

Tom Maze Transportation Seminar

Mid-America Transportation Center (MATC)

March 6, 2015

Role of Transportation and Reverse Logistics Analytics in Achieving Corporate Sustainability

Presented By:



College of Business

UMSL Center of Transportation Studies

Dr. Ray A. Mundy Ph.D Director

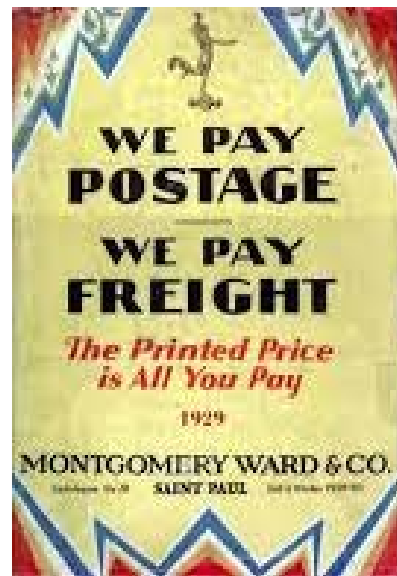
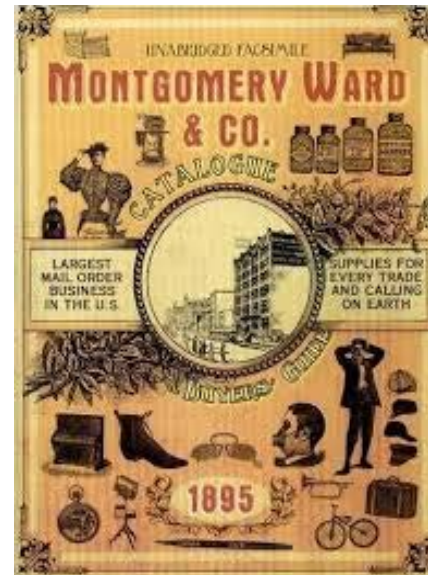
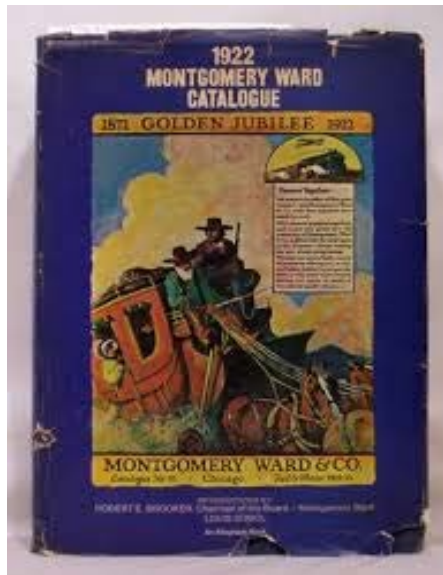
Barriger Professor of Logistics & Transportation



Product Remanufacturing Centers

Michael G Edwards

Vice President Supply Chain and Logistics



The Quest for the Perfect Order—7R's

- ▶ Right Product
- ▶ Right Place
- ▶ Right Price
- ▶ Right Time

- ▶ Right Condition
- ▶ Right Quantity
- ▶ Right Information

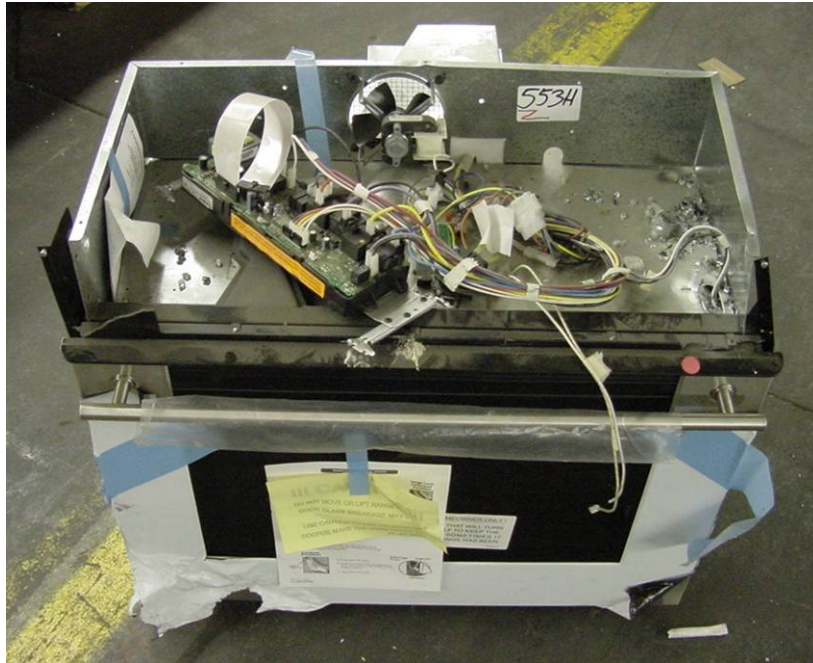
As Received



After Processing



As Received



After Processing











Reverse Logistics Industry Background

- ▶ 2014 US Consumer Spending \$15.6 T
 - Non-Durable Goods \$4.0T
 - \$430B in Estimated US Returns Expense Annually
 - Consumer Non-Electronics Returns Percentages
 - Inclusive of First COGS, In & Out Freight, Admin, Retailer Returns Allowance, Disposal, Warehousing, Returns Management, Secondary Returns, Non-Qualified Returns Processed, Warranty Expense
 - Companies with Managed RL Supply Chains Lead Their Industries in Reducing RL Costs
 - Sustainability and Responsible Recycling as Corporate Commitments to Environment

Sources of Returns

- ▶ Buy Backs
 - A Goods
 - Excess and Obsolete
 - Competitor Product

- ▶ Consumer Returns
 - Direct from Consumer
 - Centralized Retailer Return
 - Store Direct Return

- ▶ Destroy in Field (DIF)

Drawbacks of As Is and DIF

- Liquidation
- Disrupts Market Pricing
- Double Returns at Original Retail
 - Increased Return Rate
 - Freight and Handling
 - Unearned Retailer Credit
- Customer Quality Perception
- Diversion
- Social Media Pressures
- Extended Producer Regulatory Responsibility

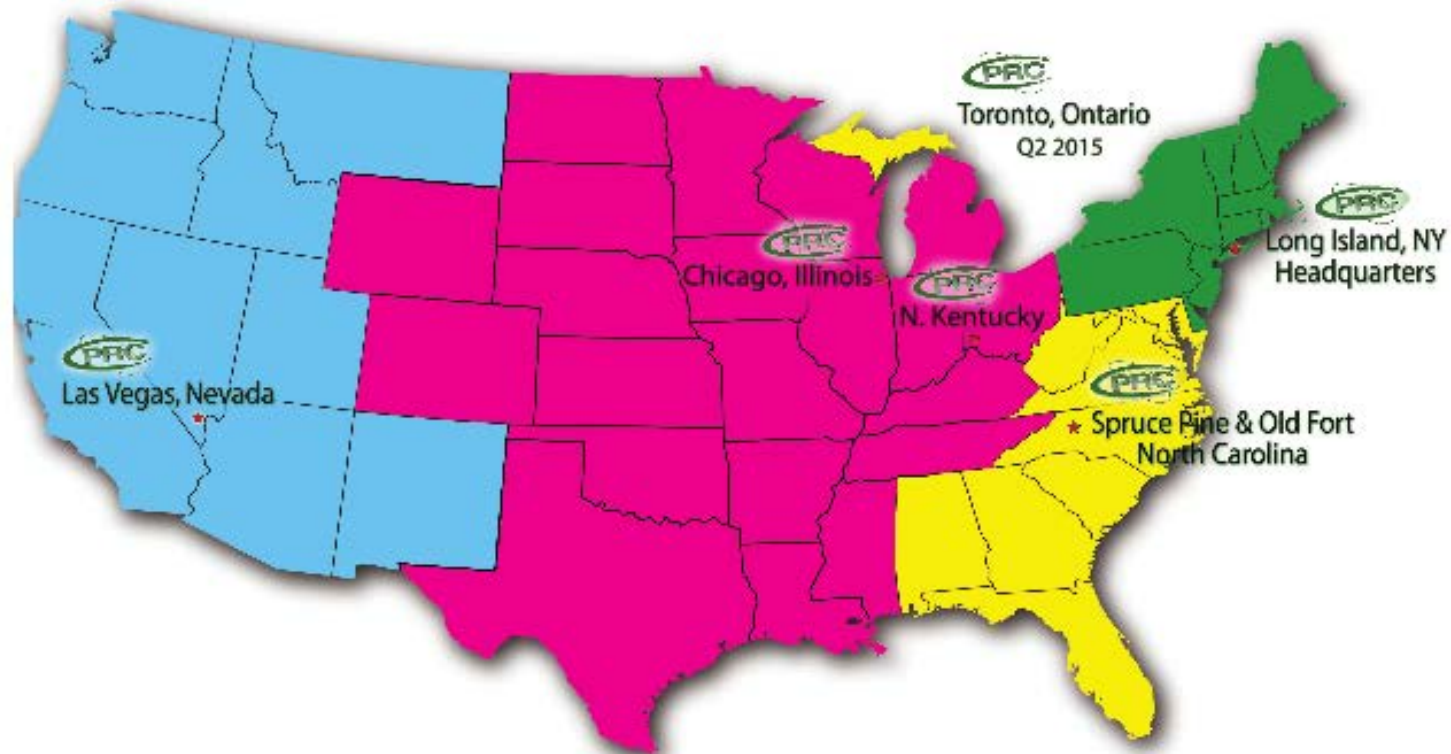
About PRC Industries Product Remanufacturing Centers

PRC is a North American Remanufacturing Company with over 23 Years of Expertise in Return Center Management, Engineering/Quality Assurance Emphasizing the “Why” of Consumer Returns, Second Channel Sales Management Optimizing Resale of Products, Asset Recovery and Warranty Services to Manage Liability for a Wide Array of Product Categories, Including:



- Kitchen Appliances
- Major Appliances
- Cookware
- Coffee Makers and Espresso Machines
- Floor Care Products / Vacuums
- Microwave Ovens
- Air Conditioning / Home Comfort
- Water Dispenser / Filtration Product
- Laundry Appliances
- Electro-Mechanical and Water Process Products
- Compact Refrigeration

PRC Facility Network and Services Menu



Reverse Logistics Management
Secondary Market Sales
Return Center Management
System Failure Analysis
Corrective Action/Preventative Action
3PL Subsidiary

Recycling/End of Life
Warranty & Service Center Activities
Supply Chain Consulting
Fulfillment
Remanufacturing/Refurbishing
e-Commerce Subsidiary

PRC Transportation Business Development



Build Local Based Fleet Management
53', 13'6" Swing Door Trailers
Box Trucks (if needed)
Drop and Hook Agreement Options
Daily Service Availability
Delivery to Client Based Retailers



3PSP Sustainability Solutions

- ▶ Traceability – Proven chain of custody
- ▶ Sustainability – Certified recycling percentage
- ▶ Efficiency – Drive recovery through innovation & flexible labor
- ▶ Compliant – Vetted processes for product categories
- ▶ Visibility – Reporting & visible downstream process
- ▶ Scalability – Ability to handle volume variances and seasonality
- ▶ Flexibility- Many program solution sets to select from to optimize recovery to meet individual client needs

