

Sorting Equipment Location and Selection

How Value, Automation and Movement Influence MRF Cost, Design and Location

Patrick Tierney

22 August 2018

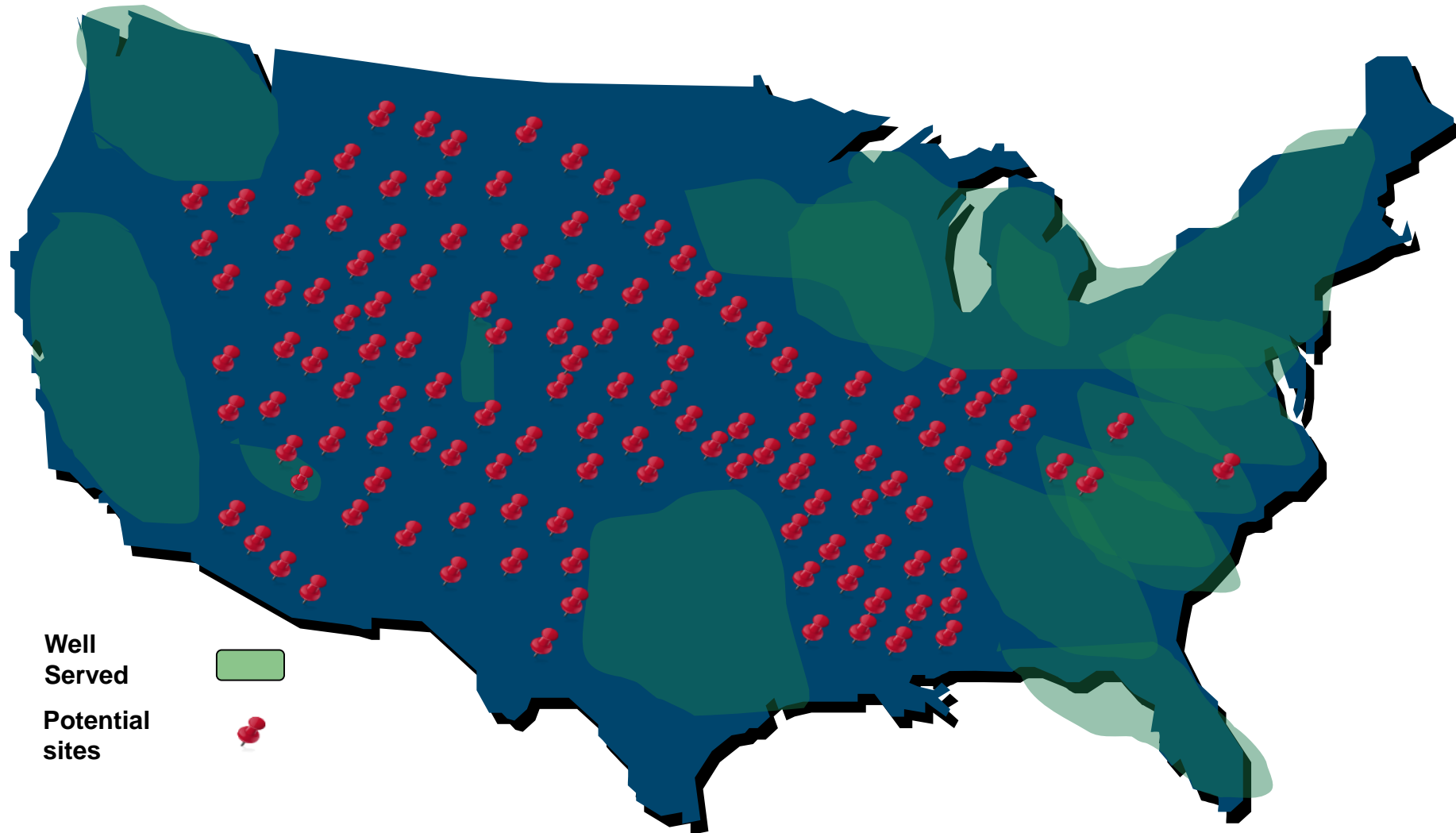
The Opportunity:



