

Wegman's Parbake Rounding Ergonomics - P12713

Brandon Bova – Team Lead, IE

Adam Hugunine – ME

Conrad Kloc – IE

Mike Marsillo – ME

5/18/12 @ 8:30 AM

Agenda

- Project Description & Customer Specs
- Concept Summary
- System Architecture
- Design & Fabrication Summary
- Testing Results
- Ergonomic Results
- Objective Project Evaluation: Success and Failure
- Opportunities for Future Work

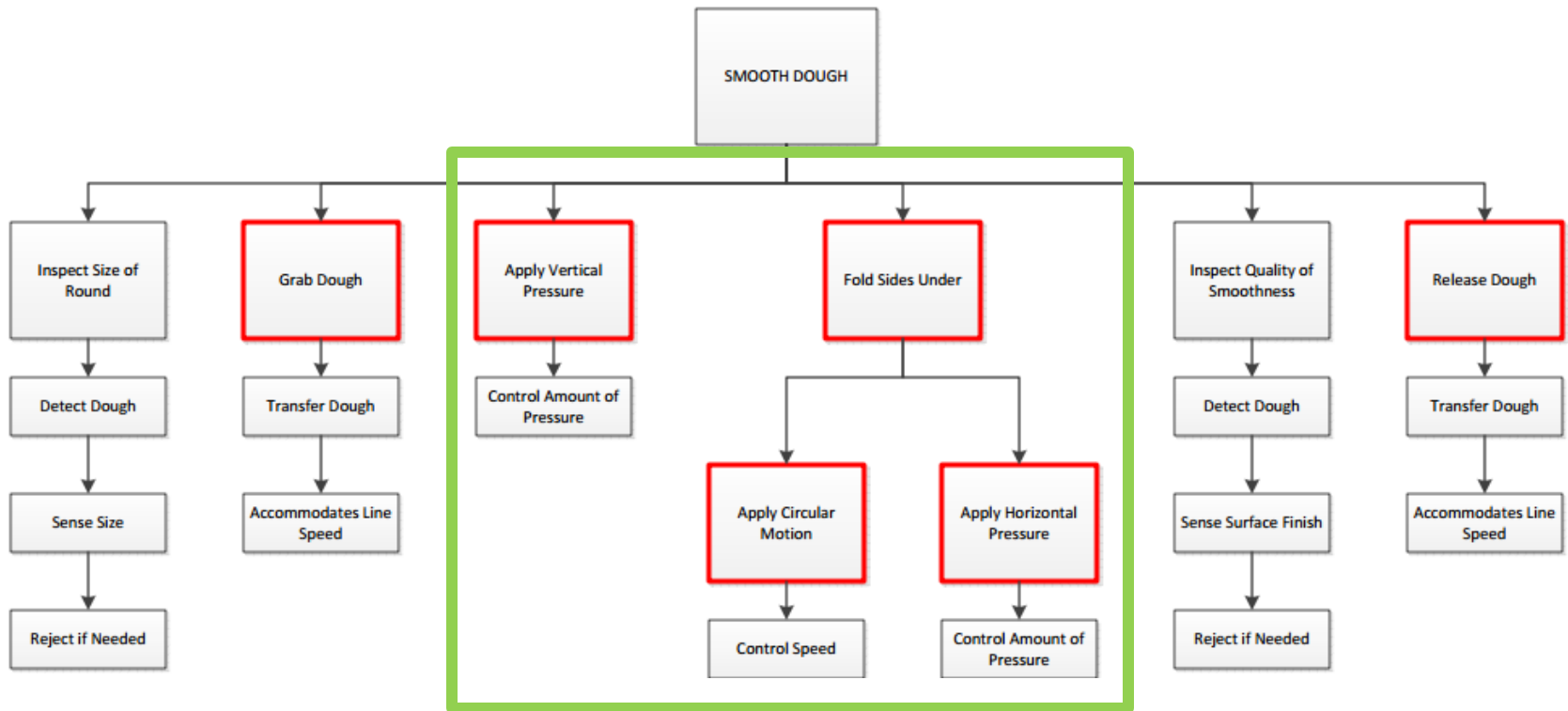
Project Description

- Improve the Wegmans Parbake line by reducing ergonomic injuries that may occur

Spec. #	Function	Specification (metric)	Unit of Measure	Marginal Value	Ideal Value
	Cost effective				
S1		Budget	dollars (\$)		
S2		Fits corporate ROI	years	<2 yrs	<1 yr
	Good Quality				
S3		Hand Made Look	go/no go	Go	Go
S4		Minimum Degassing	go/no go	Go	Go
S5		Low defect rate	percentage	<5%	0%
	Meeting demand				
S6		Improve Employee pacing	ratio (s/s)	<1	<0.5
S7		Production rate - Apple, RWB, CranOrange, Cinna, 3 varieties of Round Rye	loaves/min	44	>44
S8		Production rate - Round PDC	loaves/min	34	>34
S9		Production rate - Tuscan	loaves/min	38	>38
	Safety and Ergonomics				
S10		Effort Level	1-4	2	1
S11		Time per Effort	1-4	1	1
S12		Efforts per Minute	1-4	4	3
S13		Task Duration	1-4	3	2
S14		Number of Employees	1-4	2	2
S15		Recordable Strain/Sprain Injuries	1-4	3	1
	Improving Productivity				