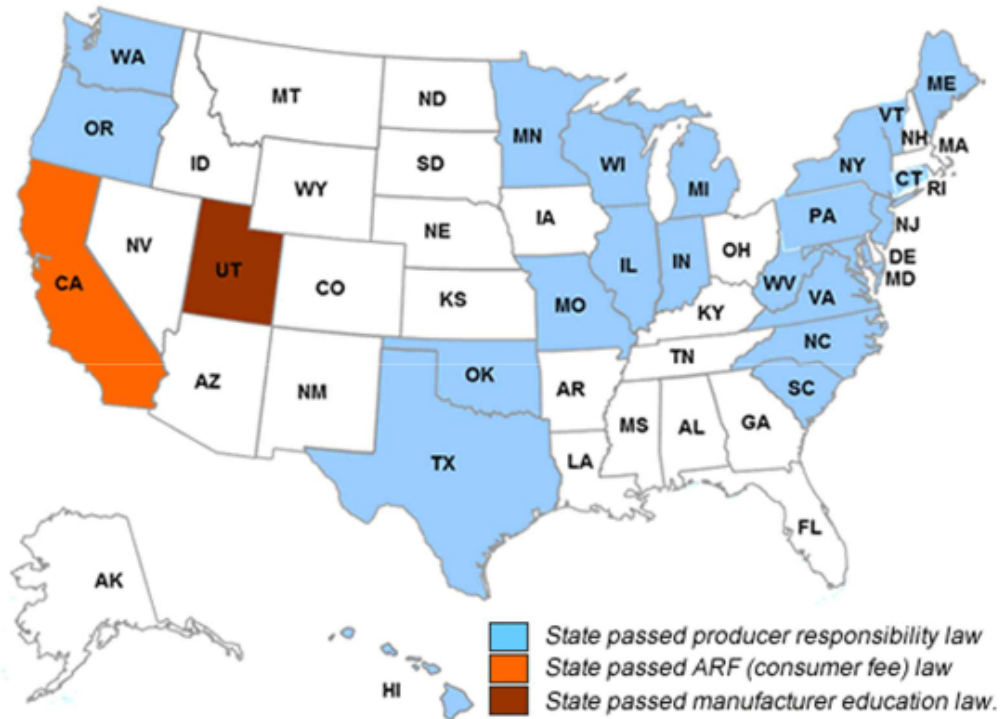


Manufacturer's Exploratory Discussion Points

- Cost Avoidance on Returns from Existing Retail Model
- Avoid Channel Conflicts
- Non Program Returns Debit Reconciliation Visibility
- Engineering Quality/Defect Reporting
- Higher Product Recovery Rate
- Re-deploy Assets Committed to Consumer Returns
- Leveraged and Scalable Solution to Support Growth
- Transparency through Data Exchange
- Sustainability

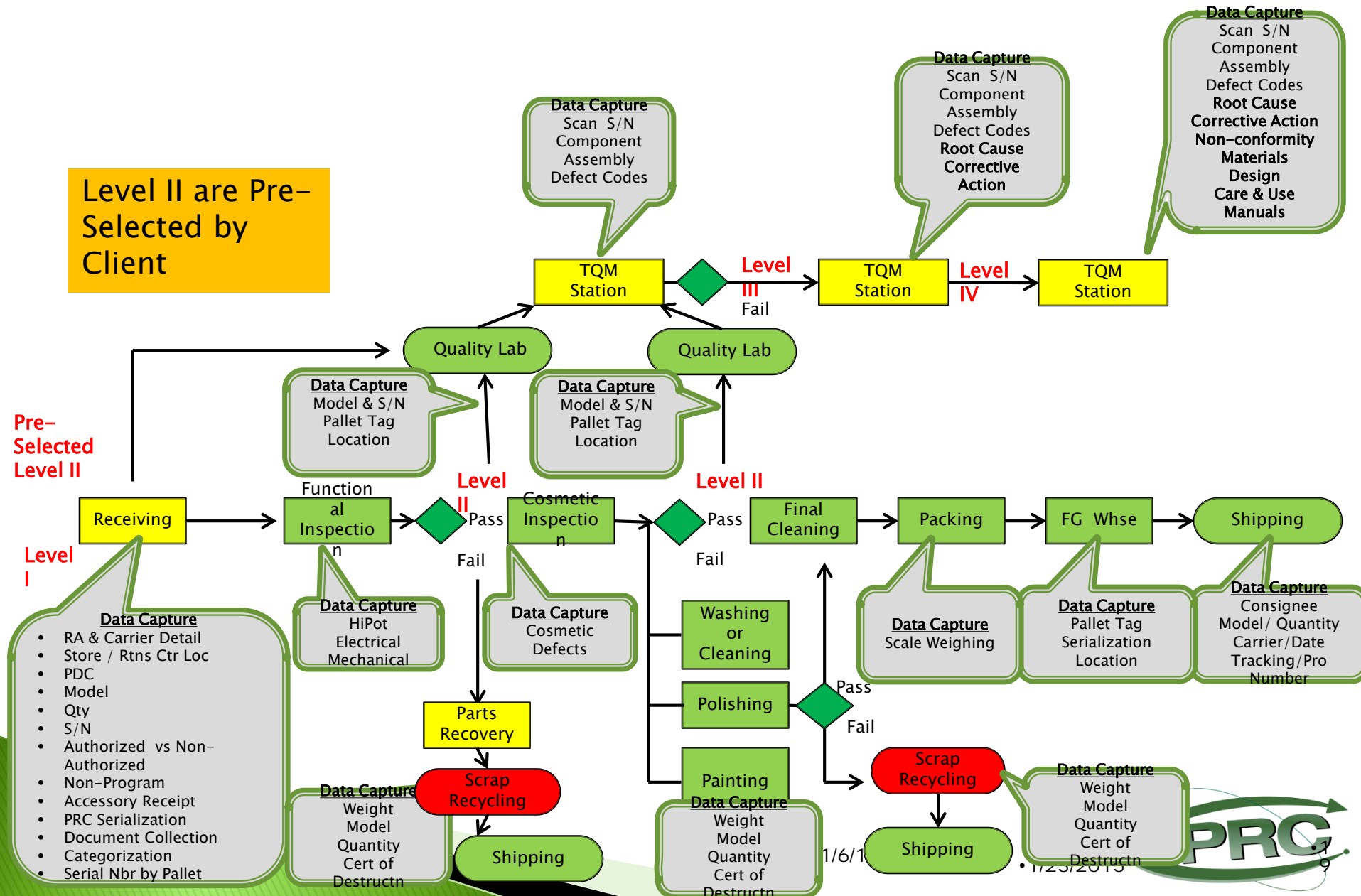
EPR Expanding Over Past 5 Years

Extended Producer Responsibility (EPR)



TQM Process Map

Level II are Pre-Selected by Client



Parts Touch Screen Options on Accountability Recording for Client Returns (Generic Example)

Change Model

TOUCH SCREEN RECEIVING - BETA 1.0
Model: XXXXX

Model	Qty
XXXXX	1053
Type 618 A2	1
	1054

NOTE: If you make a mistake, press F5 or to refresh and start over with the current item.

1-CORE UNIT



2-INSTRUCTION DVD



3-DESCALER PACK



4-COFFEE COVER



5-SPOON COVER



6-MEASURING SPOON



7-KNOB



8-TUBE COVER



9-CUP PLATE



10-TRAY



11-GROUND BIN



12-DIFFUSER KIT



13-TANK COVER



14-TANK

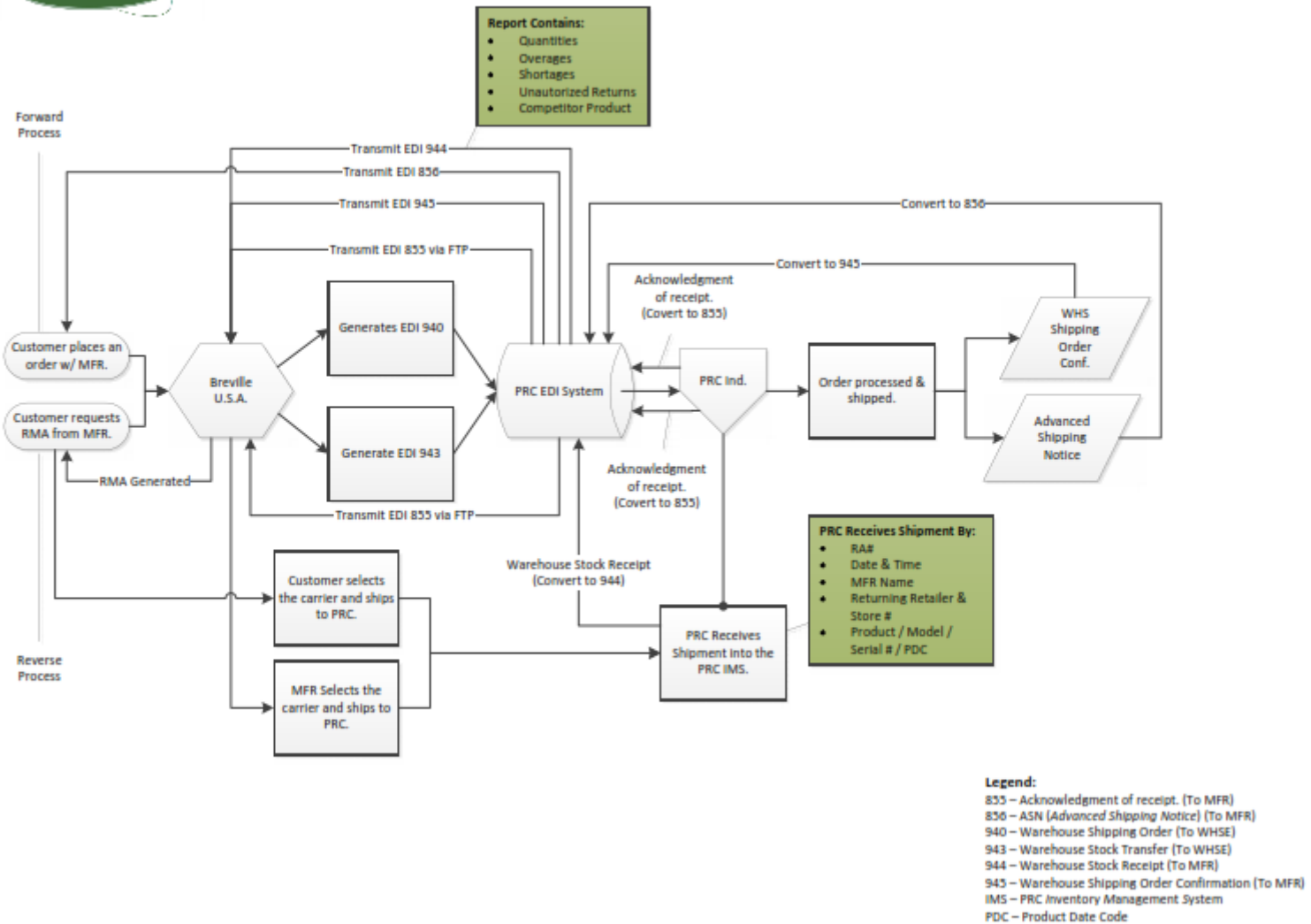


UNIT SERIAL NUMBER: DE123456789

Submit



Bi-Directional EDI Process



Engineering & Quality Interface

Quality

Methods

Lean (5S, Muda)

Kaizen

Kanban

Six Sigma



Engineering

Sustaining

Incremental improvements to automated data collection and process quality

Developing

Scaling equipment, processes, and instrumentation for production.