**Small towns in America throw away
over \$1,400,000,000 every year
in unclaimed recyclables.**

* 2015 EPA *Advancing Sustainable Materials Management: 2013 Fact Sheet*, 2016 market pricing

At least 2500 communities do not have local, sustainable recycling



* 2015 EPA *Advancing Sustainable Materials Management: 2013 Fact Sheet*, US Census Data, Waste Management and Republic Annual Reports

© Revolution Systems 2018

Choice of System and Efficient collection

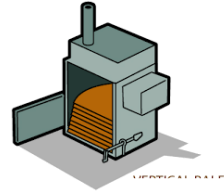


Source Separated	Dual or Single Stream	Zero Stream or Dirty MRF
Whose Time Matters?	Easier for Consumer	No effort
20-30 Sec/bin, 4 bins Sectioning or multiple trucks	More Efficient Collection	No Effort
Unloading	Lower contamination, better quality	Separation Difficult, Expensive High Contamination
High Yield, low diversion	High Yield, High Diversion	Low yield
Clean, Expensive, Low Volume, Lower Impact	High Volume, Lower cost, High impact	High Volume, Expensive, higher impact

The Process: Where is the Value?



The Process: Where is the Value?



Process	Collect	Feed/Move	Sort	Move	Bale	Store	Transport	Recycle
Value Add	Yes?	No	Yes	NO	*Yes?	No	No	Yes
Costs	Equipment Fuel Labor	Building Equipment Labor	Labor Power	Building Equipment Labor	Equipment Labor	Building Equipment Labor	Equipment Fuel Labor	Handling Processing
Drivers	Distance Density # Pick ups	Space, Distance # Drop offs	Mix, Position	Space, Distance	Volume	Space, Distance # Pickups	Distance Density	*Format Quality
Remedy	Optimize	Reduce	Optimize	Reduce	Reduce	Reduce	Reduce	Increase
Remarks	Tight Pack damages material	Process immediately Automate	People Exercise Judgement	Shorten Automate	Automate	Scheduling Local Outlets	Local Outlets	Ease of processing increases value

Efficient Transportation



- Density and truck loads

- Transfer Trucks
- Collection Trucks
- Freight Trucks
- “Weighting out” vs “Spacing out”
- Baled vs compacted vs loose