S16		Quick Changeovers	minutes	<30	<15
S17		Effective Utilization of Space	Sq'm	<16.25	<2
S18		Minimize Handling of Products	seconds	<3	<1
S19		Reduce Downtime	minutes	<15	<5
S20		High Reliability	percentage	>95%	100%
S21		Operator Feedback Test	1-5	>3	5
	Food Safety				
S22		Material Grade for Production	material grade	Food Grade	Food Grade
S23		Materials touching Food	qty	Minimum	Minimum
S24		Exposed Material Type	unit	SS, PVC, UHMW	SS, PVC, UHMW
S25		Water Resistant	unit	Yes	Yes

Concept Summary

Functional Decomposition



- Focused our design efforts in this more critical space

Concept Summary

- The team evaluated 4 different designs
- Decided on the Twister since it included the advantages of other designs without the disadvantages

Mold with Rollers

Plus	Minus
Gives rotational contact	Flush with the table top
Gives tucking motion	Hard to tuck under the dough
Operator interaction	Seams staying on the sides of the dough
Can utilize rotating arms	Different dough sizes means different contact points
	Only tucks from one half
	Dough sticking on conveyors

Ice Cream Scoop

Plus	Minus
Gives better tucking motion	Flush with the table top
Operator interaction	Hard to tuck under the dough
	Seams staying on the sides of the dough
	Different dough sizes means different contact points
	Contact point at two scrapers creates a twist
	Dough sticking on conveyors