Quality

Culture

VOC onboarding

Demand pull

CAPA

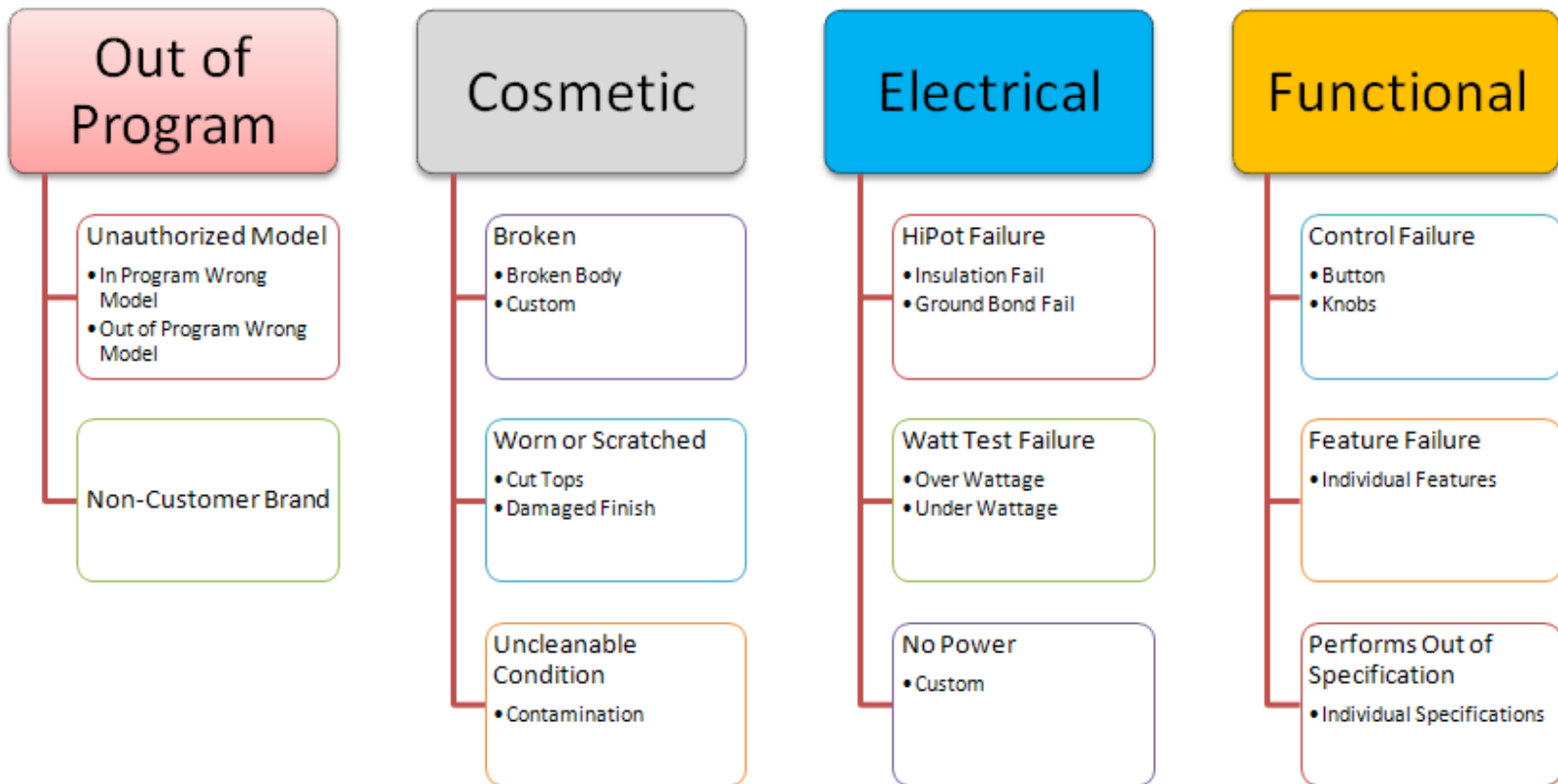
Problem prevention

VOC–Voice of the Customer

Blenders	does not perform according to description
Blenders	The Spout is broken.
Blenders	Unit moves around the counter top when operating. too light?
Blenders	Cosco. \$29.99
Deep Fryers	The lid was broken during shipping. the corner of the box is damaged.
Deep Fryers	The fryer is much too small for our needs. Thank you.
Toaster Ovens	no longer needed..
Toaster Ovens	Product package was broken. opened and taped before delivered. Product has a dent where package is broken.
Toaster Ovens	We meant to order the full sized Breville Smart oven but inadvertantly purchased this one. We are buying the full sized on a separate order
Toaster Ovens	To large for cabinet space.
Toaster Ovens	Just received this item and unless I am doing something wrong. I can not get all functions on the touch pad to work.
Toaster Ovens	all the reviews were great but it was just so enormous -- wouldn't fit on countertop.
Toaster Ovens	Didn't have all the features I needed.
Toaster Ovens	Just ordered one. not sure how 2 got ordered
Toaster Ovens	Upon opening shipping carton small pieces of glass or ceramic fell out.
Toaster Ovens	Meant to order white color

Mapping to Failure Codes

Integrate Coding into Classes of Product Failures



Example of Level I Data Collection

Pass	2,891	Fail	1,971	Total	4,862	Yield	59%
------	-------	------	-------	-------	-------	-------	-----

Error Details

Cut Power Cord	3	-	0%
No Self Clean	6	-	0%
HiPot Failure	10	-	0%
Bad Cord	33	-	1%
Electronic Fault	64	-	1%
Cosmetic Failure	83	-	2%
No Power	93	-	2%
No Steam	102	-	2%
Unit Has A Leak	206	-	4%
No Spray	215	-	4%
No Burst	235	-	5%
Broken Steam Switch	269	-	6%
Broken Body	301	-	6%
Watt Test Failure	351	-	7%
Pass	2891	-	59%

Cut Power Cord	Cosmetic
No Self Clean	Functional
HiPot Failure	Electrical
Bad Cord	Electrical
Electronic Fault	Functional
Cosmetic Failure	Cosmetic
No Power	Electrical
No Steam	Functional
Unit Has A Leak	Functional
No Spray	Functional
No Burst	Functional
Broken Steam Switch	Functional
Broken Body	Cosmetic
Watt Test Failure	Electrical
Pass	Pass

Upgraded Reporting Example Production Line Data Capture

Please choose a model : 

Detailed Report for S3251

Pass	2,981	Fail	1,691	Total	4,672	Yield	64%	Historical	64%
-------------	-------	-------------	-------	--------------	-------	--------------	-----	-------------------	-----

Error Details

HiPot Failure	1	0%
Broken Handle	8	0%
Bad Cord	10	0%
Watt Test Failure	21	0%
Unit Has A Leak	32	1%
No Power	38	1%
Incorrect Model	222	5%
No Steam	286	6%
Cosmetic Failure	514	11%
Broken Body	561	12%
Pass	2981	64%

Tools

Checklist Options

Inventory

Euro Pro

Reman Totals

Detailed Report

Historical Report

Euro-Pro Production By Line

Example of Level II and III Data Collection

Engineering Lab Program
Development for Level II,
Level III and Level IV Product
Reviews (Example)