- Dead legs

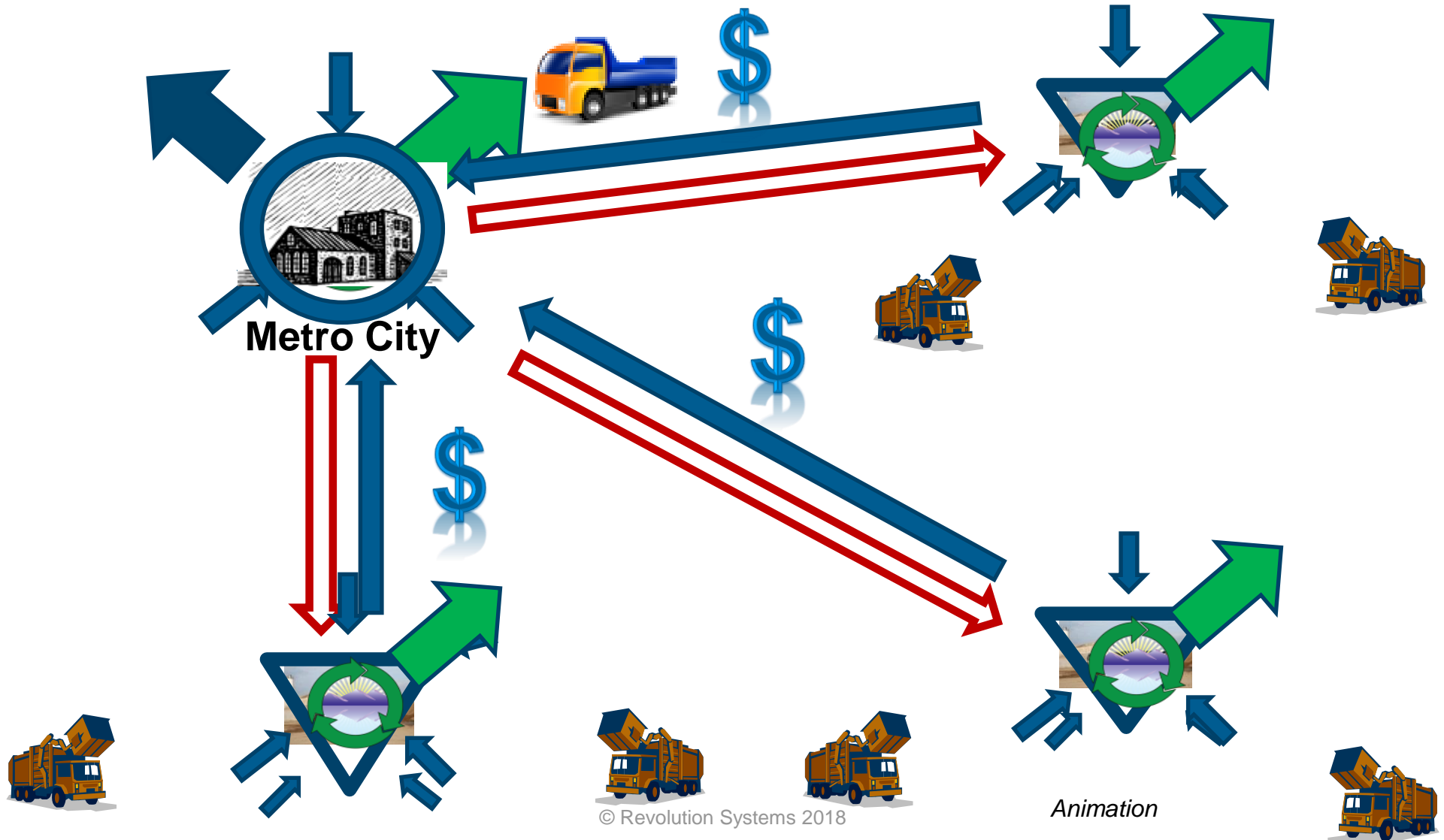
- Route truck takes empty to return and pick up another load
- Special use vehicles
 - Transfer Truck
 - Collection Trucks



Implications:

- Shorter distances for less dense transportation
 - Earlier baled/densified the better
 - Compaction affects quality
 - May mix loads
-
- Avoid long routes for special use vehicles
 - Get into freighter earlier

