

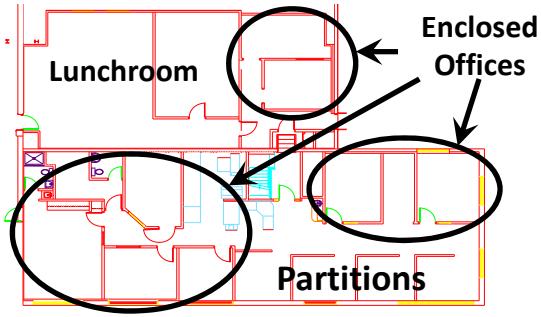
Team Deliverables

- Documentation of current layout and space utilization
- Documentation of proposals for redesigned layout
- Documentation of required budgets to support proposed improvements and cost savings
- Outline of recommendations for future planning and additional projects

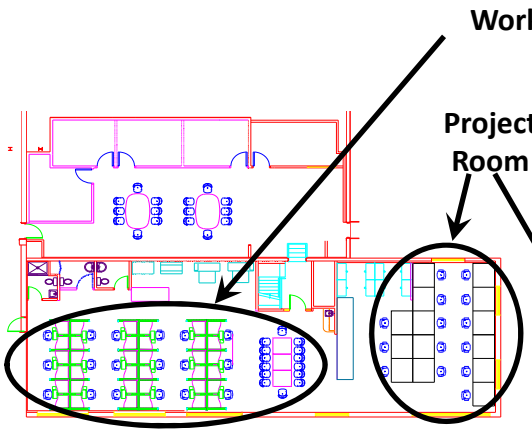
Recommendations

- A demolition and construction plan to create an open-office layout and allow for future growth
- Introduce systems furniture to utilize work area and promote efficient working environment

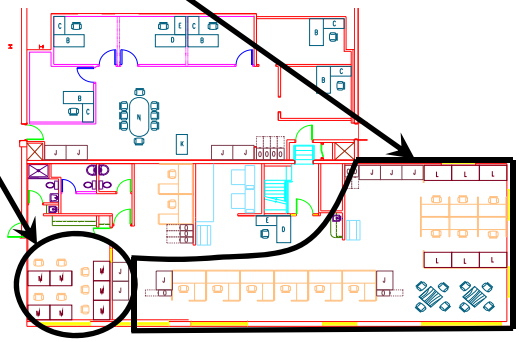
Zoning Space	Floor	Current	Proposed	
			Option 1	Option 2
		Square Feet	Square Feet	Square Feet
Work	First	2090	1227	1094
	Second	2055	2076	1678
Storage	First	105	99	40
	Second	144	47	207
Community	First	258	1265	1222
	Second	1161	575	545
	Employees	**25**	**32**	**30**



Current Layout – Second Floor



Proposed Layout One – Second Floor



Proposed Layout Two – Second Floor

Airbus A380LD Cell Layout and Cycle Time Reduction

Project Team Members: Mitch Keller, Adam Steinke, Adam Buckhouse, Jeremy Heim.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Goodrich

Research Project Objective

The purpose of this project was to redesign the A380LD manufacturing cell to help with reducing cycle time and increasing capacity

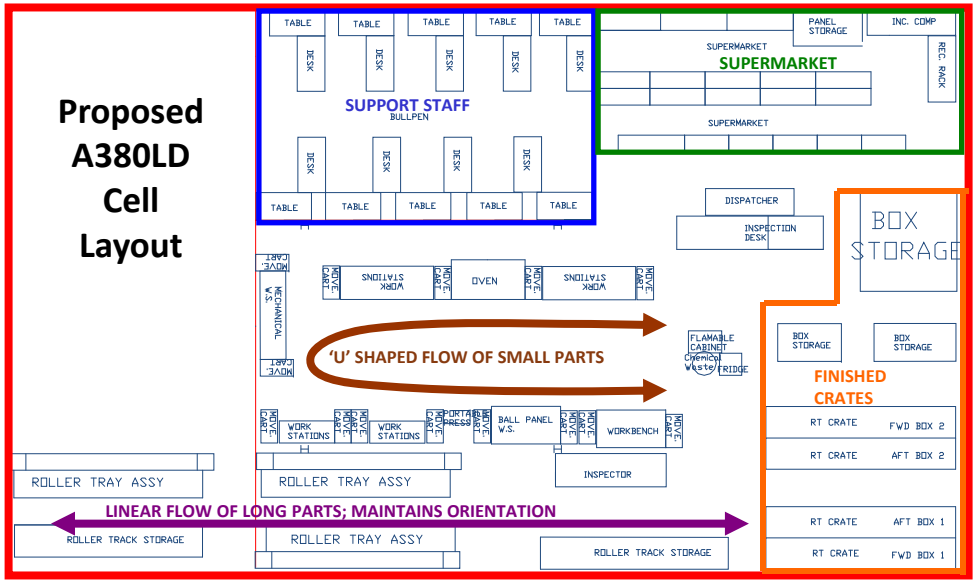
Team Deliverables

- Documentation of current manufacturing cell including the major issues effecting cell throughput
- Documentation of proposed cell addressing key issues utilizing lean concepts
- Documentation of cost and time savings that may result from implementing proposed solutions
- Document for implementation plan
- An outline of recommendations for future projects and improvements

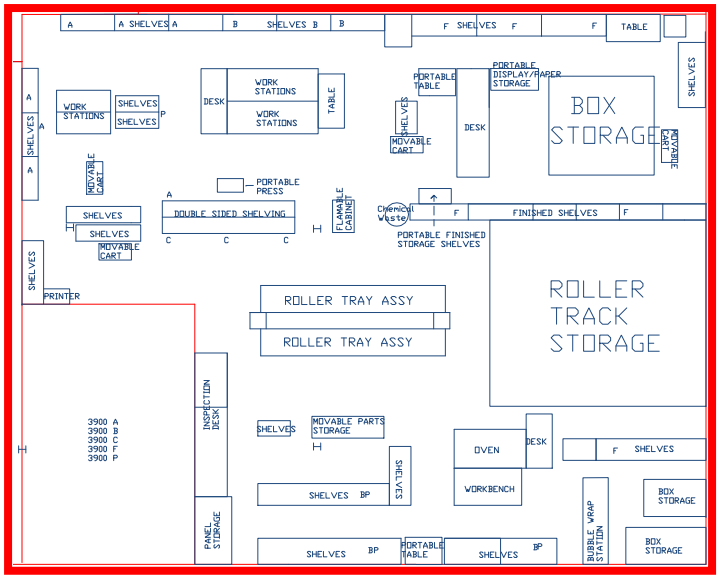
Techniques Used

- Design of kitting to reduce operator part collection
- Centralized parts storage/"Supermarket" optimization
- Eliminated non-value added operations
- Addition of three workstations (future growth)
- Improve existing assembly methods (workstation design, product design

Proposed A380LD Cell Layout



Current A380LD Cell Layout



Potential Benefits

- MLT reduced by 16%
- Operator travel distance reduced by 97%
- $8,500 cost savings per cargo system
- Support Staff area accommodates two more engineers
- Cell supports three additional workstations

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

Airbus A380 Lower Deck Packaging and Logistics Redesign

Project Team Members: David Bartholome, Yuriv Astanasov, Kristin Nuss, Adam Maus.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Goodrich

Research Project Objective

Develop Improved Processes and Procedures for the Packaging and Shipping Logistics for the Airbus A380LD Cargo Handling System.