Failure Code

Cause Code – Visual

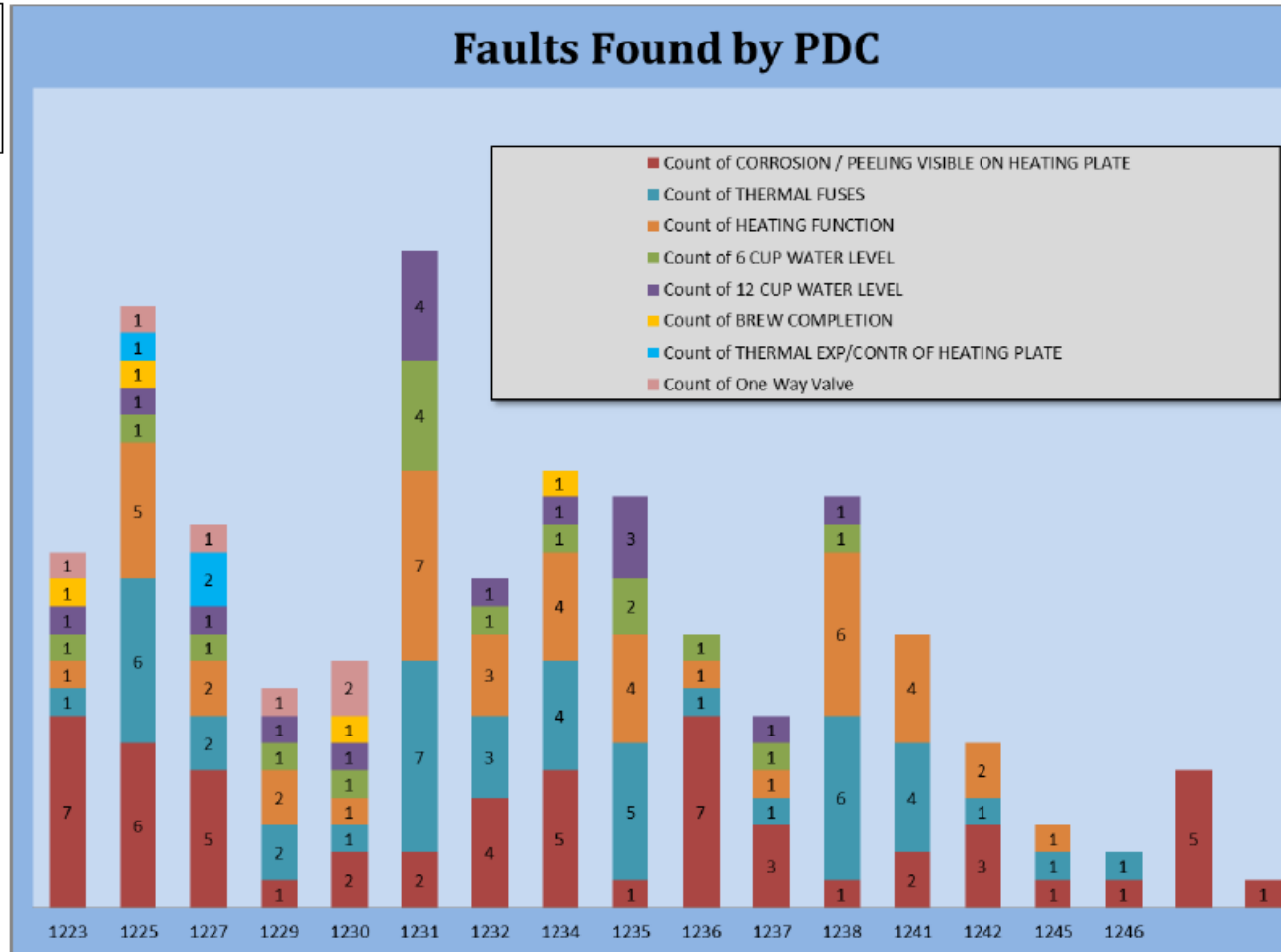
Cause Code – Component

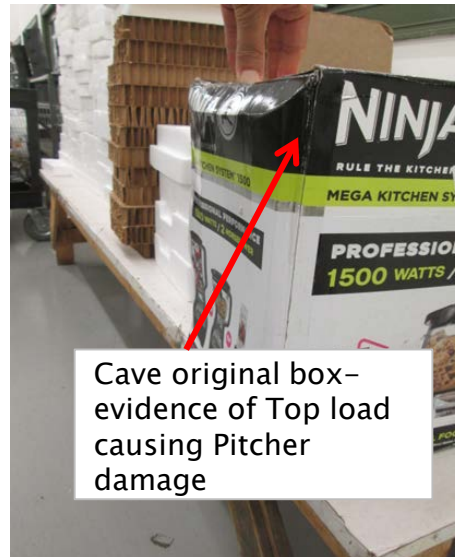
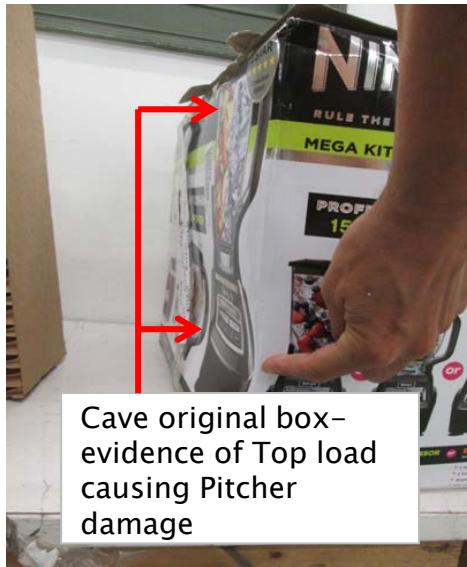
Cause Code – Root

category_title	defect_group_title	defect_code_title
Steam	Damaged	Mop Head, Broken
Steam	Damaged	Nozzle, Damaged
Steam	Damaged	Water Tank, Broken
Steam	Components Missing	Concentrator, Missing
Steam	Components Missing	Extension Tube, Missing
Steam	Components Missing	Handle, Missing
Steam	Components Missing	Head, Missing
Steam	Components Missing	Steam Frame, Missing
Steam	Electrical	Cord, Damaged
Steam	Electrical	Electrical, Contacts, Bent
Steam	Electrical	Fuse, Blown
Steam	Electrical	Hall sensor not working
Steam	Electrical	Heating Element Damaged
Steam	Electrical	Motor, Defective
Steam	Mechanical	Actuator
Steam	Mechanical	Boiler, Inlet, Hose, Bent
Steam	Mechanical	Boiler, Inlet, Hose, Broken
Steam	Mechanical	Boiler, Outlet, Hose, Broken
Steam	Mechanical	Pump Inlet, Defective
Steam	Mechanical	Wheels, Front, Don't Spin
Steam	Mechanical	Wheels, Rear, Don't Spin
Steam	Performance	Boiler, Clogged
Steam	Performance	Boiler, Does not Heat
Steam	Performance	Boiler, Inlet, Clogged
Steam	Performance	Boiler, Outlet, Hose, Clogged
Steam	NANC Returns	Used RTV--Unit Noted Broken
Steam	NANC Returns	Unit Noted Broken
Steam	NANC Returns	Noted Customer Dissatisfied
Steam	NANC Returns	Used RTV

Example of Level II and III Data Collection

Chart 2:
Faults
by PDC



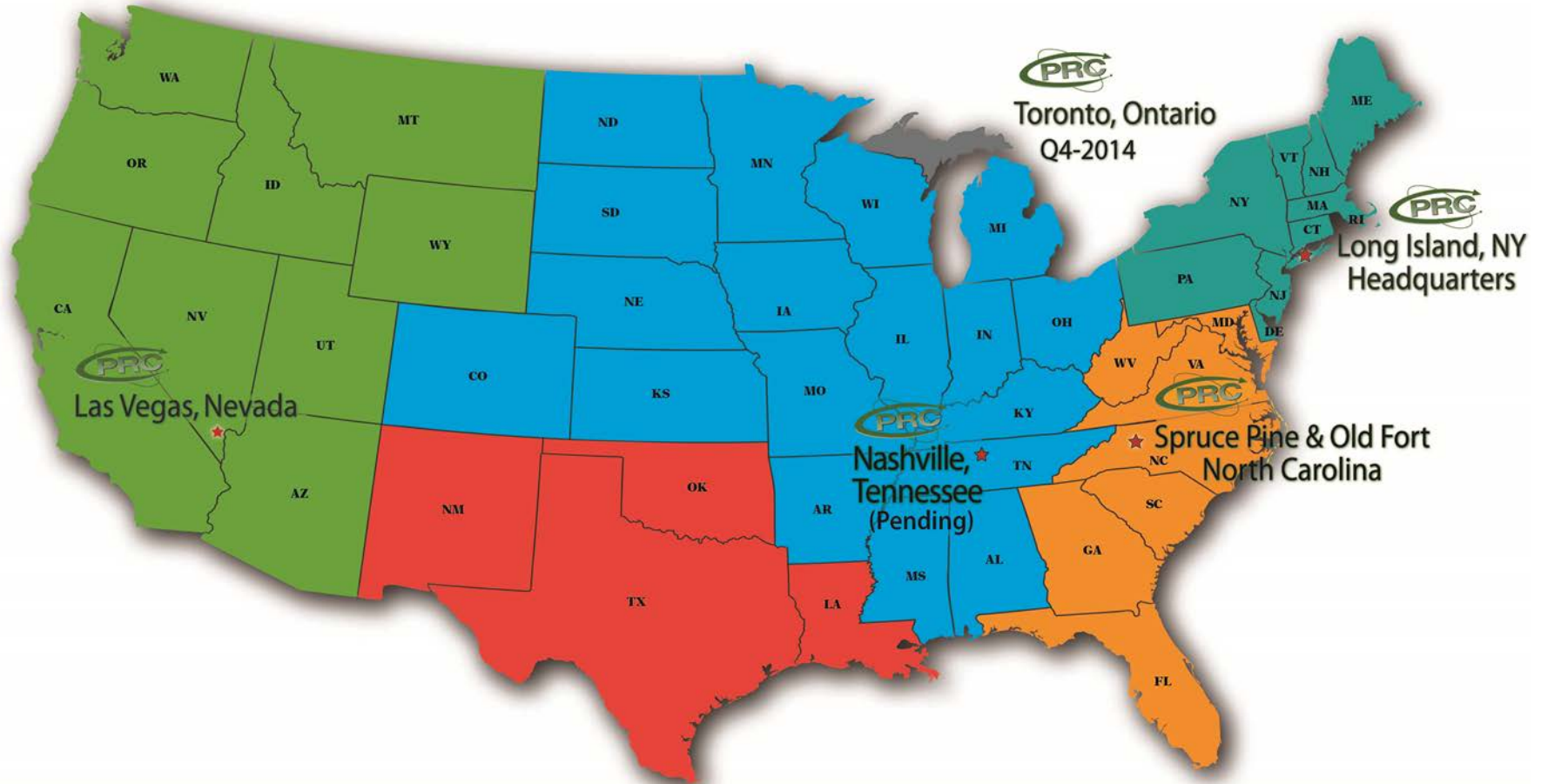


BL 771 Packaging Review

Freight Analytics

- ▶ 2014 YTD Units by State by Carrier
- ▶ Applied Discounted UPS Parcel Rates Net of FSC, Dimensional and Residential Fees
- ▶ Applied CZARLITE LTL 2003 FAK 70, 75% Discount includes FSC
- ▶ Truckloadrate.com includes FSC
- ▶ Applied per Unit Weight of 13# based on Mix

Regional Splits



6 Month Run Rate

Units and Potential Freight Reduction

Region	LTL	PARCEL	TL	Grand Total
EAST	2870	27380	2833	33083
SOUTHEAST	4037	43511	14279	61827
MIDWEST	5752	21208	27028	53988
SOUTHWEST	829	7989	361	9179
WEST	3311	20454	3210	26975
AK	0	13	0	13
HI	0	15	0	15
VI	0	33	0	33
TOTAL	16799	120603	47711	185113

Region	LTL	PARCEL	TL	Grand Total
EAST	\$17,162.00	\$277,359.00	\$6,515.00	\$301,036.00
SOUTHEAST	\$19,942.00	\$382,897.00	\$18,922.00	\$421,761.00
MIDWEST	\$41,875.00	\$216,321.00	\$40,271.00	\$298,467.00
SOUTHWEST	\$7,220.00	\$90,915.00	\$1,704.00	\$99,839.00
WEST	\$48,208.00	\$291,265.00	\$17,064.00	\$356,537.00
TOTAL	\$134,407.00	\$1,258,757.00	\$84,476.00	\$1,477,640.00

Freight Reduction Potential Annualized \$1M+ Savings

Region	LTL	PARCEL	TL	Grand Total
MIDWEST	\$14,955.20	\$176,228.00	\$1,206.00	\$192,389.20
SOUTHWEST	\$10,779.60	\$69,093.00	\$1,705.00	\$81,577.60
WEST	\$29,268.20	\$174,458.00	\$21,368.00	\$225,094.20
Total	\$55,003.00	\$419,779.00	\$24,279.00	\$499,061.00

Non Wal-Mart Freight Potential

3 Facility Network 6 Month Sample

Region	LTL	PARCEL	TL	Grand Total
EAST	2870	27380	2833	33083
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East to West Comparison

Category			Shipped to Spruce Pine		Shipped to Las Vegas		Estimated Savings
			Cost/Unit	Extended	Cost/Unit	Extended	
Compact F	4.3 Compa	7,526	\$ 34.67	\$ 260,937.35	\$ 19.92	\$ 149,924.20	\$ 111,013.15
Chest Free	7CF Chest	724	\$ 104.62	\$ 75,739.37	\$ 89.69	\$ 64,930.84	\$ 10,808.53
Dehumidif	60PT Dehu	2,764	\$ 31.06	\$ 85,863.29	\$ 15.59	\$ 43,097.51	\$ 42,765.78
Window A	DAC6011E	8,352	\$ 30.16	\$ 251,903.58	\$ 15.24	\$ 127,288.15	\$ 124,615.43
Portable A	12K DPAC	7,014	\$ 37.04	\$ 259,810.28	\$ 21.89	\$ 153,543.39	\$ 106,266.90
		26,381		\$934,253.87		\$538,784.08	\$395,469.79
			Cost/Unit	Extended	Cost/Unit	Extended	Estimated Savings
			\$34.78	\$261,765.24	\$18.18	\$136,828.41	\$124,936.83
			\$160.99	\$116,548.28	\$109.08	\$78,968.17	\$37,580.11
			\$36.46	\$100,791.23	\$19.35	\$53,491.78	\$47,299.45
			\$35.37	\$295,418.75	\$18.22	\$152,177.83	\$143,240.93
			\$47.42	\$332,618.89	\$29.02	\$203,555.47	\$129,063.42
				\$1,107,142.39		\$625,021.65	\$482,120.74