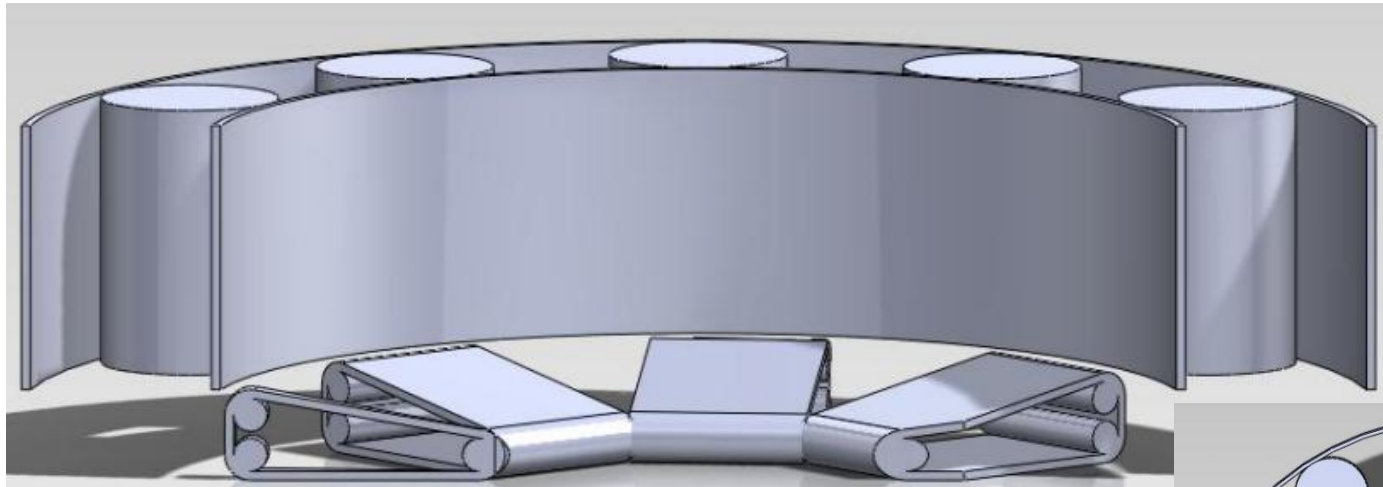
Drop & Pinch

Plus	Minus
Gives better tucking motion	Contact point at two scrapers creates twisting
Operator interaction	Dropping into the device difficult to keep shape
Able to get all the way around the dough	Flipping out of device difficult to keep shape
Tucks to a point	Dough rolls on itself while flipping out
Contact at all points since it drops in	Dough sticking on conveyors

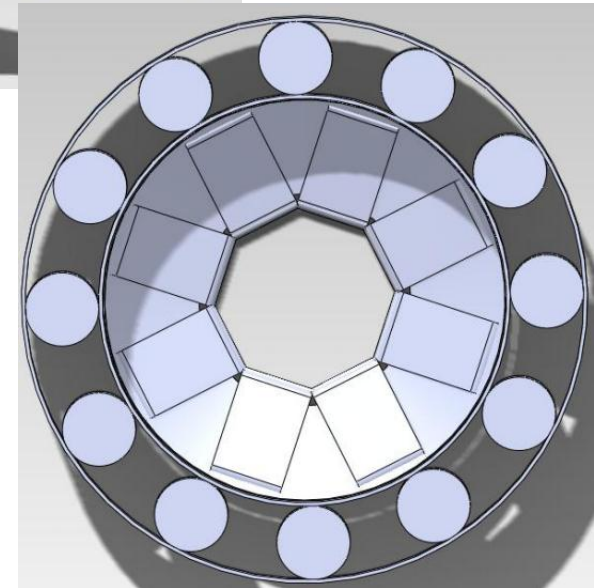
Twister

Plus	Minus
Gives tucking motion	How to get dough into the device
Operator interaction	Dough sticking on conveyors
Able to get all the way around the dough	
Tucks to a point	
Contact at all points since it drops in	
No flipping out of the device	

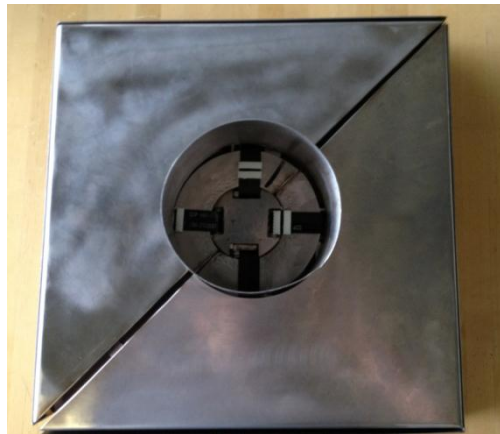
System Architecture



- A concept design was drawn up in SolidWorks
- A full CAD assembly with tolerances was never completed prior to the start of fabrication