Deliverables

- Documentation of Current Processes
- Documentation of Alternative Methods for Improved Packaging and Shipping
- Documentation of Cost and Time Savings
- Recommendations for Future Improvements

Cargo Handling System

Improving Process

- Standardize Packaging Process
- Standardize Packaging Material

Explore Alternatives

- Reusable Shipping Containers
- Methods of Transportation
- Eliminate Repackaging in Hamburg

Current Packaging and Shipping Operations

Potential Benefits

Proposed Method	Range of Savings*		Remarks
	Min	Max	
Standardization	$750	$2,000	Includes 7.5 Hours Material Preparation Time
Packaging Material	$0	$400	Cost Savings Only
Shipping Method	$4,122	$6,571	Ocean
Total Savings/Shipment	**$4,872**	**$8,971**	
Total Savings/Year	**$243,600**	**$448,550**	1 Shipment/Week by 6/2007

* One Cargo Handling System (Savings Based on $25-$40 Wage)

Gremada Industries, Inc.
Material Numbering Transition

Project Team Members: Kyle Rolfson, Chris DeHaan. Shawn Nieuwsma, Jace Manning

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Gremada Industries

RESEARCH PROJECT OBJECTIVE

The purpose of this project is identifying what processes and procedures are affected and determine what material number cross-references are required to support operations at Gremada Industries, Inc. due to Gremada transitioning to a new business model

PROJECT DELIVERABLES

- ❑ Documentation of requirements for a new numbering system.
- ❑ Recommendations for a numbering system to satisfy the requirements.
- ❑ Recommendations for training employees.
- ❑ Recommendations for the use of Gremada's current infrastructure to support the proposed numbering system.
- ❑ Documentation of potential benefits.
- ❑ Recommendations for future projects.

RECOMMENDATIONS

- ❑ Additional production support and system analyst positions
- ❑ Additional computer monitors for production support
- ❑ New Wireless Data Collection System
- ❑ Mobile Wireless Data Collection Hardware
- ❑ Online Quality Assurance forms

POTENTIAL BENEFITS

- ❑ Better understanding of functional department needs
- ❑ Tighten inventory control
- ❑ Increase control over shipping and receiving
- ❑ Create an environment to explore engineering opportunities
- ❑ Accommodate new customers at a faster rate
- ❑ Increase employee access to information
- ❑ Reduce paper consumption inline with ISO requirements
- ❑ Establish organizational identity unique to Gremada

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

New Facility Design and Analysis of Supply Chain

Project Team Members: Scott Blegen, Ryan Schumacher, Scott Bader, Adam Guderian, Tim Mack, Matt Buchnan.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: IMAR Group, LLC

Research Project Objectives

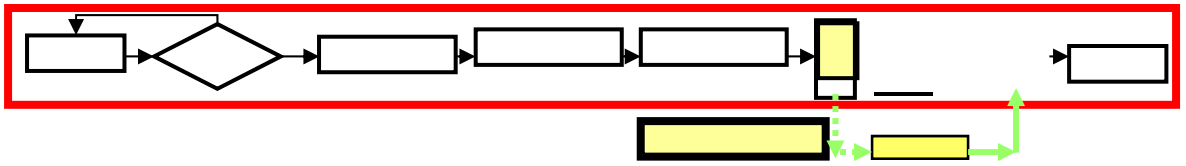
Develop a proposal for a new facility layout as well as a proposal for an improved supply chain to help IMAR Group, LLC meet expected growth and demand.

Project Team Deliverables

- ❑ Document the current layout, manufacturing and assembly processes, as well as procurement practices
- ❑ Document of recommendations for improved processes, layout and supply chain
- ❑ An outline of recommendations for future projects and improvements
- ❑ Documentation of cost and time savings that may result from implementing proposed suggestions

Station/Operation	Average Time (min)
Move Boat from Storage	82
Gel Coat	271
Fiberglass Shop	1597
Grind Shop	333
Engine Installation / Merging	334
Buffing/Inspecting	61
Final Assembly/Trailer	112
	46 Hours

Station/Operation	Average Time (min)
Move Boat from Storage	20
Gel Coat	80
Fiberglass Shop	1355
Grind Shop	212
Buffing/Inspecting	30
Final Assembly (Manufacturing Cells)	389
Trailer/Move Outside	10
	35 Hours



Current Building and Layout Capacity			
	Gekko	Sugar Sand	Total Boats
Per Day	1	1.8	2.8
Per Week	5	9	14
Per Year	250	450	700
Model Mix	*35%*	*65%*	

New Facility and Layout Capacity			
	Gekko	Sugar Sand	Total Boats
Per Day	2.5	4.5	7
Per Week	12.5	22.75	35
Per Year	625	1125	1750
Model Mix	*35%*	*65%*	

Proposed Layout and Supply Chain Recommendations

- ❑ Decreased mold transportation distances
- ❑ Side by Side gel-coating and fiberglass operations
- ❑ vs. single mold Bottlenecks
- ❑ Increased Curing area square footage
- ❑ Increased Grind Shop Capacity
- ❑ Decreased Buffing time
- ❑ Optimized Final Assembly Kitting
- ❑ Cellular Manufacturing Techniques
- ❑ Alleviated Finished Product Bottlenecks
- ❑ Trailer assembly close to shipping doors
- ❑ Develop Tool to Evaluate Suppliers
- ❑ Work to Establish Local Network of Suppliers
- ❑ Reduce some lead time issues
- ❑ Develop metrics to have better control over information flow
- ❑ Introducing a Kanban Ordering System
- ❑ Lead into MRP system
- ❑ Enhance 5S Program (housekeeping)

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

INFINITY® from MARVIN

Replacement Windows

Ultrex® Waste Reduction

Project Team Members: Hugh Medal, Eric Rossland, Peter Sedgeman, Dana Martin.

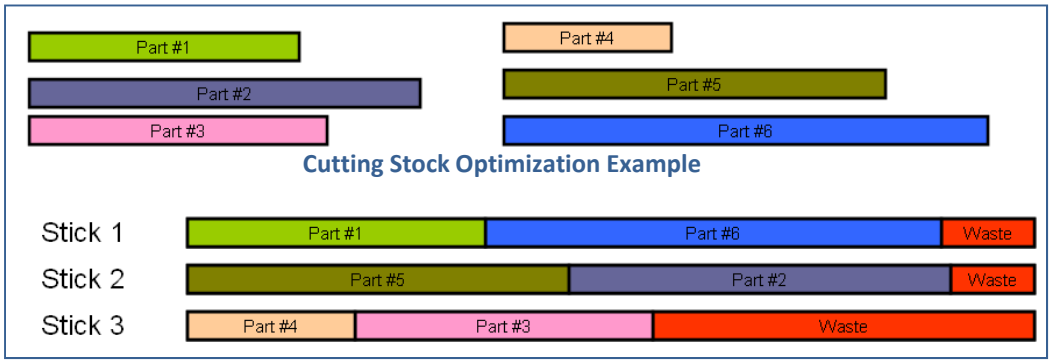
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Infinity Windows and Doors

Research Project Objective:

Analyze, refine, & document processes for reducing and accurately measuring Ultrex waste.



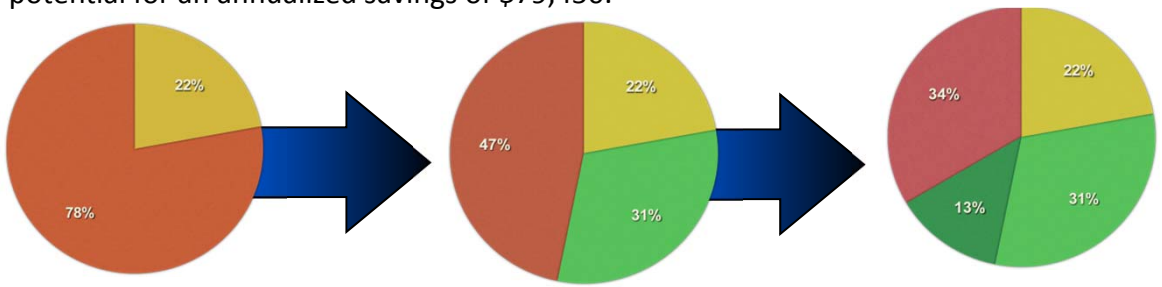
Project Team Deliverables:

- Documentation of current Ultrex utilization process
- Procedures for accurate measurement & disposal of Ultrex waste
- Methods for reducing waste
- Financial justification
- Recommendations for future projects & improvements

Recommendations:

- Change system to accommodate 2 lineal lengths of Ultrex and larger batch size
- Order and install self dumping hoppers
- Phase in computational weight recording method

Expected Benefit: Waste reduction (44%) and ergonomic improvements present potential for an annualized savings of $79,450.