KEY CARRIER PROFILE

Row Labels	CH ROBINSON	ESTES EXPRESS	R & L Carriers	SAIA	Southeastern Freight Lines	TRUCKLOAD	UPS	UPS Ground for Costco.com	YRC Freight	Grand Total
BESTBUY	581	881					18			1480
COSTSEA		10973	3				1925	66	1	12968
DANSPAR	1169		1				3			1173
GREGG		1467	507				14			1988
HOMEDEPOT		635	109		213		1141		18	2116
LOWEDOM		328		23	27	2	9544	1		9925
MENARDS		503					0			503
NFM			88	165			5			258
PRRICFA		191					0			191
SAMS CLUB		23	5	7			9		20	64
WALMART		111					0		10	121
Grand Total	1750	15112	713	195	240	2	12659	67	49	30787



Preliminary East to West

Category	Return Facility	% Split	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Avg Wt	Total	Avg. Value	Extended	Zone 8	Zone 3	Difference	Total Leverage
Compact Fridge	Spruce Pine	38%	308	217	195	220	120	287	108	559	818	707	801	272	4,613	70	322,903	\$96.34	\$444,407.06				
	Las Vegas	62%	503	355	319	359	195	468	177	912	1,335	1,154	1,307	443	7,526	70	526,842	\$96.34	\$725,085.20	\$50.37	\$21.42	\$28.95	\$217,886.82
Chest Freezers	Spruce Pine	65%	105	121	80	87	49	74	46	130	148	83	192	229	1,344	95	127,725	\$140.28	\$188,602.76				
	Las Vegas	35%	57	65	43	47	27	40	25	70	80	45	103	123	724	95	68,775	\$140.28	\$101,555.33	\$60.55	\$37.78	\$22.77	\$16,484.28
Dehumidifiers	Spruce Pine	90%	514	634	514	517	485	1,028	270	3,174	8,978	2,194	3,010	3,564	24,880	40	995,196	\$106.07	\$2,639,010.66				
	Las Vegas	10%	57	70	57	57	54	114	30	353	998	244	334	396	2,764	40	110,577	\$106.07	\$293,223.41	\$36.98	\$14.52	\$22.46	\$62,089.16
Window A/C	Spruce Pine	65%	114	109	40	48	71	407	29	2,115	9,079	921	1,021	1,558	15,511	63	977,212	\$152.41	\$2,364,077.87				
	Las Vegas	35%	62	59	21	26	38	219	15	1,139	4,889	496	550	839	8,352	63	526,191	\$152.41	\$1,272,965.01	\$48.62	\$19.96	\$28.66	\$239,375.22
Portable A/C	Spruce Pine	62%	21	23	30	116	141	633	1,323	2,898	2,637	1,173	2,204	245	11,444	66	755,331	\$189.60	\$2,169,860.36				
	Las Vegas	38%	13	14	19	71	87	388	811	1,776	1,616	719	1,351	150	7,014	66	462,945	\$189.60	\$1,329,914.41	\$49.55	\$20.64	\$28.91	\$202,783.89
All Units	Spruce Pine	69%	1,063	1,104	859	988	866	2,429	1,776	8,876	21,661	5,079	7,227	5,866	57,793	55	3,178,367	\$135.07	\$7,805,958.71				
	Las Vegas	31%	691	563	459	560	400	1,229	1,058	4,250	8,917	2,658	3,645	1,951	26,381	64	1,695,330	\$141.11	\$3,722,743.36	\$48.47	\$20.48	\$28.00	\$738,619.38
			1,754	1,667	1,318	1,548	1,266	3,658	2,833	13,126	30,578	7,736	10,872	7,817	84,174	57.9	4,873,698	\$136.96	\$11,528,702.07				
															2,437								

Category	Unit	Danby Weight	PRC Weighted by Category	Carrier
Compact Fridge	4.3 Compact	75 lbs.	70 lbs	UPS
Chest Freezers	7CF Chest	98 lbs.	95 lbs	LTL
Dehumidifiers	60PT Dehum	48 lbs.	40 lbs	UPS
Window A/C	DAC6011E	46 lbs.	63 lbs	UPS
Portable A/C	12K DPAC	80 lbs.	66 lbs	UPS

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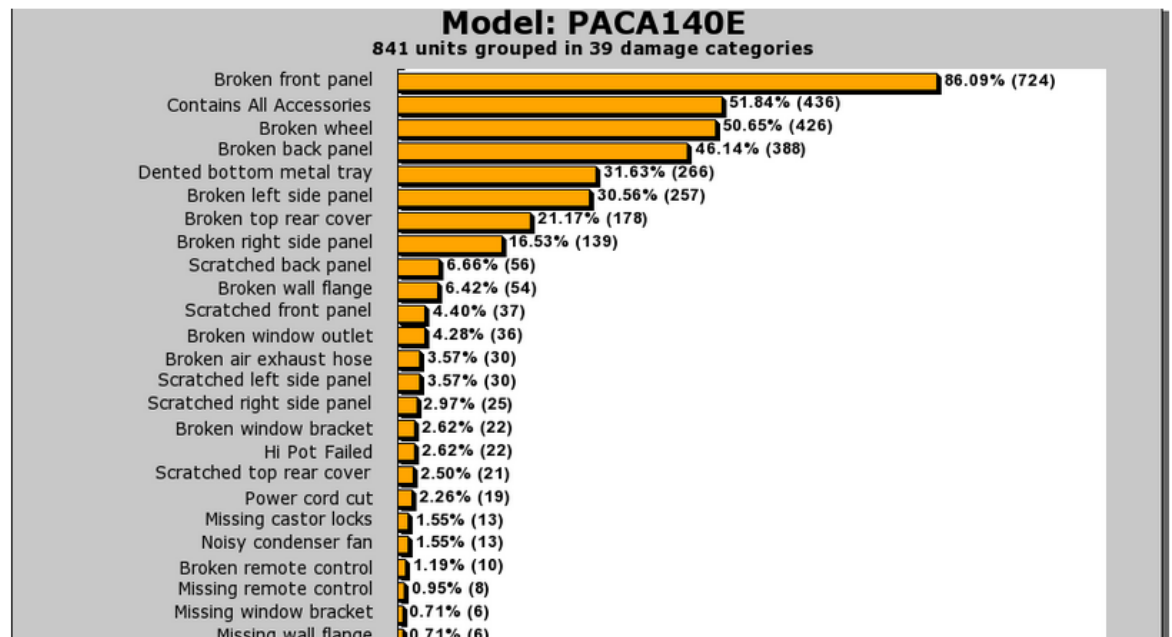
**Excludes Pallet Weight +50#



Fault Code Reporting Example of Portable A/C Production Run



Welcome! Alan Michael (log out)



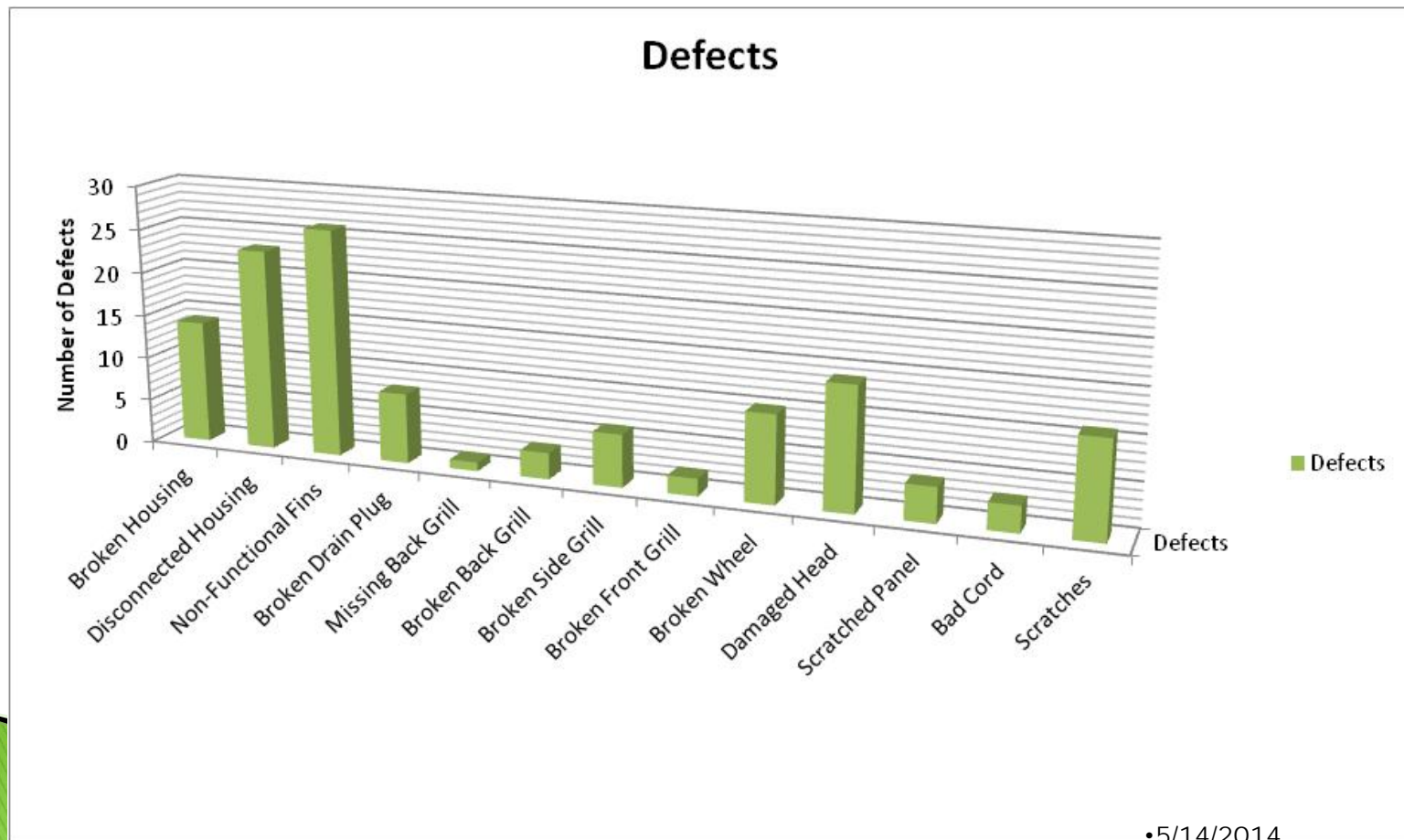
IDYLIS 416709 (DPA100A2GDB) Recovery Opportunities

Defect	Count	Percentage	Comments
Broken Housing	14	14.00%	Repairable with recovery or extra parts
Disconnected Housing	23	23.00%	
Non-Functional Fins	26	26.00%	
Broken Drain Plug	8	8.00%	
Missing Back Grill	1	1.00%	availability of recovered or extra parts
Broken Back Grill	3	3.00%	Serial number only available on back (Swap Backs)
Broken Side Grill	6	6.00%	
Broken Front Grill	2	2.00%	
Broken Wheel	10	10.00%	
Damaged Head	14	14.00%	
Scratched Panel	4	4.00%	
Bad Cord	3	3.00%	Scrap or Liquidation based on severity. Sell As-Is
Scratches	11	11.00%	Severe Scratches, Non-Repairable. Sell As-Is
Unrecoverable Failures	21	21.00%	

Recovery potential between 55-60%+ potential with time invested to blend mechanical and cosmetic repairs required with parts harvesting

IDYLIS 416709 (DPA100A2GDB) Defects

- A sample size of 100 units was reviewed and yielded 146 defects.
- Of the 146 defects found, 100 defects could be mitigated with additional measures to increase recovery