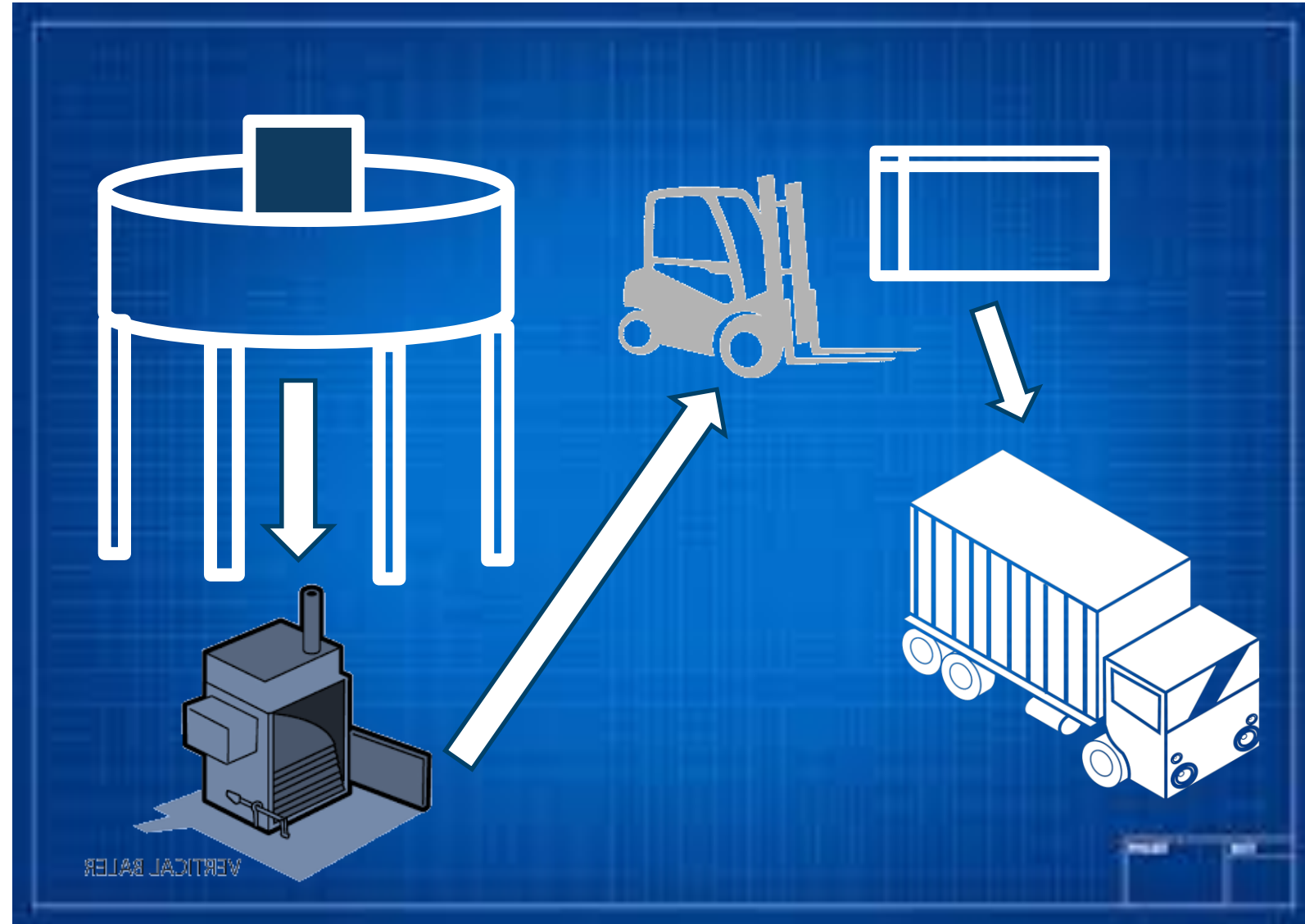
Location Matters



Movement and Flow



- In the plant
 - Shorter distances matter.
 - 15,000 people = 23,000 bales/year
 - 50 feet from the baler to storage, 50 ft to the truck:
 - 264 miles round trip for a lift truck (7.5 man-weeks!)

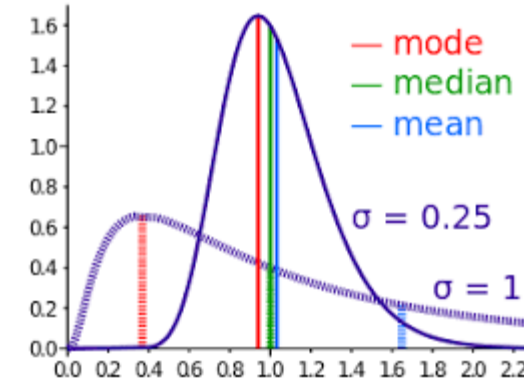


Variation



Waste Characterization Studies are intended to understand the volume and mix of material recovered in the community:

- Cost money
- Are an average
- Volume and mix variation occur because of:
 - Events/Seasons
 - Holidays
 - Demographic changes
 - Growth



The Flaw of Averages

An estimate based on the assumption that average conditions will occur will almost always be wrong (with there usually being no way to determine ahead of time whether the estimate will be optimistic or pessimistic).