Current Waste (22% Recovered Using Remnants)

2 Length Savings (31% Recovered Using 2 Lengths)

Batch Size Savings (13% Recovered Using Batch Size of 32 units)

Spring Semester 2006

Integrated Program/Project Management and Capstone Experience

Facility Layout Improvements

Project Team Members: Justin Brotzler, Brent Swanson, Kurt Landwehr.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

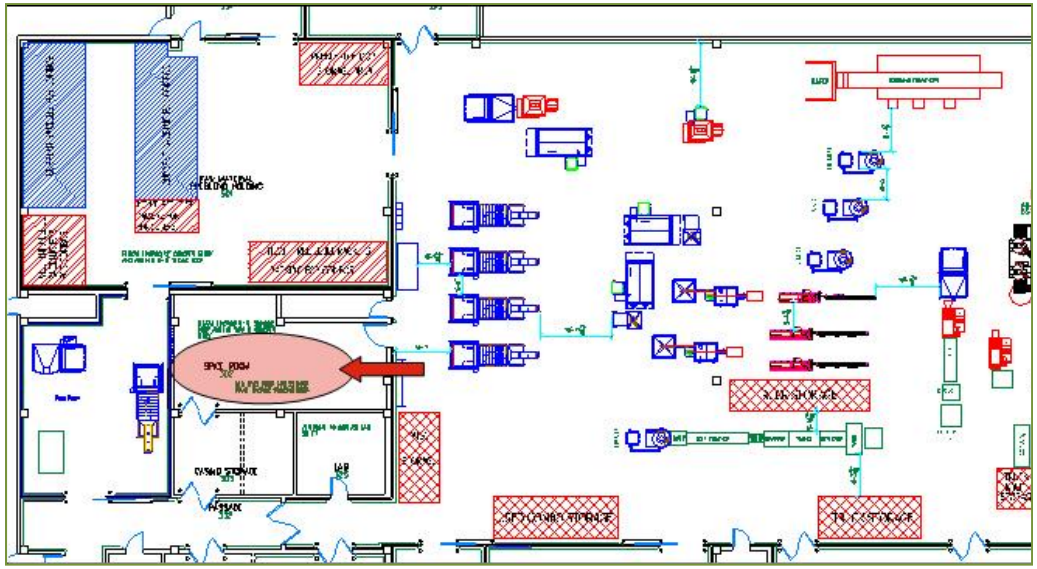
Funding Source: Cloverdale Meats

Research Project Objective

Provide the documentation of current and proposed process flow and layout in the production facility. Study and document operations for improved ergonomics in facility.

Project Deliverables

- Documentation of current and proposed production Kitchen area layout and flow
- Documentation of current and proposed material handling system
- Documentation of current ergonomic issues and recommendations for improvements



Time Savings Summary

Product Family	Current Dist Traveled	Proposed Dist Traveled	Total Savings
Emulsified	1884 ft.	608 ft.	1276 ft.
Coarse Ground	2339 ft.	1233 ft.	1106 ft.
Fresh Ground	881 ft.	623 ft.	258 ft.
Total Distance Traveled X 2 (1)	8446 ft.	2464 ft.	5982 ft.
Time @ 2.5 FT/Sec	3378 sec.	986 sec.	**40 min.**

Space and Investment Savings Summary

Floor Space Saved	SQFT
Cooler	638
S Side of Current	239
Cooler	325
Used Combo Storage	583
Total Storage Added	1785
Warehouse Space Saved	1202
Production Space Saved	583
Cost for Warehouse Space	$75
Cost for Production Space	$200
Total Cost to Add Space	**$206,746**

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

Material Handling Analysis

Project Team Members: Tadd Busch, Mike Lougheed, Mathew Mueller, Marcus Vetter
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

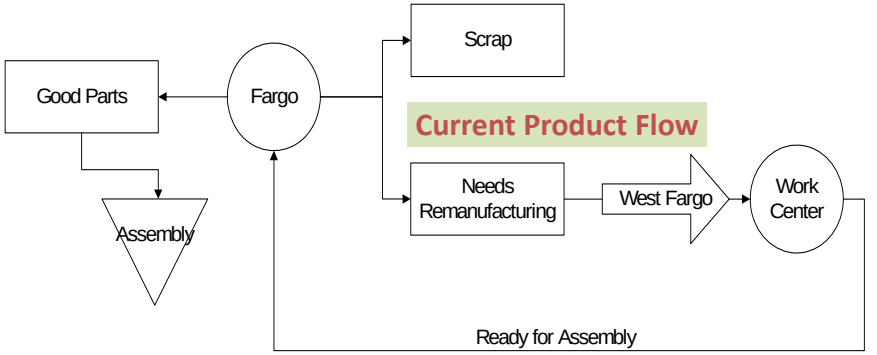
Funding Source: Gremada Industries, Inc.

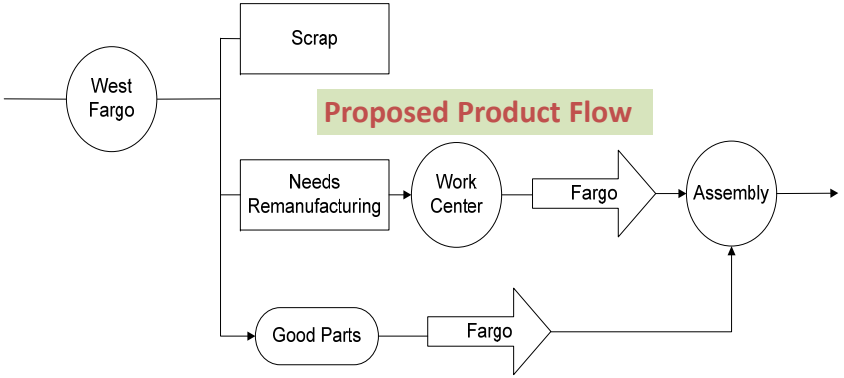
Research Project Objective

- Analyze material handling and its effect on warehousing cost
- Quantify the benefits and costs associated with relocating the inspection and disassembly of transmission units to West Fargo

Deliverables

- Document outlining recommendations
- Cost benefit analysis
- Future project recommendations





Potential Benefits

- More reliable data associated with material handling and transportation costs providing for better management decisions
- Improved product and process flow
- Reduced material handling and warehousing costs

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

New Facility Layout

Project Team Members: Lisa McCarvel, Tyler Albert, Derrick Tuma, Jordan Graff, Laura Anderson.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

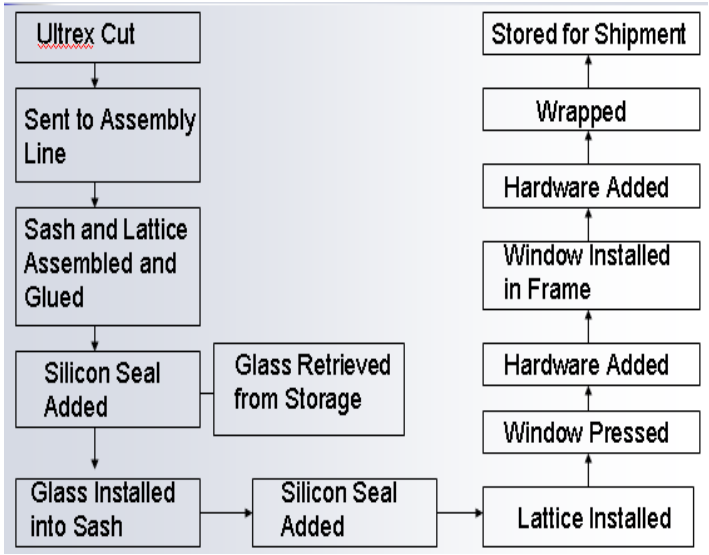
Funding Source: Infinity Windows and Doors

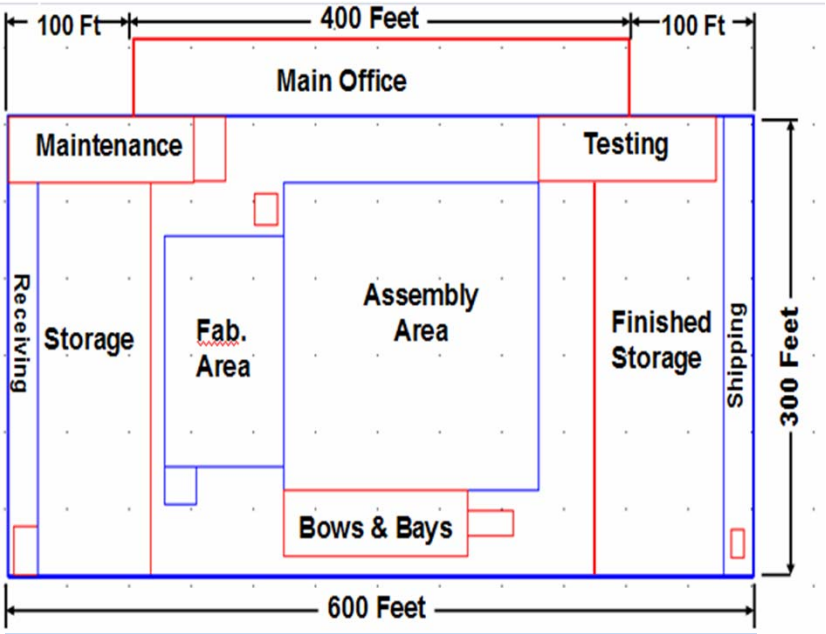
Research Project Objective

To develop a proposal for a new facility layout capable of meeting anticipated production needs and future expansion.