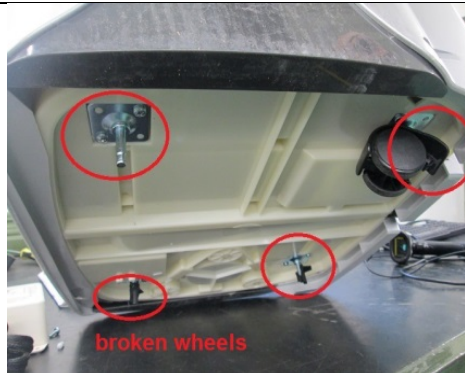
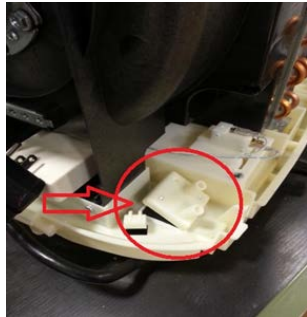
Danby Defect Data Analysis

Broken housing



Housing is failing at point of molded fastener at connection to shell. The anchor is too long and snapping at fulcrum point

Broken wheels

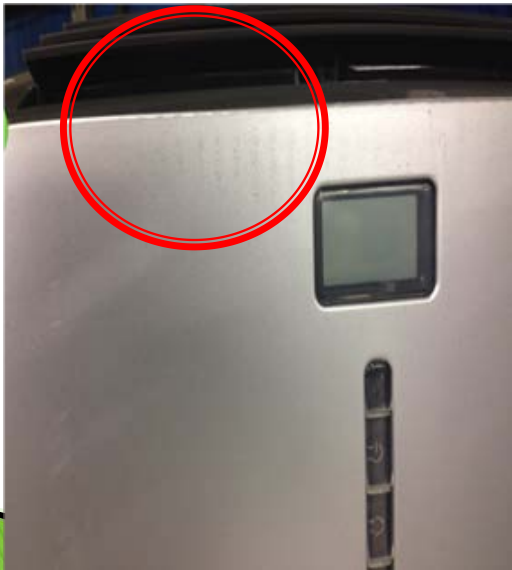


Housing floor is breaking at point of bracket where attached to the housing floor due to shear stress. Exactly along lines bracket plate.

Danby Defect Data Analysis

Cracked top louver

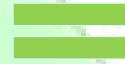
Shipping damage, louver pins disengage easily. Need longer pins.
Center support beam connection points for lever arm are too thin.



Certified Recycling Programs e-Stewards and R-2 Compliant

Select Compliant Partners by US Region

Polystyrene
Foam



Cardboard
& Paper
Products



Plastic
Segregation



Metal
Segregation



Full Unit
Shredding
(Availability)



ZLoop (NC)
Synergy Recycling (NC)
US MicroCorp (LV)

Maturing 2nd Channel Marketplaces

- ▶ **Major Brick and Mortar**
 - Big Lots
 - Fred's
 - Variety
- ▶ **2nd Tier Brick and Mortar**
 - Ocean State
 - Ollies
 - Grocery Outlet
- ▶ **3rd Tier Brick and Mortar**
 - Christmas Tree Shoppes
 - Here Today
 - National Wholesale
- ▶ **Scratch and Dent**
- ▶ **On Line Private Marketplace**
 - Woot
 - OPTORO
 - Overstock
 - GroupOn
 - One Sale a Day
- ▶ **Liquidation Fully Functional, Cosmetically Unrepairable**
- ▶ **AS IS On Line Auction Sites**

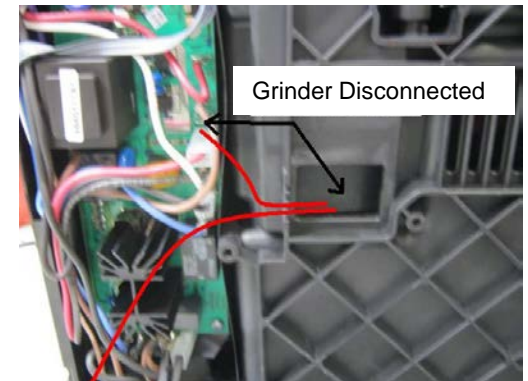
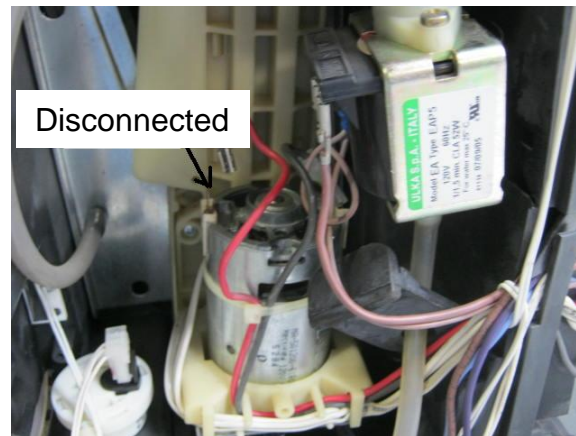
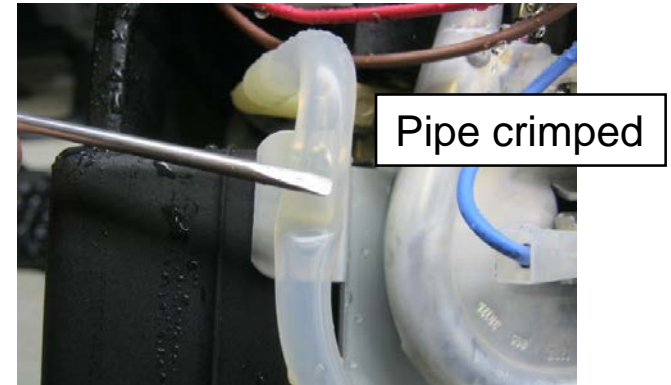
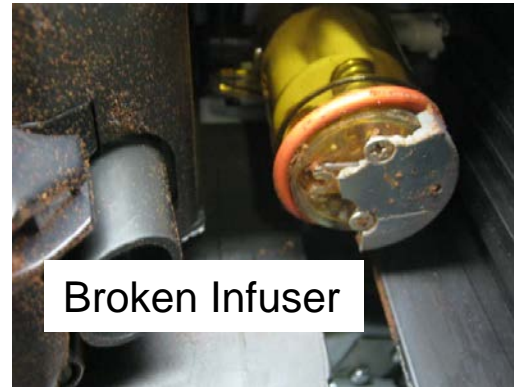


Figure 5: Groove from unit #2.

Figure 6: Groove from unit #3.

Figure 2: Pin and groove.

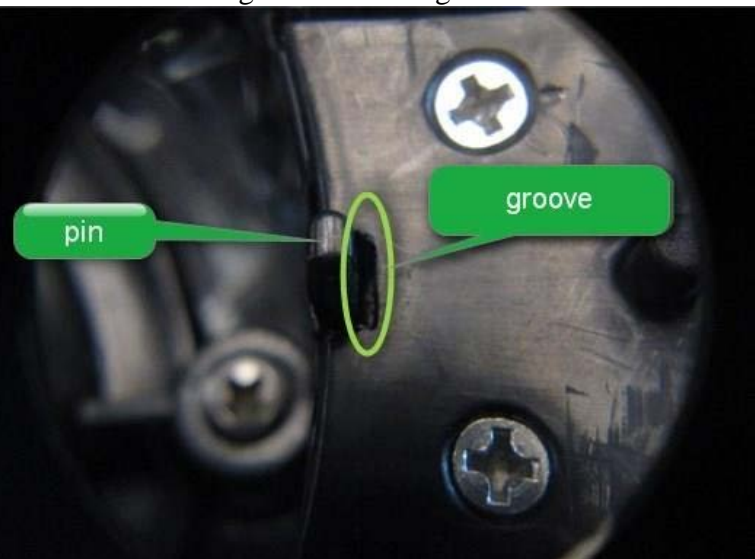


Figure 3: Groove with machine-manufactured dimensions.

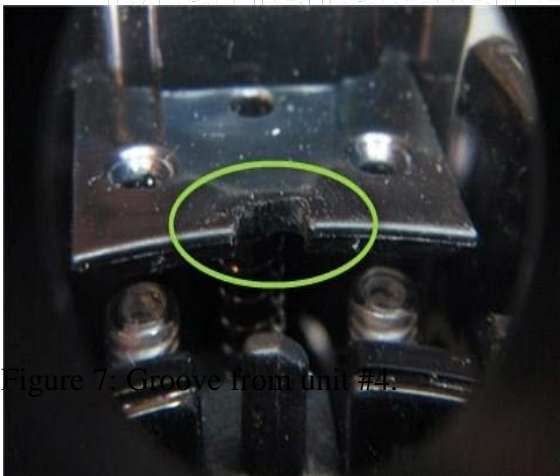


Figure 7: Groove from unit #4.



Figure 8: Groove from unit #5.



Program Goal – Broader Engineering Solution

- ▶ Examples of MIR and RCA
 - Materials – plastics and metals
 - Mechanics/thermodynamics/fluids
 - Electronics/sensors/software
 - Systems

Thermodynamics / Fluids

- ▶ Watery and bitter coffee brew.
 - Power required for boiler to deliver NCAA brewing guidelines,
<http://www.ncausa.org/>



$$P = \frac{mass * c * (T_2 - T_1)}{t}$$

$$c = \text{specific heat of water} = 4.219 \frac{kJ}{kg * K}$$

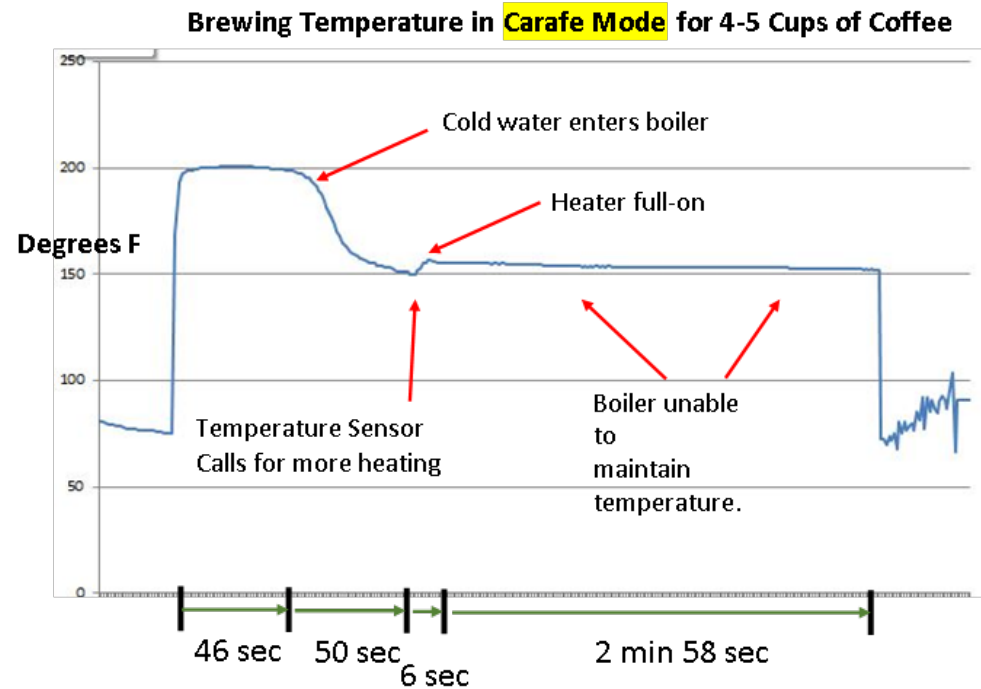
$$T_1 = 20C = 293K$$

$$T_2 = 87.8C = 360.8K$$

- ▶ CFD shows poor mixing of cold and hot water in boiler, and, placement of water temperature sensor limits effectiveness.