Dealing with Variation



In Volume:

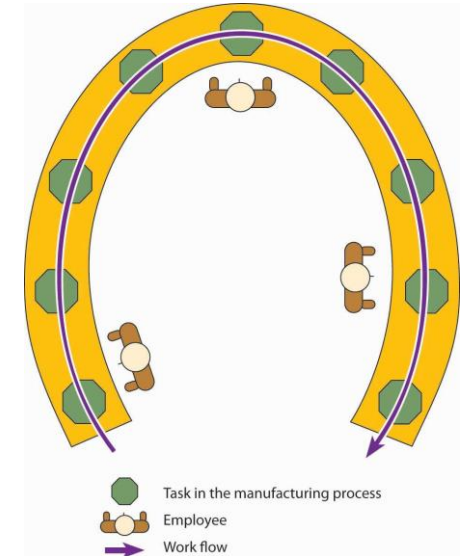
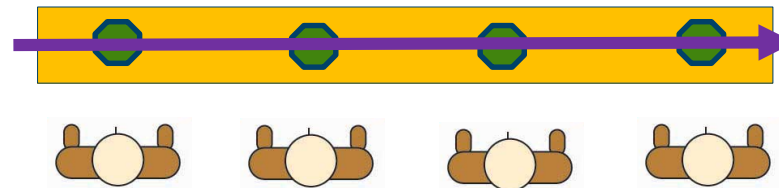
- Can be difficult or expensive to deal with in automated systems
- Additional equipment is typically not an option
- Usually requires adding a shift or extending hours
- With less automation, adding staff permanently or temporarily can solve the problem

In mix:

- Automated systems can have difficulty coping when mix exceeds limits
- Manual systems can adapt dynamically through staff adjustment or re-assignment

The best systems can adapt to change

Balancing the line – mix matters



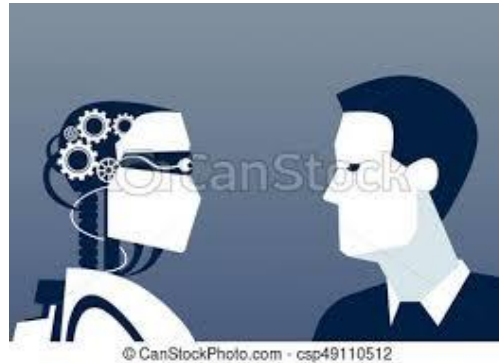
Material/ Manpower	OCC	Paper	Plastic # 1 & 2	Plastic # 3-7	Aluminum	Other Metals	Glass	Baling	Total
Workload	.920	1.185	.312	.7023	.109	.592	.390	.590	4.8
Non-Rev	1	1	1	1	1	1	1	1	8
Revolution	1	1	1		1			1	5

Where to Automate?



Automation

- Can handle simple tasks cheaply
- Can handle complex tasks expensively
- Is very specific
 - Design Volume
 - Design mix
 - Design quality
 - Design weight
- Is not perfect – must check
- Does not “choose” or exercise judgement



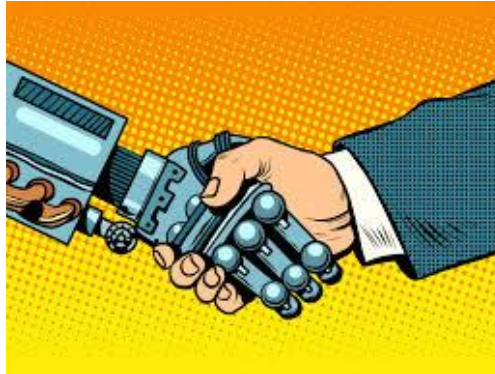
People

- Aren't cheap
- Can handle complex tasks
- Are adaptable
 - More volume – more people
 - Can flex with mix
 - Can adapt to quality
- Need help when task exceeds strength
- Aren't perfect, but they check machines
- Are best when judgement is needed