Project Team Deliverables:

- Document of current process flow, material handling, and storage requirements
- Detailed plan for new layout
- Cost estimate of the site preparation and building construction





Proposed Block Diagram Layout

Implementation Plan:

- Create schedule for moving into new facility
- Organize purchased equipment in new facility
- Move existing equipment gradually
- Train employees on new layout & equipment

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

NDSU ADVANCE

Childcare Facility Feasibility Study

Project Team Members: Andrea Keller, Brad Andersen, Holly Stadstad, Heidi Rogahn .

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: None

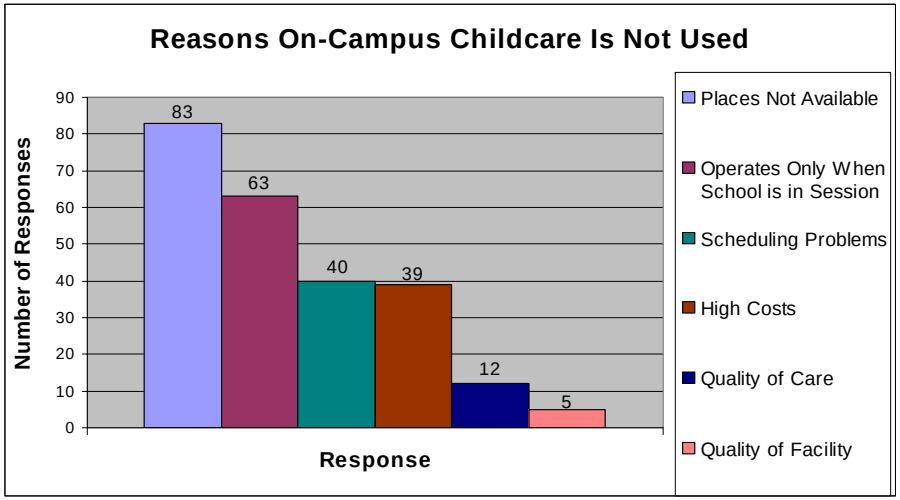
Research Project Objective

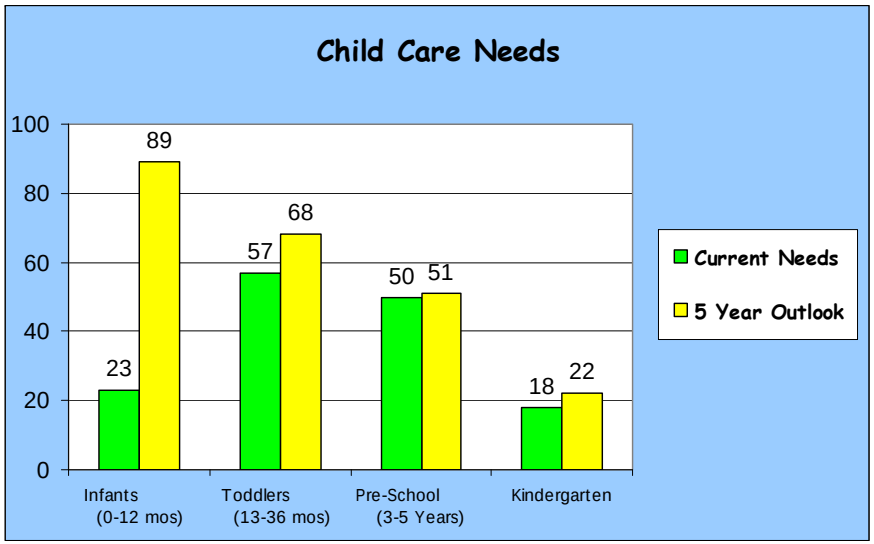
Determine the feasibility of establishing a full-service childcare center for faculty, staff, and students at NDSU.

Project Team Deliverables

Documentation of:

- Current and future childcare needs.
- Location and funding sources.
- Recommendations for future projects.





Recommendations

- Build new on-site childcare facility to be managed by NDSU or a 3rd party.
- Partnership with YWCA to assist with the expansion and use of its current facilities.

Project Benefits

- Provide child care services for NDSU faculty, staff & students.
- Increase employee satisfaction.
- Attractive benefit to recruit & retain young faculty and staff.

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

Sioux Manufacturing

Plant Layout and Process Improvement

Project Team Members: Brian Dodd, Ryan Schwoch, Charles Sloan, Travis Olson.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Sioux manufacturing

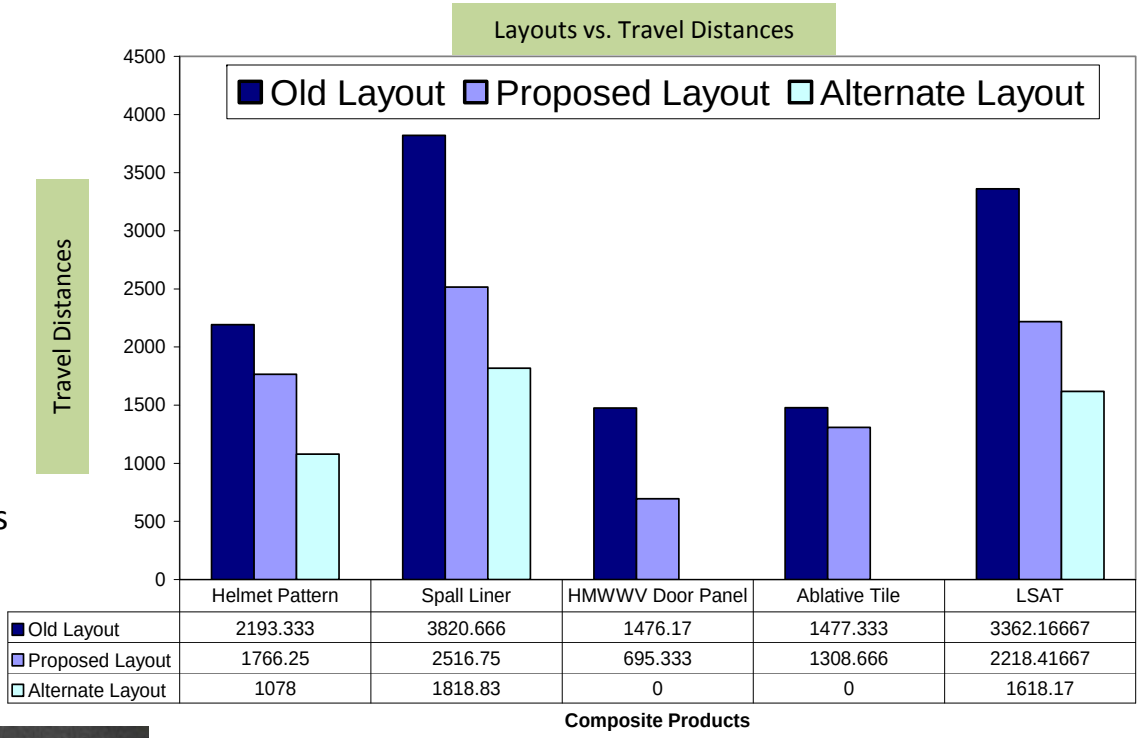
RESEARCH PROJECT OBJECTIVE

To study, document and evaluate the current layout, material and process flow and propose an improved plant layout that can contribute to improved throughput.