Thermodynamics/Fluids

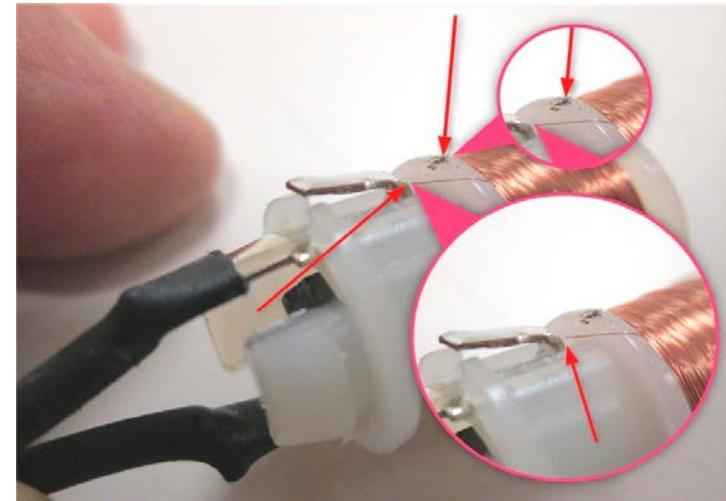
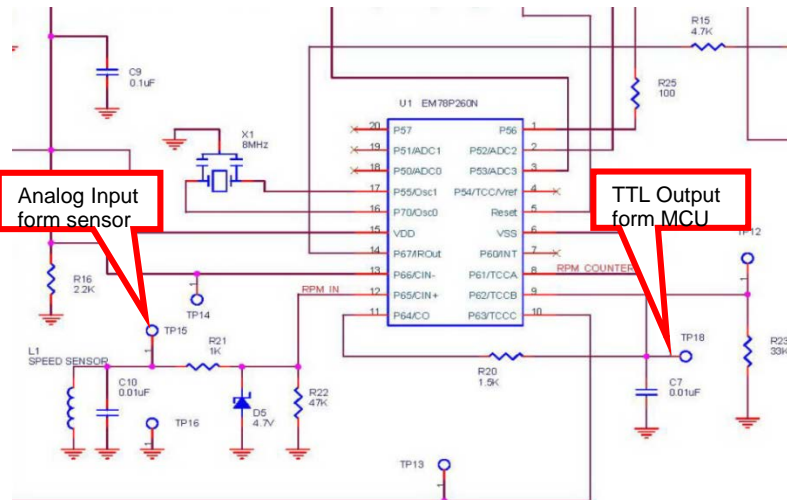
- ▶ Brewing temperature outside NCAA guidelines.



- ▶ Corrective Actions: added baffle and deflector plate to boiler

Electronics/Sensors

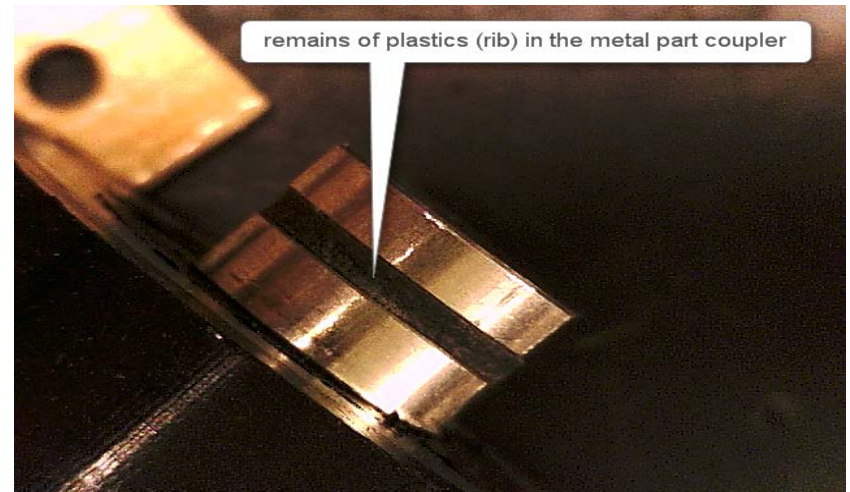
- ▶ Serial defect in motor speed sensor.
 - Can be detected before complete disassembly.



- ▶ Corrective Action: replace sensor in FG and change work instructions.

Systems

- ▶ Cascading failures lead to safety issue.
 - Sensors, software, materials all fail in series.

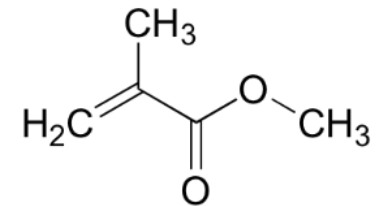
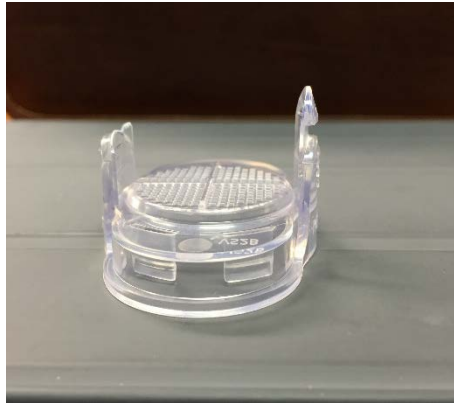


- ▶ Corrective Action: change sensor, add redundant sensor, correct software algorithm, design coupler and drive shaft as one dynamically balanced unit.

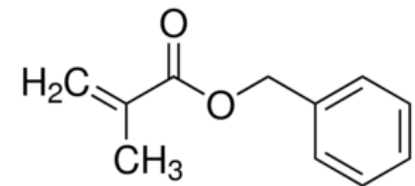
Materials

► Coffee filter tabs breaking

- Plastic identified as Poly(methyl methacrylate) (PMMA with a comonomers benzene ring replacing the CH_3
- Rib missing at stress concentration.



methyl methacrylate



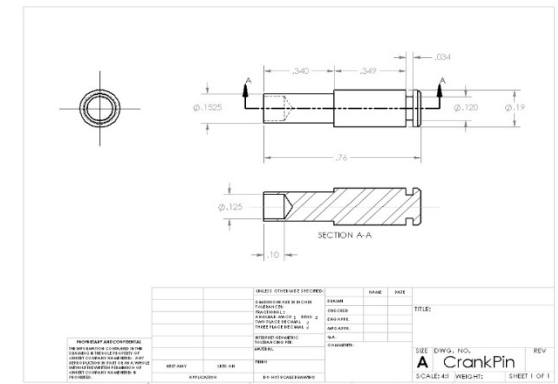
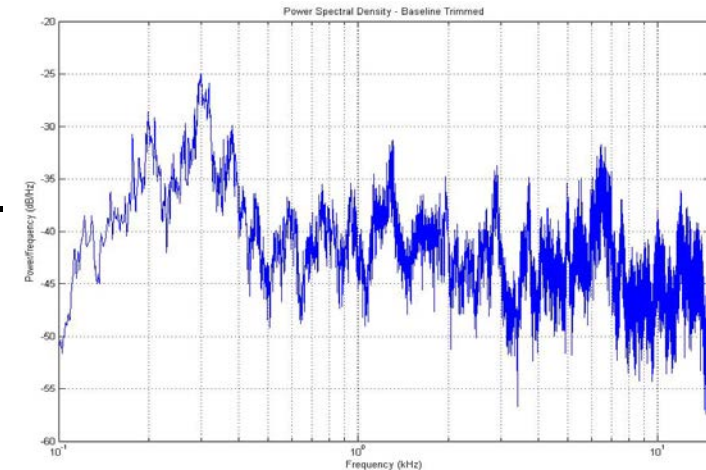
benzyl methacrylate

► Corrective Actions:

- Replace PMMA with Polycarbonate (PC)
- Rib added in mold.

Mechanics

- ▶ Noisy pump and early failures
 - Loose linkage causes pump stall at BDC.
 - Pump stroke > diaphragm design.
 - Diaphragm assembled inverted.



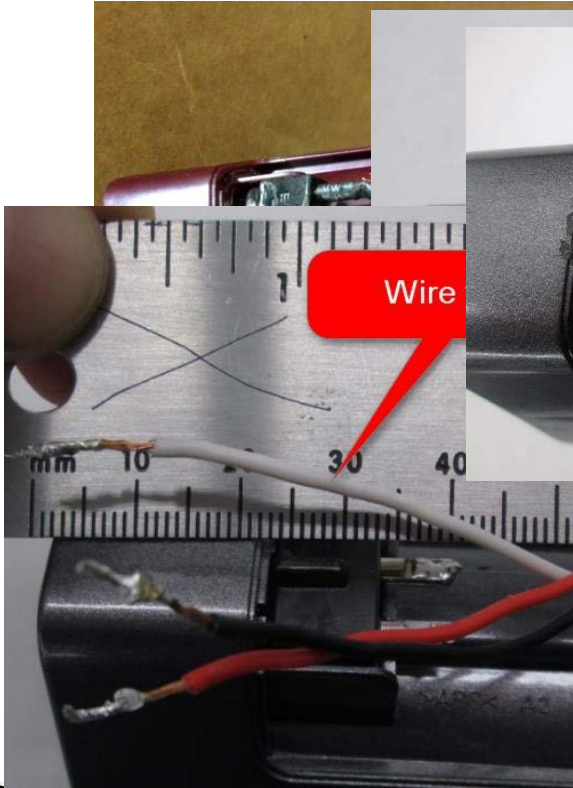
- ▶ Corrective Actions: increase diameter of joint pin, spec double-ribbed diaphragm, change work instructions.