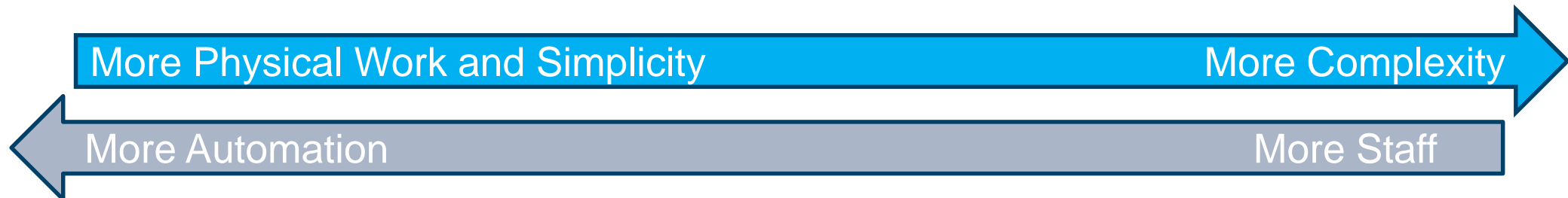
Implications: Automation



- Minimize all tasks
- Automate the simplest tasks first:
 - Handling
 - Movement
 - Quality demand is low
- Staff complex tasks
 - Optimize position, presentation
 - Augment strength where needed
- Volume matters



- Placement of machines
- Loading Mechanisms
- Feed Conveyors
- Metering Wheels
- Conveyors
- Magnets
- Auto-tie Balers



Value



- Price: Rises and lowers with supply and demand, BUT:
- Quality impacts the ability to process material
 - Ceramics, lead in glass
 - Grease in paper
 - Wrong Plastic in sack
- Readiness for use increases value
 - Right hand/left hand
 - Dumping/untying
 - Shred/Unshred
 - Cleaning/Drying
- China; transpacific shipment of trash?



Value and Single Stream (CHINA)



- Automation is a source of contamination
- Negative sort systems assume if it is picked, it's right
 - Foreign material
 - Material not contemplated (Tennis shoes?!?)
- Positive sort systems (manual) require a choice to be included
 - Judgement exercised in choice
 - Feedback
 - Sorters can be pickier when markets are down to get more value
 - Sorters can be less picky when markets are up to get more volume
- Single Stream material is being shipped to CHINA today – but it is higher quality and the process used has been inspected, is under control and monitored



Positive Sort and Quality are Key

Space



- Costs Money (\$15-\$40/sqft)
- Drives movement up and handling costs up
- Tends to fill up when available

Interesting Facts

- 1 Bale Requires 10-14 yd³ Steel Cans
12-15 yd³ Aluminum Cans
3-5 yd³ Paper
5-10 yd³ Cardboard
20 yd³ Plastic



Bale Containers Right Away

The myth of machine utilization, a case study



Equipment Case I	Cost	Equipment Case II	Cost
Auto-Tie Baler	\$150,000	4 Vertical Balers	\$80,000
4 Bunkers (@ 100 Sq ft each)	\$10,000		
Conveyor (2)	\$20,000		
Skid Steer	\$40,000		
Lift Truck	\$5000	Lift Truck	\$5000
Total	\$225,000		\$85,000
Labor (2) (move/load/unload)	\$70,000	Labor (2.5) (Tie/Unload	\$88,000
Difference: Capital	\$140,000		
Labor			\$18,000

It would take 8 years to recoup the difference

Some Thoughts



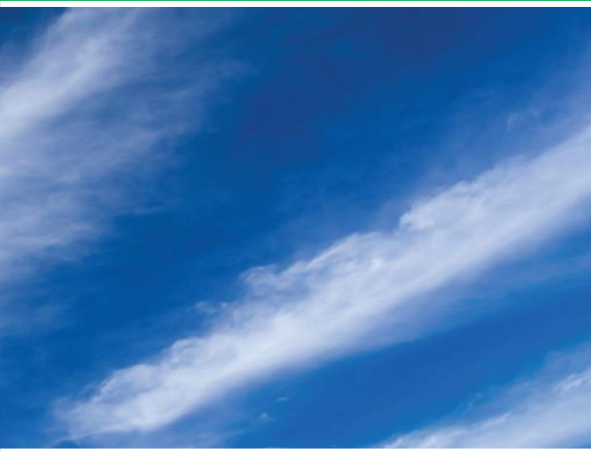
- Minimize movement of uncompacted material (process locally)
- Choose MRF location to reduce travel distance
- Reduce movement inside MRF to reduce space and labor costs
- Reduce storage to shorten cash cycle
- Handling costs money but does not add value.
- Automate simple, laborious tasks first
- Put people where they can make decisions; optimize their environment



Thank you!