PROJECT TEAM DELIVERABLES

Documentations of:

- Current layout, material flow and processes
- Proposals for improved layout and processes
- Savings resulting from improvement proposals
- Recommendations for future projects



	Helmet Pattern	Spall Liner	HMWWV Door Panel	Ablative Tile	LSAT
Old Layout	2193.333	3820.666	1476.17	1477.333	3362.16667
Proposed Layout	1766.25	2516.75	695.333	1308.666	2218.41667
Alternate Layout	1078	1818.83	0	0	1618.17

Composite Products

POTENTIAL BENEFITS

- Improved productivity of some of the processes
- Improved quality
- Reduced travelling distances
- Increased throughput
- Improved safety and ergonomics

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

Bottling Operations Throughput Improvement

Project Team Members: Mike Rooks, John Rogstad, Phillip Gaugler, Brad Okonek.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Swanson Health Products

Research Project Objective

Develop and document a proposal that can help with increased bottling operations throughput.

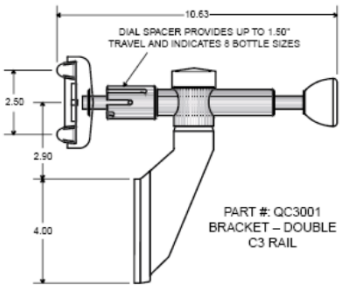
Team Deliverables

1. Documentation of current bottling process
2. Improving Bottling Operations throughput by use of setup reduction methodology
3. Economic justification of recommendations

Recommendations

1. Transfer Double Cremer cleaning operations from an internal setup to an external setup
2. Utilize Double Cremer Computer Programming capabilities to reduce setup time
3. Purchase Trackstar brackets to improve guide rail systems

Bottling Operation Layout CAD Drawing



Trackstar Brackets

Bottling Operations Throughput Increase			
	Cremer Cleaning	Cremer Standardization	TrackStar Brackets
Time saved	25 min	10 min	10 min
Setups Completed	4 per shift	4 per shift	0.333 per shift
Time saved per shift	100 min	40 min	3.33 min
Bottles filled per shift	2700	1080	90
Throughtput Increase per Year	675,000	270,000	22,500
Total Throughput Increase Per Year: 967,500			

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

White Earth Health Center

Improving Patient Access

Project Team Members: Audrey Rondeau, Nichole Haan, Alesia Schilke, Nick Zilka.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: White Earth Health Center

RESEARCH PROJECT OBJECTIVE

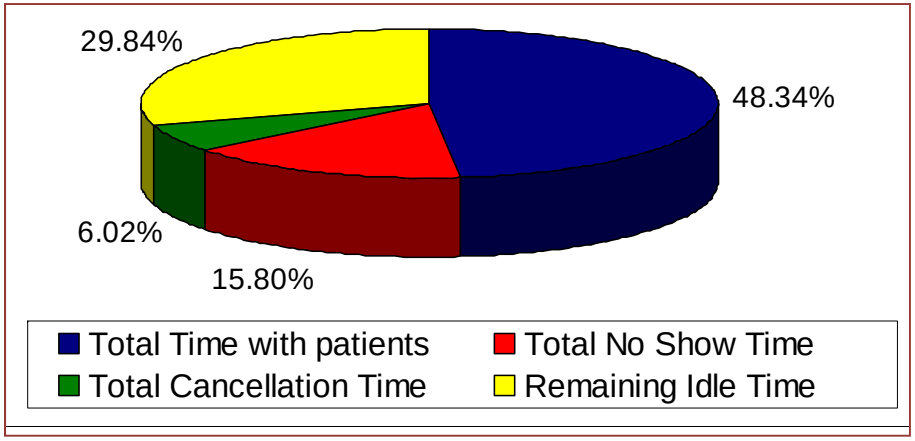
Determine and propose methods to improve patient access, by increasing the number of patients seen per provider through analysis, documentation, and recommendations.

PROJECT DELIVERABLES

Documentations of:

- Current appointment scheduling process
- Recommendations for addressing scheduling problems
- Recommendations to increase patients seen per provider
- Recommendations for future projects and improvements

Summary of Providers' Activities During the Study Period



RECOMMENDATIONS

- Reduce number of "ruled" appointment slots
- Reduce number of carved appointment slots
- Require providers' work availability three months in advance

Provider	Total Hours Currently Scheduled w/ Appointments	Total Hours Available for Appointments after Implementation of Recommendations	Additional Hours Available for Appointments after Implementation of Recommendations	Additional Patients after Implementation
1	68.00	86.65	18.65	36
2	78.75	98.88	20.13	39
3	82.50	88.27	5.77	11
4	60.50	74.21	13.71	26
5	39.00	53.74	14.74	28
6	15.75	22.93	7.18	13
7	0.00	0.00	0.00	0
8	34.00	42.15	8.15	15
9	32.50	39.19	6.69	12
10	63.31	92.77	29.46	58
			TOTAL	238

POTENTIAL BENEFITS

- Increase number of fifteen minute appointment slots able to be filled by general or follow-up appointments by 8.
- Help to reduce no show rates as patient's appointment will be scheduled while they are still at the health center.

Spring Semester 2005

Integrated Program/Project Management and Capstone Experience

Small Miscellaneous Parts (SMP) "Supermarket" Design

Project Team Members: Patrick Brandt, Tom Tveter, Josh Tysver, James Klein.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

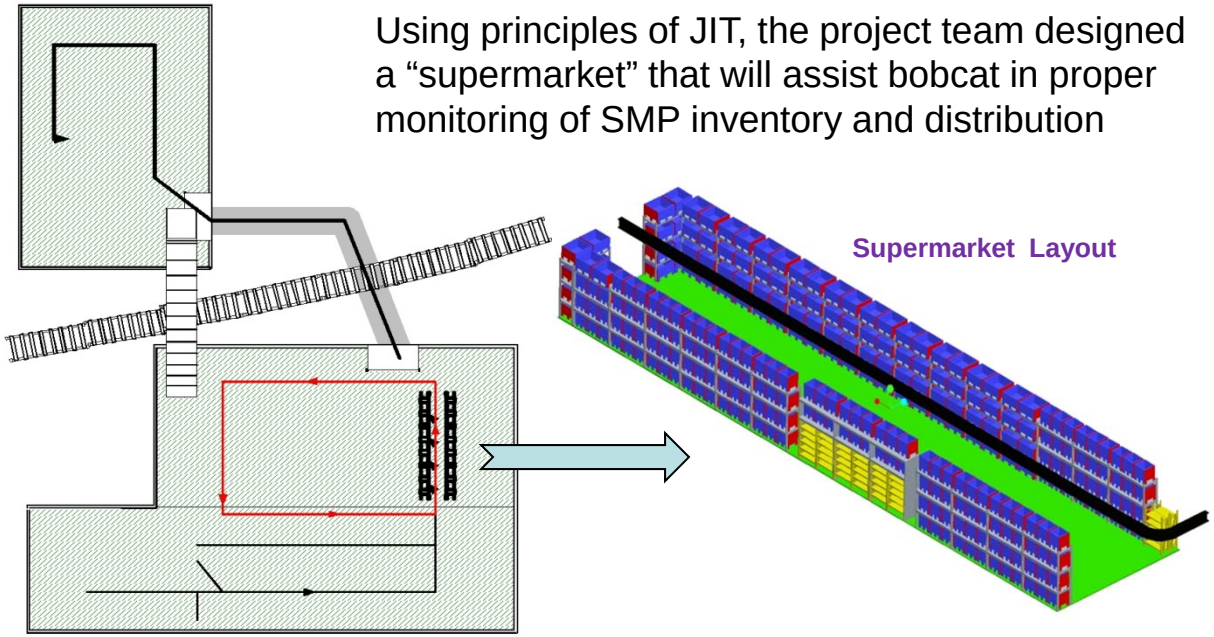
Funding Source: Bobcat

Research Project Objective

Design a centralized "supermarket" facility to be used for the storage and distribution of small miscellaneous parts

SMPs are produced and painted in Gwinner and used in the assembly of Bobcat skid-steer loaders

Using principles of JIT, the project team designed a "supermarket" that will assist bobcat in proper monitoring of SMP inventory and distribution



Project Deliverables

Documentation of

- ❑ Layout and hardware requirements for the "supermarket"
- ❑ Inventory replenishment policies for the "supermarket"
- ❑ SMP delivery routes
- ❑ Recommendations for future projects

Potential Benefits

- ❑ System for monitoring of both painted and unpainted parts
- ❑ A more reliable delivery system for SMPs to assembly
- ❑ Reduced lead time
- ❑ Higher number of inventory turns
- ❑ Decreased material handling

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Design of a Flexible Assembly Device

Project Team Members: Neil Anderson, Chris Knipfer, John Bonicelli, Brian Thompson.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Braaten Cabinets

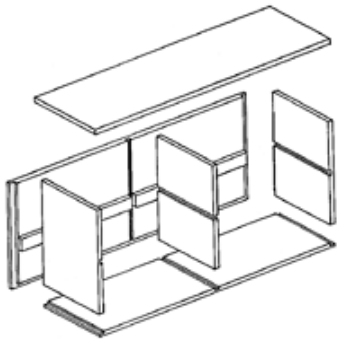
Research Project Objectives

Design a flexible holding device that will aid in improving cabinet assembly processes.