Figure 1: Location of damage

Damage point



A wire can break w
Figure 2: Wire damage



7 Too much slack in the wires.

Too much slack



Figure 8: 30mm wire

Good wire length - 30mm

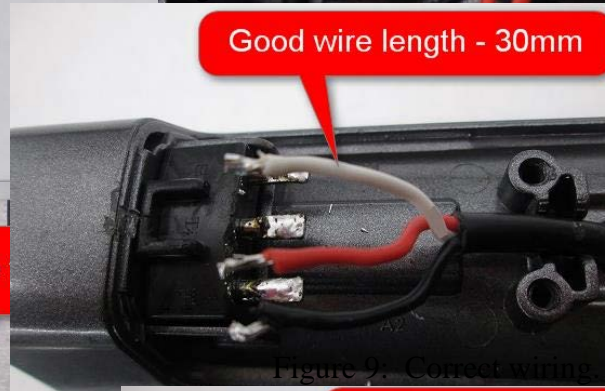


Figure 9: Correct wiring

Proper installation of wires

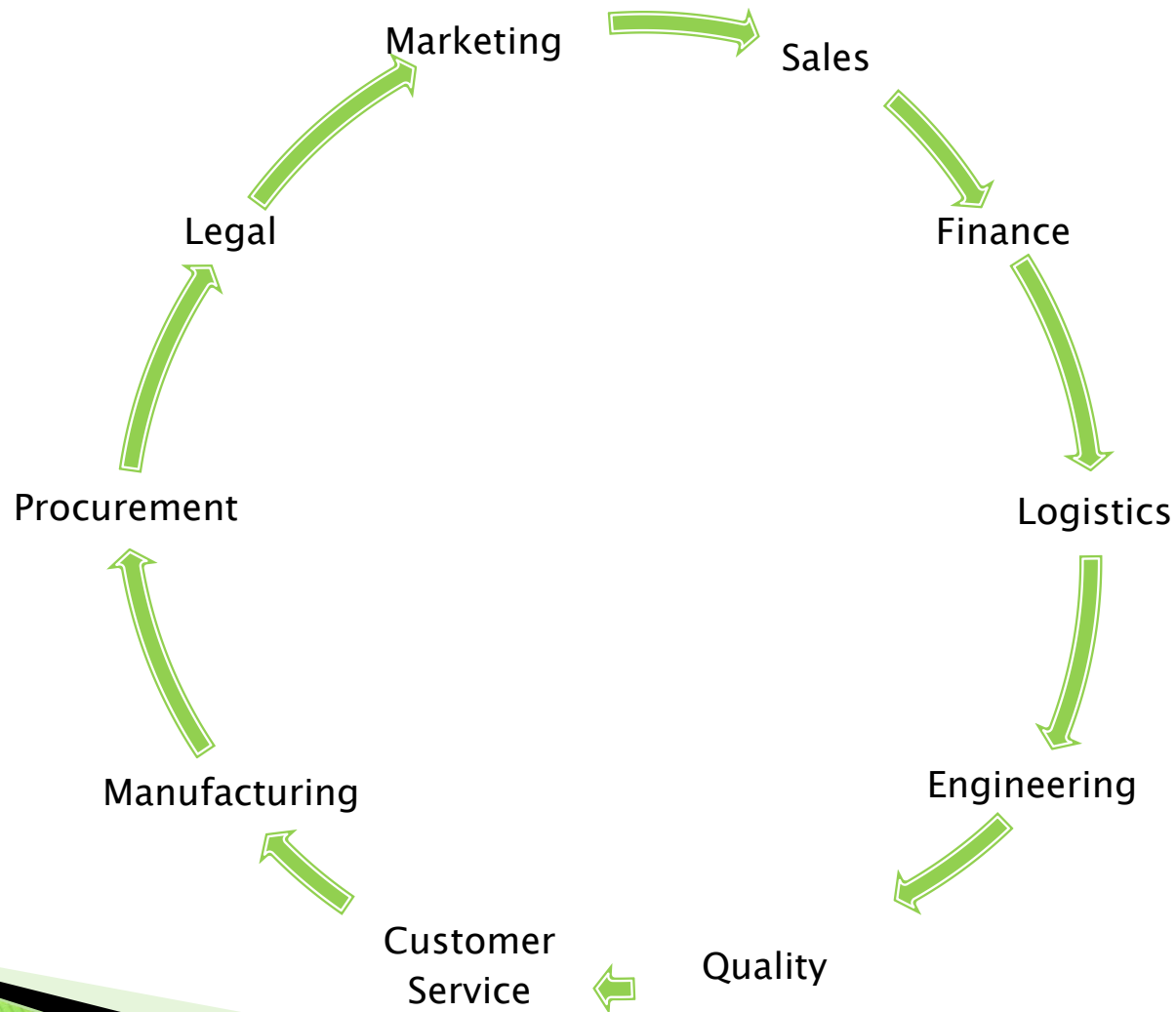


off by the latch.

ire on the latch

closing direction

RL is Cross-Functional



BACKGROUND

- We received data on Whirlpool's re-manufactured appliances on April 14, 2011
- We received data on 48 Origins and 86 destinations
- The inbound flow is 1,320 truckloads per year while the outbound is 1,034 per year
- The imbalance is due to scrap and a slightly more efficient loading on outbound than inbound
- The following analysis specifies optimal repair locations based on these inbound and outbound patterns and certain transportations assumptions

2

Chicago Consulting

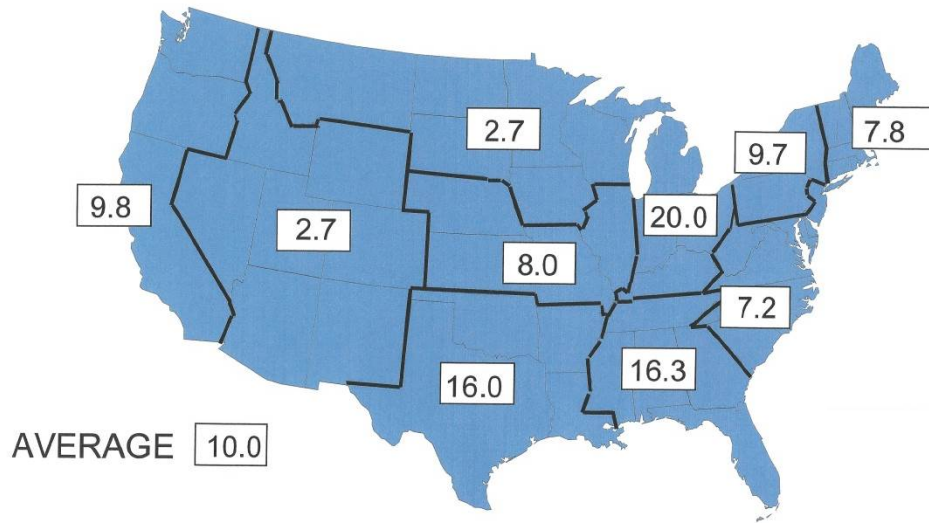
BACKGROUND

- We developed networks of re-manufacture facility locations based on two criteria
 - Servicing the outbound pattern of customers
 - Transportation costs—both inbound and outbound
- Regarding transportation costs we have modeled the following
 - An inbound truckload can carry 61 units
 - An outbound truckload can carry 63 units
 - All moves are truckload (TL) at \$2.50 per mile



INBOUND PATTERN

(Percent of 80,520 Units [1,320 Truckloads] Per Year)

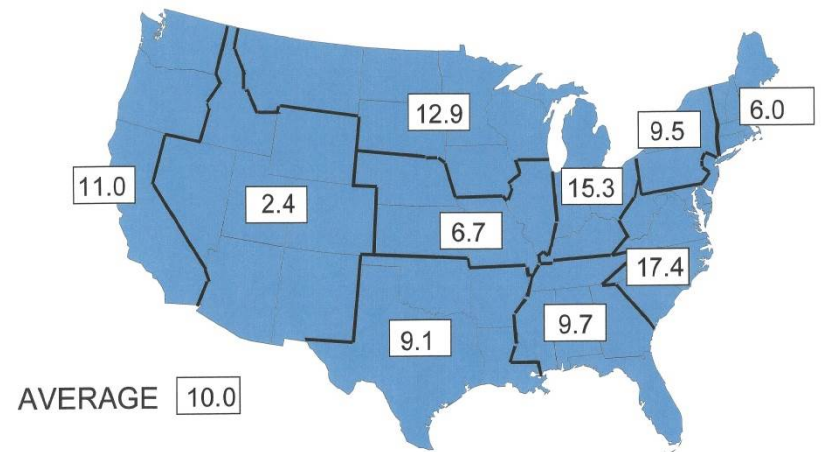


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Chicago Cor

OUTBOUND PATTERN

(Percent of 65,140 Units [1,034 Truckloads] Per Year)



OPTIMAL SERVICE-BASED FACILITY NETWORKS¹

NUMBER OF REMAN FACILITIES	AVERAGE DISTANCE TO CUSTOMERS	AVERAGE TRANSIT TIME TO CUSTOMER	LOCATIONS (% THROUGHPUT)		
THE CURRENT FIVE ²	218	0.5	Deer Park, NY (21) Grand Prairie, TX (9)	Acworth, GA (23) Fontana, CA (13)	Alsip, IL (34)
ONE	597	1.4	New Albany, IN (100)		
TWO	380	0.9	Cincinnati, OH (87)	Bakersfield, CA (13)	
THREE	280	0.7	Petersburg, WV (47)	Edwardsville, IL (40)	Bakersfield, CA (13)
FOUR	227	0.5	Harrisburg, PA (31) Bakersfield, CA (13)	Charlotte, NC (19)	Edwardsville, IL (37)
FIVE	175	0.4	Harrisburg, PA (30) Dallas, TX (19)	Charlotte, NC (18) Bakersfield, CA (13)	Dubuque, IA (20)
SIX	144	0.3	Lancaster, PA (18) Madison, WI (17)	Charlotte, NC (18) Jonesboro, AR (18)	Cleveland, OH (16) Bakersfield, CA (13)

NOTE 1: Networks that minimize the distance to outbound destinations

NOTE 2: With optimal (closest) assignment of territories in the current network

OPTIMAL COST-BASED FACILITY NETWORKS¹

7 Chicago Cons

NUMBER OF REMAN FACILITIES	TRANSPORTATION COST (\$000)			LOCATIONS (% THROUGHPUT)		
	INBOUND	OUTBOUND	TOTAL			
THE CURRENT FIVE ²	710	1,430	2,140	Deer Park, NY (17) Grand Prairie, TX (17)	Acworth, GA (26) Fontana, CA (11)	Alsip, IL (29)
ONE	1,535	1,211	2,746	Columbus, IN (100)		
TWO	1,098	1,246	2,345	Columbus, OH (65)	Shawnee, OK (35)	
THREE	819	1,350	2,169	Columbus, OH (56)	Jonesboro, AR (31)	San Bernardino, CA (13)
FOUR	667	1,388	2,054	Harrisburg, PA (24) San Bernardino, CA (13)	Columbus, OH (32)	Jonesboro, AR (31)
FIVE	553	1,432	1,986	Harrisburg, PA (23) Fayetteville, AR (20)	Columbus, OH (26) San Bernardino, CA (12)	Chattanooga, TN (19)
SIX	419	1,499	1,918	Harrisburg, PA (23) St. Louis, MO (16)	Atlanta, GA (15) Fort Worth, TX (13)	Columbus, OH (22) Riverside, CA (11)

NOTE 1: Networks that minimize the total transportation cost

NOTE 2: With optimal (least cost) assignment of territories in the current network

Closing Summary

- ▶ **Leading SC Companies are Applying Forward Supply Chain Principles to Reverse Supply Chain**
- ▶ **SC Organization is Best Positioned Organizationally to Own RL**
- ▶ **Information Drives Relevance**
- ▶ **Information Provides Clarity on Numbers**
- ▶ **Information Doesn't Do Anything**

Extended Producer Responsibility (EPR)

- ▶ EPR is a policy approach that requires manufacturers to finance the costs of recycling or safely disposing of products consumers no longer want.
- ▶ **WHY EPR?**– The idea of extended producer responsibility has galvanized a coalition of interests including local and state governments, established environmental advocacy groups, and newer organizations dedicated to reducing the environmental and societal costs of consumer products. To varying degrees, many of these stakeholders worked together previously on waste management and other issues, but their current shared focus on EPR is significant, and suggests the extent to which EPR offers benefits to each set of interests
- ▶ **Cradle to Cradle Solutions**– Plastics and Metals Solutions

