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Process Improvement...
• OK, today we’ll be talking about Process Improvement ... but first we need to talk about Safety!

Our Industry ... not so good
• The solid waste industry is the 5th most dangerous injury in the U.S. ... in terms of fatalities (per capita worker)
• Landfill Fatalities ... 1 per month
• Waste Industry ... 40 per year

“...So How’s That Working For You?” Dr. Phil
Tradition is the Problem

- 8 out of 10 solid waste managers say that tradition is the biggest hindrance to operational improvement
- We keep doing the same old thing …without thinking about the result

We Learn by Example...

- “Here’s how we do things here…”
- And that’s how we learn our job
- That’s also how traditional inefficiencies get passed down
- Consequently, all operations have room for improvement

Insanity is...

- “Insanity is doing the same thing over and over again… and expecting different results.”
  
  Albert Einstein

Anatomy of an Accident
Many Factors

*Most accidents are a result of many factors aligning in a Perfect Storm scenario*

Explanation

- I’ve been an expert witness on more than 50 solid waste cases. Most were related to an injury or fatality
- Most had multiple causes

Here’s a Typical Example *(Hypothetical)*

A landfill spotter was run over by a route truck. What was the cause?

...Or rather, what were the causes?

They Are All Key Factors!

1. Unplanned Staffing Shortage
2. Spotter Was Not Trained
3. Spotter Was Scavenging
4. Driver Did Not Follow Procedure
5. No Standard Unloading Pattern
6. Bystander Did Nothing
7. Inadequate PPE
8. Backup Alarm Not Working
9. Driver Was a Speeder
A Chain of Events

These factors represent a chain of events that all had to connect to lead to the accident.

Who Contributed?

1. Unplanned Staffing Shortage – Management/H.R.
2. Spotter Was Not Trained – Management/Foreman
3. Spotter Was Scavenging – Management/Foreman/Spotter
4. Driver Did Not Follow Procedure – Driver
5. No Standard Unloading Pattern – Foreman/Driver
6. Bystander Did Nothing – Bystander
7. Inadequate PPE – Office (supply)/Foreman/Management
8. Backup Alarm Not Working – Driver/Mechanic
9. Driver Was a Speeder – Driver/Management

Who Could Have Prevented?

1. Management
2. HR (Human Resources)
3. Foreman
4. Spotter
5. Driver
6. Bystander
7. Office Staff
8. Mechanic

Safety is Simple

1. Identify Risks
2. Create Procedures to Mitigate
3. Follow Procedures
Broken Windows Theory

- When windows are not repaired, vandals tend to break more. This leads to more disrespect ...and more crime

- Study in Bronx, NY and Palo Alto, CA

The Study

- Two cars, no license plate, hood up
- Bronx, NY
  - Attacked within minutes
  - Stripped in 24 hours
  - Then smashed, ripped and demolished
- Palo Alto, CA
  - Untouched for a week
  - Then the study author hits with sledgehammer
  - Soon after ...other people join in

At Your Facility

What Can You Do?

- Mow the weeds
- Fix the fences
- Pick up litter
- Maintain buildings
- Paint/straighten the signs
- Provide uniforms for everyone
Tackle Something Small

• Tackle something small ...Just one thing could cause a tipping point that would begin to change the safety culture

• Vests and Hardhats ...for everybody

Any Broken Windows Here?

1. Unplanned Staffing Shortage
2. Spotter Was Not Trained
3. Spotter Was Scavenging
4. Driver Did Not Follow Procedure
5. No Standard Unloading Pattern
6. Bystander Did Nothing
7. Inadequate PPE
8. Backup Alarm Not Working
9. Driver Was a Speeder

Need Another Incentive?

• The safest cultures are also the most efficient cultures

• Standardized operations:
  – Reduce Variation
  – Increase Safety
  – Increase Efficiency

Why is Process Improvement so Important?
We Need Systems

- We need systems ... procedures.
- Because we don't know what we don't know.

It's like the young driver...

Systems are Lacking

- 90% of waste facilities do not have all required systems in place
- That means 90% of our workers do not have the critical direction they need
- It's no wonder the waste industry is the 5th most dangerous industry in America!

Want an Example?

Demonstration

- Look at the importance of establishing a standard procedure
- 3 Questions...
  - Where to park for unloading...?

Choice 1

- You are driving a garbage truck ... where would you park to unload?

1 2 3
Choice 2

• You are driving a garbage truck ... where would you park to unload?

Choice 3

• You are driving a garbage truck ... where would you park to unload?

In the Solid Waste Industry

• We aren't improving operational efficiency and safety as quickly as we could.
• ...because we don't see the problem.
• ...we don't see the need for systems.
• We are so used to the same old way of doing things ... it all looks normal.

Do These Look Familiar?

Shelves full of:
- Binders
- Folders
- Plans
- Programs
Do You Use This Information?

- When was the last time one of these binders was pulled off the shelf?
- When was the last time one of them was revised?
- Does your crew know what’s in these binders?
- Do you have all the plans/programs you need?

What’s the Real Deal?

- Sure, you have:
  - But when’s the last time you heard of a landfill worker who died from hepatitis? ... or from hearing loss?

Most fatalities happen at the face!!!

The Biggest Risk

- If somebody gets hurt or killed at your landfill, it will happen here

And it Looks Normal

Like This...
We Need Systems

Step 1

Step 2

Step 3...

How We Define Systems...