Questions?

PTierney@revolutionsystems.net
www.RevolutionSystems.net



Appendix

The numbers supporting a local program*



Elimination of Hub and Spoke Transportation:

- \$80,000/month (20,000 population, 230 miles)

Profit from same 20,000 community processing single stream:

- 2018 Prices: \$100,000
- 2016 Prices: \$267,000
- 2014 Prices: \$60,000
- 2011 Prices: \$400,000
- 2006 Prices: \$600,000

Local opportunity:

- Hauler: Service Charge (\$3/home/month)
Transportation cost reduction
Tip fee reduction (20-30%)
- Landfill Operator: Development accrual reduction (>\$18,000/year),
Service charge
Incremental profit/ton (\$160 less tip fee at 2016 Prices)

** Composite of programs in Montrose, Steamboat Springs and Durango Colorado*

Composite Program



POP	15000
Blended Price/Ton	257
Contribution/Ton	\$ 137.79
EBITDA/Ton	\$ 89.83

Months		0 thru 6	7 thru 12	13 thru 18	19 thru 24	25 onward
Diversion Rate		15%	20%	24%	27%	30%
Revenue						
Glass		\$ 1,704	\$ 2,295	\$ 2,783	\$ 3,163	\$ 3,551
Paper		\$ 42,162	\$ 56,808	\$ 75,768	\$ 86,118	\$ 96,663
Plastic		\$ 223,589	\$ 301,256	\$ 401,801	\$ 456,686	\$ 512,607
Aluminum		\$ 31,941	\$ 43,037	\$ 52,182	\$ 59,310	\$ 66,572
Other Metals		\$ 19,165	\$ 25,822	\$ 31,309	\$ 35,586	\$ 39,943
		\$ 318,561	\$ 429,219	\$ 563,843	\$ 640,863	\$ 719,336
Variable Expense		1%	1%	1%	1%	1%
Tip Fees		\$4,058	\$4,884	\$5,228	\$5,169	\$4,953
Labor	3	\$ 90,000	120,000	144,000	162,000	180,000
Transportation		\$ 1,810	\$ 2,439	\$ 2,957	\$ 3,361	\$ 3,772
Packaging	5%	15,928	21,461	28,192	32,043	35,967
Parts		40,000	45,000	50,000	55,000	60,000
Maintenance	0.25	\$ 12,500	16,667	20,000	22,500	25,000
Total		\$164,296	\$210,450	\$250,377	\$280,073	\$309,692
Gross Margin		\$ 154,265	\$ 218,769	\$ 313,466	\$ 360,789	\$ 409,644
%		48%	51%	56%	56%	57%
Fixed Overhead						
Site Manager		\$ 50,000	51,000	52,020	53,060	54,122
Energy		\$ 30,000	31,500	33,075	34,729	36,465
Rent		\$ 30,000	\$ 30,000	\$ 30,000	\$ 30,000	\$ 30,000
Local Promotion		\$ 6,000	\$ 5,000	\$ 4,000	\$ 3,000	\$ 3,000
Office Expenses		\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000
Equipment Leases		\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
Total Fixed Overhead		\$ 135,000	\$ 136,500	\$ 138,095	\$ 139,789	\$ 142,587
Operating Profit		\$ 19,265	\$ 82,269	\$ 175,371	\$ 221,000	\$ 267,057

* Composite of programs in Montrose, Steamboat Springs and Durango Colorado

A Revolution in Material Separation



- Scalable: Bridges diversion gap – quicker ramp up
 - From 1-8 associates, from 1 TPH- to 24X tph (3 shifts)
 - Can serve communities from <10,000 (Walmart) to 60,000
- Configurable: Baler(s), auto separators, conveyors, bins
- Self balancing – mix variations
- Reliable: Turntable (3-5 HP motor) with gravity feed chutes
- Small footprint: Needs <5000 sq ft concrete pad – most existing buildings with low overhead
- Low cost: \$<500k
 - Within reach of small communities
 - Individual Hauler or Landfill operator can own
 - Larger communities can support more than one

The whole product