Project Deliverables

Documentation of:

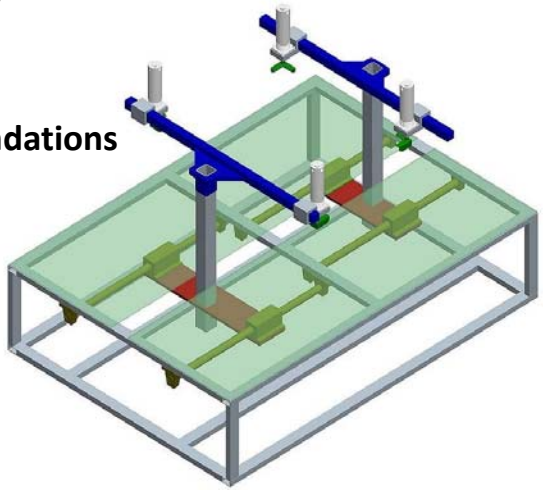
- Current Processes
- Proposed holding device
- Investment requirements
- Recommendations for Future Projects and Improvements



The Team designed a device that had the potential to:

- Reduce Assembly Time
- Improve Ergonomics
- Decrease Employee Turnover

Design Recommendations



Potential Savings and Payback Periods

Cabinets Per Day		Time Savings (minutes)					
	15	30	45	60	75	90	minutes saved/day
		374	562	749	937	1124	$ saved/month
		31	21	16	13	11	payback period (months)
		638	424	319	255	212	payback period (days)
	18	36	54	72	90	180	minutes saved/day
		449	674	899	1124	2249	$ saved/month
		26	17	13	11	6	payback period (months)
		531	354	266	212	106	payback period (days)
	24	48	72	96	120	240	minutes saved/day
		599	899	1199	1499	2999	$ saved/month
		20	13	10	8	4	payback period (months)
		398	266	199	159	80	payback period (days)
	30	60	90	120	150	300	minutes saved/day
		749	1124	1499	1874	3749	$ saved/month
		16	11	8	7	4	payback period (months)
		319	212	159	128	64	payback period (days)

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Material Handling & Ergonomics

Project Team Members: Greg Frey, Dan Anderson, Nathan Davis, Emily Ekeren.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

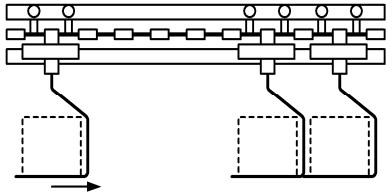
Funding Source: Dakota Growers Pasta Company

Research Project Objective
To develop a proposal and make recommendations for improved ergonomics through utilizing improved methods and equipment for material handling and packaging equipment loading.

Project Team Deliverables
Documentation of:
- ❑ Current procedures for material handling
- ❑ Detailed report on improved methods for material handling
- ❑ Cost benefit analysis for proposed solution
- ❑ Future project recommendations

Recommendations

Power & Free Conveyor System
- ❑ Transports two loads at one time
- ❑ Relieves the operator of carrying the load
- ❑ Basic
- ❑ Takes up minimal space



Fork Lift
- ❑ Adjustable height
- ❑ Maneuvers easily
- ❑ No scissor arm

Additional Recommendations
- ❑ Footwear
- ❑ Lifting Techniques - Training
- ❑ Stretching – Encouraged

Self-Leveling Cart
- ❑ Transports two or more loads at one time
- ❑ Relieves the operator of carrying the load
- ❑ Takes up minimal floor space

Recommendations	Cost	Benefit
Lift Truck	$12,200	Workers will not have to bend over.
Overhead Trolley	$5,400	Workers will be able to move corrugate easily.
Spring Loaded Cart	$500	Workers will be able to move corrugate easily.
Footwear	$1,600	Reduce foot fatigue.

Additional Potential Benefits of the Recommendations :
- ❑ Reduce worker injuries
- ❑ Reduce time loading magazine
- ❑ Reduce travel distances
- ❑ Labor time for load/unload

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Paint Line Productivity Improvements

Project Team Members: Dustin Jung, Chad McNea , Nathan Kent, Bo Hicks.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Integrity Windows and Doors

RESEARCH PROJECT OBJECTIVE

To develop a proposal and make recommendations for the material handling methods for loading, transferring, and unloading of wood parts to improve the overall productivity and quality of the paint line.

PROJECT TEAM DELIVERABLES

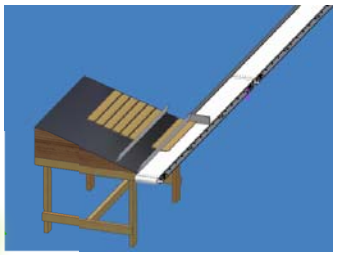
- Documentation of current processes
- Documents proposing improved material handling methods
- Cost justification for improvements
- Recommendations for future projects

RECOMMENDATIONS

- Automated in-feed loading system for Primer line
- Transfer with robotics from Primer line to Paint line
- Installation of ring wrapper in the unloading area of the paint line

RING WRAPPER

- Reduces amount of material handling for wrapping of pallets
- Decreases the amount of distance traveled for this process

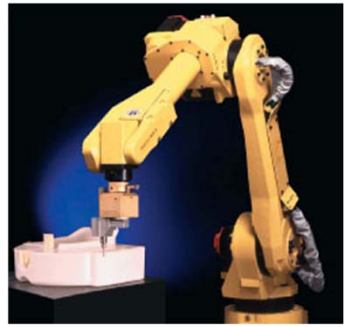


AUTOMATED IN-FEED SYSTEM

- Allows for operator to concentrate on inspection
- Consistency in the loading process and the release of parts
- Creates even spacing of product on the oven belt
- Increases the overall utilization of the oven belt

ROBOTIC TRANSFER

- Relieves operator from repetitive motions
- Reliable system for consistency in transfer
- Maintains the utilization from the priming process
- Minimal defects due to part handling



Recommendations have potential to help with:

- Improved throughput
- Decrease in labor input

Potential additional improvements in:

- Quality
- Ergonomics
- Employee morale
- Turnover rate

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Lake Agassiz Regional Library

Improving Methods for Processing Library Materials

Project Team Members: Amy Paul, Derrick Tuma, Jonathan Auel.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Lake Agassiz Regional Library

Research Project Objective

to study, document, and analyze the existing methods for processing library materials and propose a streamlined process and workplace layout.