Design/Fabrication Summary



Final Bill of Materials

Item	Quantity	Units	Unit Price	Total Price
Stainless Steel Top Enclosure - 1/8" thick	270.25	sq. in.	\$0.38	\$101.34
Stainless Steel Bottom Enclosure - 1/8" thick	302.81	sq. in.	\$0.38	\$113.55
Stainless Steel Top Ring - 1/16" thick	51.84	sq. in.	\$0.26	\$13.48
Stainless Steel Cone - 1/16" thick	17.82	sq. in.	\$0.26	\$4.63
Stainless Steel Center Piece - 1/16" thick	5.94	sq. in.	\$0.26	\$1.54
Roller - 0.5" diameter	4	each	\$11.41	\$45.62
Roller - 0.25" diameter	4	each	\$7.80	\$31.20
Roller - Electric Motor Drive	4	each	\$5.70	\$22.81
Conveyor Timing Belt - 40 D.P., 3/8" wide	12	each	\$3.00	\$36.00
Bearing - 1/8" diameter shaft	16	each	\$9.46	\$151.36
Conveyor Material	3	sq. in.	\$0.00	\$0.00
Aluminum Roller Assembly	48	sq. in.	\$0.73	\$34.94
Brackets - 1" L Brackets	10	each	\$0.47	\$4.70
Socket Head Screws - 6-32 x 1/4"	12	each	\$0.00	\$0.00
Nuts - 6-32	12	each	\$0.00	\$0.00
Socket Head Set Screws - 6-32	4	each	\$0.00	\$0.00
Electric DC Motor - 24V DC, RPM >= 240 rpm, Torque >= 1.125 in*lb	4	each	\$11.95	\$47.80
Electric Toggle Switch	1	each	\$3.99	\$3.99
Wiring Harness	1	each	\$0.00	\$0.00
DC Power Supply	1	each	\$28.00	\$28.00
AC Power Cable	1	each	\$4.50	\$4.50
			Total	\$645.47

- Estimated under \$5,000 for parts and although this is not the full design it is a majority of the fabrication

Testing Results

- Bread types' reject rates are all the same
 - Tuscan bread has a higher reject rate than seasonal breads
- One time through the current automatic rounder
 - Higher reject rate than current operation
- Twice through the current automatic rounder
 - Was not able to complete due to scheduling
- Twister concept testing
 - Will be testing during week 11

Design Recommendations

- Accommodate more off the shelf components where capable
 - Reduces fabrication time
 - Easier to maintain
- Make enclosure out of a lighter metal or plastic for ease of separation
- Tighter tolerances on the ring and cone so that they fit tightly together
 - Eliminate places where flour can get to the motors
- Shrink the overall footprint of the device to better integrate onto the line

Ergonomic Results

- Recommended Conveyor Height: 33 – 42 inches (84 – 107 cm)
- Current Conveyor Height = 38 inches (97 cm)
- Recommended worker height: 5'4" to 5'9"