Project Team Deliverables

- Documents for:
  - Current layout and methods
  - Improved layout and methods
  - Furniture and equipment specifications
  - Budget and cost benefits analysis
- Document of Recommendations for:
  - Material handling equipment
  - Future projects
  - Further improvements

Some Facts

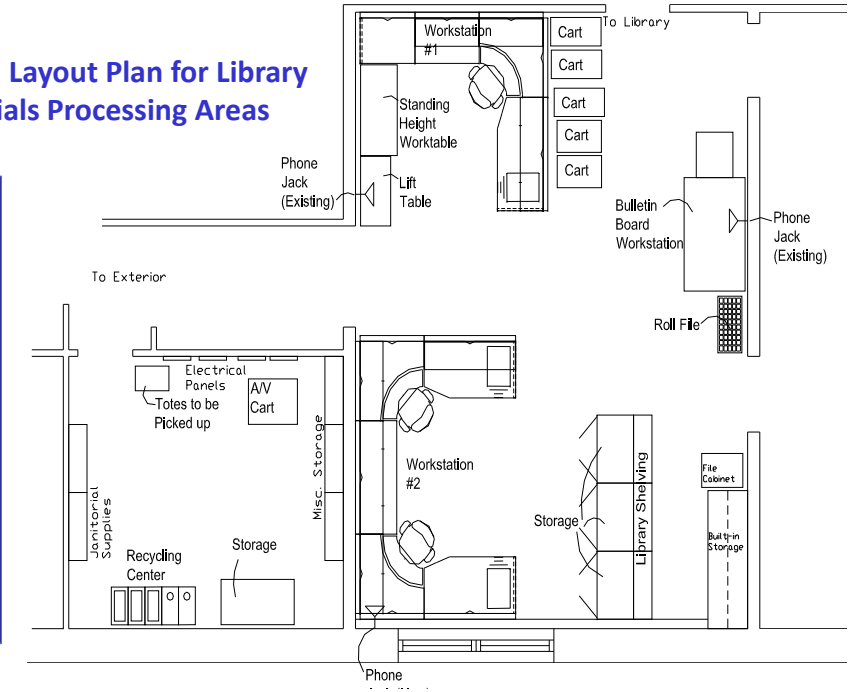
The library processes books, magazines, CD's, DVD's and donated items

2003: the library processed 163,000 materials

The work room where processing takes place is not designed to accommodate large numbers of materials efficiently

The number of materials processed is continuing to grow

Proposed Layout Plan for Library Materials Processing Areas



Problems Identified

- Material handling issues
- Cluttered work areas
- Inefficient process/workflow
- Outdated furniture and equipment
- Storage spaces not being utilized effectively

Proposed Solutions

New ergonomically correct furniture, up to date equipment, a more efficient process and a new layout with better usage of space was proposed.

Implementing proposed changes will:

- Accommodate future processing needs
- Utilize space more effectively
- Save processing time
- Increase safety
- Improve staff morale

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Operating Room Turnover Efficiency

Investigators: Chris Phillips, Melissa Kram, Chris Opskar, Randy Merkle.

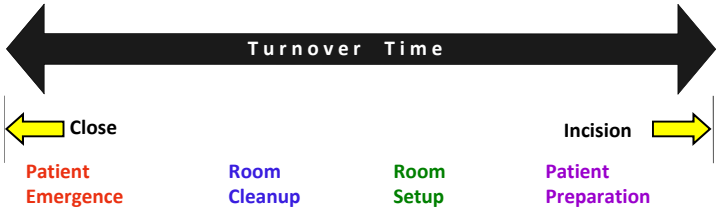
Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: MeritCare

RESEARCH PROJECT OBJECTIVE

To determine and propose methods to minimize the operating room downtime and recommend ways to improve efficiency and turnover rates.



PROJECT TEAM DELIVERABLES

- Documentation of the current turnover process of the operation room suites
- Document with recommendations for improving operating room suites
- Documentation providing cost benefit analysis for the proposed improvements
- An outline of recommendations for future projects and further improvements

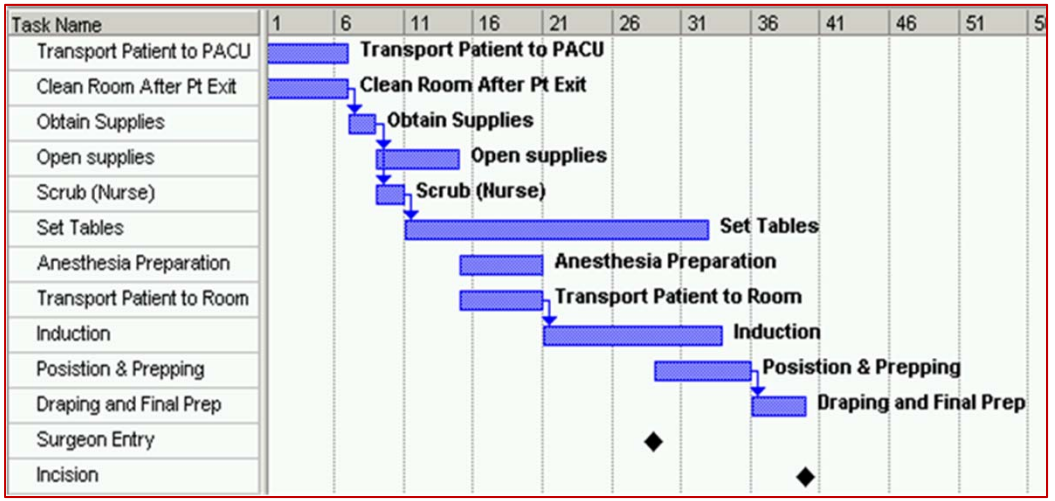
RECOMMENDATIONS:

- Early Patient Entry
- Local Certified Registered Nurse Anesthetist (CRNA)
- Front Loaded Anesthesia
- Redefining Patient Transportation

RECOMMENDATIONS INVOLVE:

- Parallel processing
- Reducing wait time and wasted time
- Redefining staff roles

Proposed Process



PROJECT BENEFITS:

- Implementation costs negligible
- Possible additional cases & revenue
- Increased surgeon satisfaction

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Error Rate Reduction in Order Picking

Project Team Members: Andrea McGhan, Ben Ostarello, Adam Jones, Sun Ho Nam.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Swanson Health Products

Research Project Objective

The objective of this project was to improve the quality inspection process for order picking.

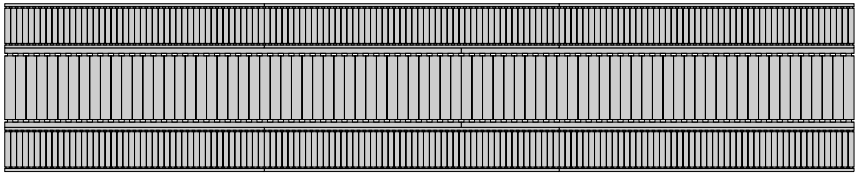
Project Team Deliverables

Provide Documentation for:

- Current process used for picking orders and quality inspection
- Recommendations for improving picking order process and quality inspection
- Recommendations for an improved order picking layout
- Cost benefits analysis for the proposed improvements
- Recommendations for future projects and further improvements

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17

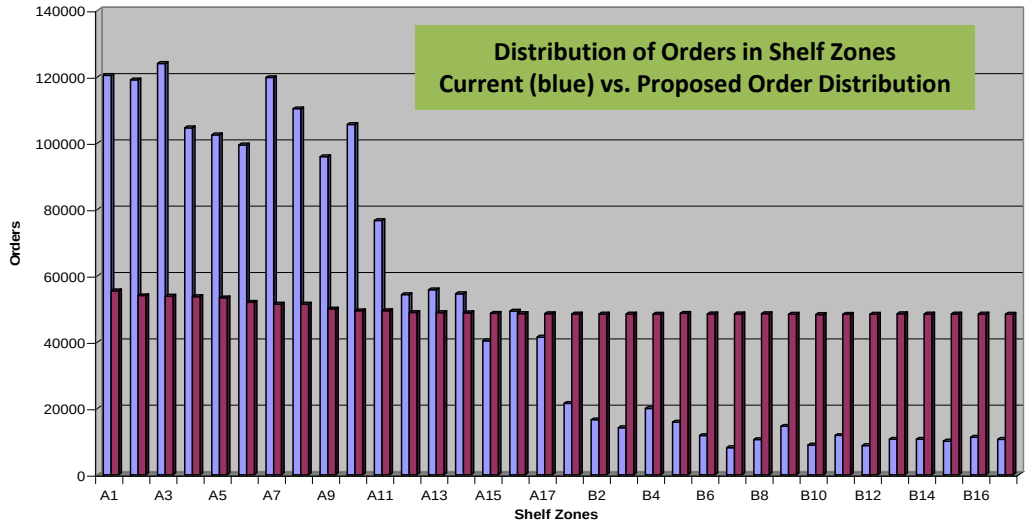
Order Picking Layout



A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17

Quality Assurance Alternatives

- Solution sought to replace current quality assurance methods and process
- Weight Scale is not best solution
- Alternatives:
  - Keep current inspection process but use fixed scanners
  - Begin eliminating inspection process
  - Best Solution: **Place quality into order picking process**



Potential Benefits

- Implementing the proposed layout will decrease error rate by reducing operator fatigue and separating similar sized products.
- An in-line scanning system will put quality into the process and eliminate the existing quality inspection area.

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

WCCO Belting, Inc.

Improving Press Department Throughput

Project Team Members: Phil Langevin , Karl Anderson, Josh Payne, Peter Ajo.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

Funding Source: Not Funded

Research Project Objective

Develop a proposals for improving the throughput of the press department while optimizing the number or operators through improved setup and operator interaction with the press equipment.

Project Team Deliverables

Documentation of:

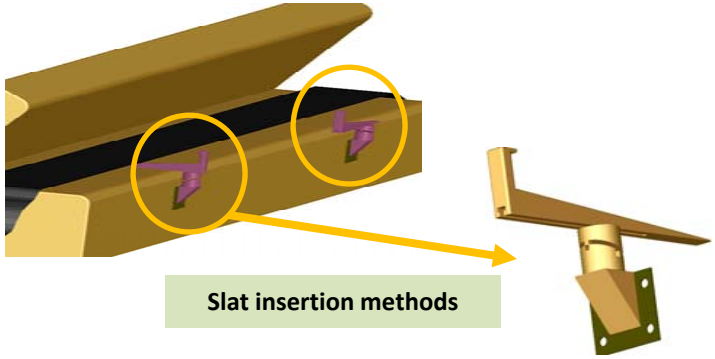
- Current methods of operations
- Improved methods and operator interface with press equipment
- Effective mix of products, people, and work-centers
- Economic analysis
- Recommendations for future projects

The recommendations made included proposals for improving the following:

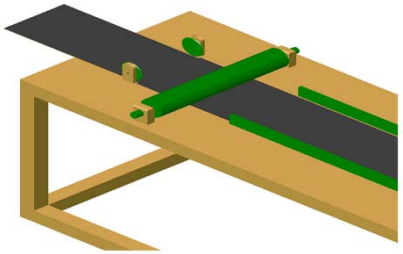
- Storage and retrieval of press plates.
- Slat insertion methods
- Trim operations
- Product/worker matrix

Potential Benefits

- Reduce worker movement and time to perform operations. In turn, this can help with:
  - reduce employee turnover rate
  - reduce worker fatigue
  - reduce insurance premiums
- Increase press uptime
- Improve employee and production scheduling



Slat insertion methods



Automated Trim Table

Time available per shift (min)	420	<< excludes breaks and cleanup			
Product	Flat Stock, 14 oz Press 8	MRT 1003541 Press 8	Swather belt, rubber slat 1001551 Press 1	Swather belt, rubber slat 1001551 Press 6	Totals (Averages)
Annual demand	500	800	1200	2000	4500.0
Monthly demand	42	67	100	167	375.0
Weekly demand	10	15	23	38	
Daily demand	2.1	3.3	5.0	8.3	18.8
Percent of total sales	11%	18%	27%	44%	
Takt time (min/unit)	201.6	126.0	84.0	50.4	**89.6**
Operator cycle time	154.3	154.6	151.4	161.2	**156.6**
Ideal # of operators	**0.8**	**1.2**	**1.8**	**3.2**	**2.2**
*Based on 5 section belts					

Product / Worker Matrix

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience

Analysis of Service Work Order System

Project Team Members: Deb Longtine, Bekki Majerus, Lucas Graunke, Tasha Hoffman.

Faculty Advisor and Consultant: Reza Maleki
Email: Reza.Maleki@ndsu.edu.

Department: Industrial and Manufacturing Engineering

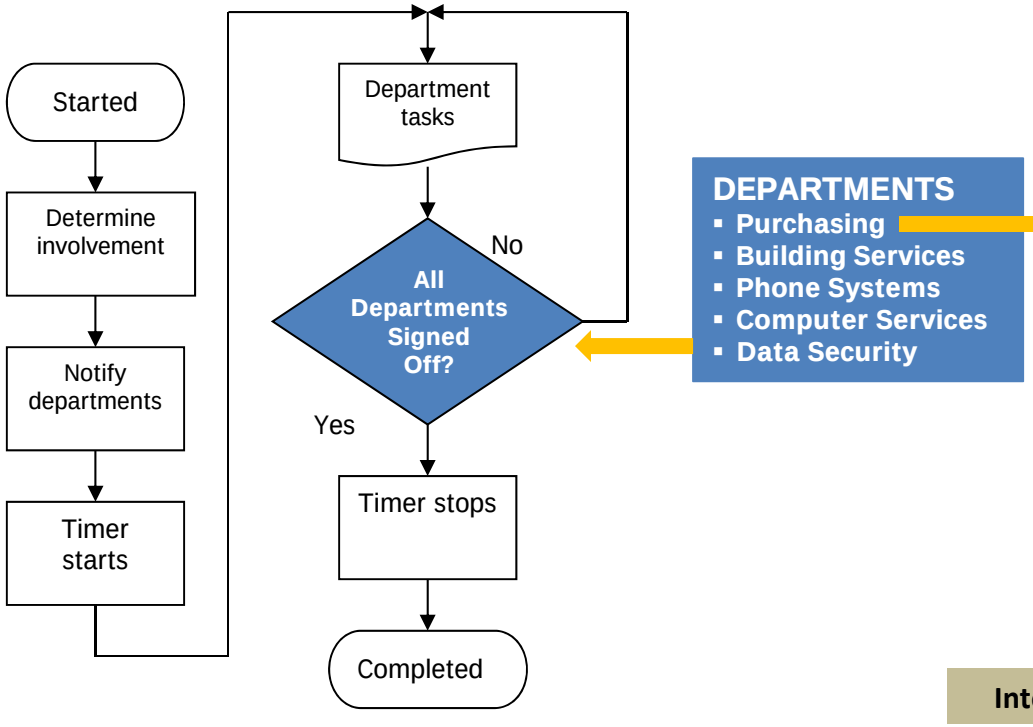
Funding Source: Noridian Administrative Services

RESEARCH PROJECT OBJECTIVE

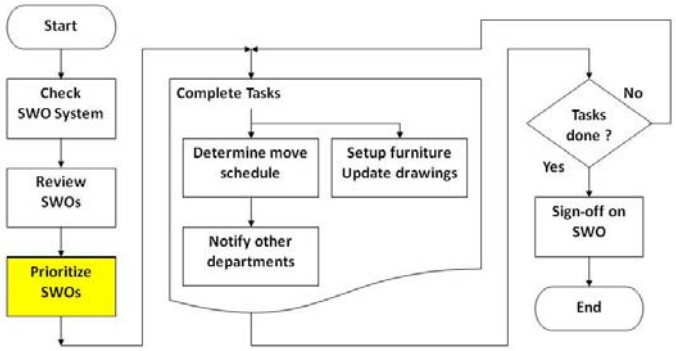
The objective of this project was to document the current service work order (SWO) system's process, any employee concerns discovered during the interview process, and a formal submission of any potential improvements the group recommends.

PROJECT TEAM DELIVERABLES

- ❑ Document describing existing SWO System process.
- ❑ Document detailing user feedback obtained during department interviews.
- ❑ Document detailing group recommendations.



DEPARTMENTS
- **Purchasing**
- **Building Services**
- **Phone Systems**
- **Computer Services**
- **Data Security**



RECOMMENDATIONS

- ❑ Hire SWO System Coordinator
  - ✓ Coordinate department schedules
  - ✓ Minimize overtime
  - ✓ Quality management
  - ✓ Avenue for voicing concerns
- ❑ Only notify involved departments
- ❑ Improve communication between departments
  - ✓ SWO team attitude

Potential Benefits

The recommendations should:

- ❑ Contribute to boosting employee moral and satisfaction with the current SWO System
- ❑ Better departmental coordination
- ❑ Minimizing overtime due to imperfect scheduling

Spring Semester 2004

Integrated Program/Project Management and Capstone Experience