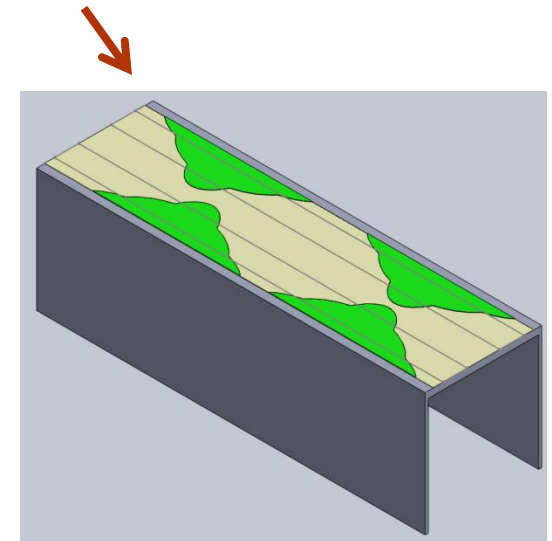
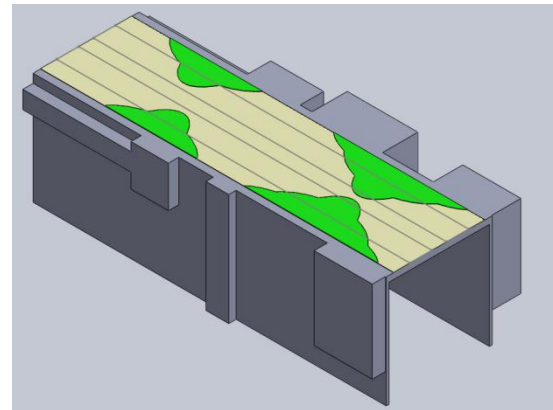
- Current Process
 - 3-6 seconds per rounding task
 - 0-3 seconds of resting between tasks
- Recommendations to mitigate repetitive motion injuries
 - Pre-work stretching & stretching breaks
 - Job rotation
 - Proper/standard work techniques
 - Tool design (MSD group is concept testing)

Ergonomic Results

- Current state trunk flexion to future state



22°
Trunk
Flexion



Ergonomic Recommendations

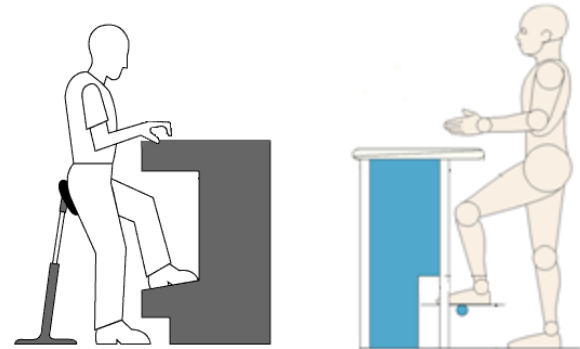
- Recommendations for reducing reach and trunk flexion injuries

- Anti-fatigue mats

\$30 - \$150



- Foot rests

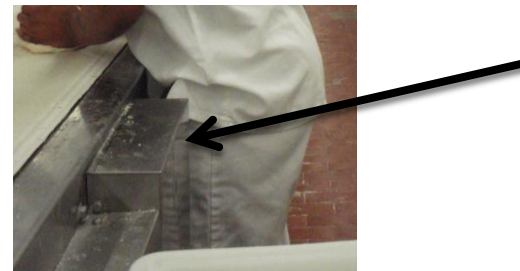


- Sit/Stand stools

\$150 - \$300



- Relocation of Conveyor Electrical Boxes



Project Evaluation

- The overall project we view as a success
 - Were able to evaluate the ergonomic needs of the Parbake line
 - Made suggestions for how to improve the line for the current operators
 - Learned the current state of the dough (where the seams are located) without operator involvement
 - Learned that the current belt rounder will not suffice without the operators
 - Began the first stage of an engineered rounding device that can integrate onto the production line

Project Evaluation

- The failures that led to changing the scope during week 5 of MSD II
 - Could not complete fabrication in 5 weeks
 - Cause: Lack of the right expertise in the Detailed Design Review at the end of MSD I
 - Cause: Delayed contact with the Wegman's fabrication shop
 - Result: Cut the scope of fabrication to just the conveyor system
 - Could not get to full testing of the device
 - Cause: Delays in fabrication pushed the schedule back
 - Cause: Wrong motors ordered twice due to lack of electrical engineering support
 - Result: Short concept testing was all that could be completed in our time frame

Future Opportunities

- Pass along our engineering work to another Senior Design Team which would work on:
 - A hinging system
 - Automating the device
 - Integrating onto the line
- Wegman's team can start to implement the current recommendations to make the Parbake line better ergonomically for the operators