1. Safety Manuals
2. Operations Plans
3. Fill Sequence Plans / Soil Management Plans
4. Emergency Response Plans
5. Detailed Procedure Manuals
7. Equipment Maintenance Program (EMP)
8. Inspection / Compliance Manuals

Details of How to Do the Things You Do

BEFORE
46% of Airspace is Soil

AFTER
8% of Airspace is Soil
It's Not Always That Simple

- Sometimes solutions are very simple ...sometimes a bit more complex.
- The key is to put numbers to the basic tasks we do every day
- That's what moves us in the direction of real process improvement

Video Analysis ...for Systems

- We evaluate many hours/days of video from a typical landfill operation. And determine how long individual sub-tasks take to perform:
  - How long for a truck to unload?
  - How long does the load sit on the ground?
  - How long for the dozer to push the load?
  - How long for the dozer to return?

Optimum Cell Geometry

Differential Equation to optimize daily cell geometry:
- Machine Cost
- ADC Cost
- Airspace Value
- Pushing Cost
- ...Many Other factors

To Size the Tipping Pad

a) Truck Unload

- Note the two peaks
- Represents a mix of packer trucks and transfer trucks
- How do we use this information?
a) **Truck Unload**

- It takes on average – 2m32s for a truck to unload.
- This is the average for packers and transfer.

b) **Load on the Ground**

- Also on average – a load sits on the ground for 1m16s before it is pushed to the face.
- Total “slot” time is 3m48s.
- So, a slot can handle max 15 trucks per hour.

**Hourly Tonnage**

- If the average load is 5 tons, then each slot can receive up to 75 tons per hour.
- So, dividing hourly tonnage (received) by 75 will show how many slots are required.
- In this case: 5
- Add 1 for contingency

**Optimum Tipping Width**

- Based on 5 slots, we’ll need a tipping pad that is ~125 feet wide.
- 10’ truck + 10’ buffer.
Now ... How Many Dozers?

- Now let’s make a system for the dozer

Dozer Push

- It takes an average of 36s for the dozer to push from the tipping pad to the face

Dozer Return

- And an average of 22s to return

Dozer Push + Return

- The dozer’s total cycle time is 58s
- So, the dozer can make 62 pushes per working hour
- Using that same average of 5 tons/load, the dozer can process 310 tons per working hour.
How Many Dozers?

• Comparing this to the hourly tonnage chart, a single dozer can handle the inbound waste stream ...except for a 1-hour period on M, T & Th
• Essentially, this is a one-dozer operation
• Need to address work efficiency ...85%

Do Your Own Math...

• Start with your Daily Tonnage and then divide by tons/hr for your machine
  - D6 ... 225 tons/hr
  - D7 ... 300 tons/hr
  - D8 ... 400 tons/hr
• This is your minimum potential dozer hours on a daily basis
• How many hours is your dozer running?

Dozer Production

• The Caterpillar Performance Handbook
• Start with the Production Curves

There are Factors:

• These Factors affect dozer production:
  – Operator Skill
  – Type of Material
  – ...more on next page
More Factors:
- Slot Dozing
- Side By Side

It’s when two machines work side-by-side, production is more than doubled.

Caterpillar estimates an increase of 20%

SIDEBY-SIDE PUSHING

Here’s a look at Side-by-Side pushing

More Factors:
- Downhill
- Uphill
The Analytical Process

• It takes several days of filming...must focus on getting appropriate footage...may require multiple cameras
• May take weeks of video review...Time Studies may include thousands of individual “process” observations
• All of the analytical work is done in Excel®—Tables, charts, etc.
• Reviewer must understand landfill operations

Definition: Value Stream Mapping

• Value Stream Mapping (VSM) defines the flow of material or information through a system

3. Value Stream Mapping

• We combine what we've learned through Activity Sampling and Video Analysis
• Then, perform Value Stream Mapping

VSM: The Process

• Choose an activity
• Put individual tasks in chronological order
• Determine Current State
  – Likely to include lots of inefficient activities
  – These are referred to as Non-Value Added (NVA)
• Identify the Ideal State
  – Includes only goal-related activities
  – These are referred to as Value Added (VA)
• Work to achieve the Ideal State
Improving the Process

• Evaluate every “Current State” task
  – Compare to industry
  – Compare to “best” theoretical (i.e., CAT® Performance Handbook)
  – Find “best” actual (i.e., Time Study)

• Identify “Ideal State”

• Set goal to achieve Ideal State

• Work to eliminate NVA activities

• We’ll look at two examples:
  – Pushing waste
  – Processing wood/green waste

Pushing Waste (Current State VSM)

• Current State
  1. Wait for truck to move out of the way
  2. Reposition dozer
  3. Push trash
  4. Bulky material poses risk
  5. Wait for spotter to move to safe area
  6. Slope too steep
  7. Reposition – dozer loses traction
  8. Wait for direction from compactor operator
  9. Relocate waste
  10. Spread for compactor
  11. Reverse
  12. Wait for spotter to relocate truck – in the way
  13. Backblade the deck to remove ruts
  14. Pull off to the side to wait for next slot to open up

Pushing Waste (Ideal State)

• Ideal State
  1. Push trash
  2. Spread for compactor
  3. Reverse

• Look at mean for each activity as determined by Time Study

• Now – review pie chart
Collections

Your Routes Have Hidden Factories

- Missed Lifts
- Tipped cans...requiring driver to exit truck.
- Blocked FEL bins...driver has to return.
- Extra trips because body packs weak.
- Broken gate requires extra FEL driver time.
- Tweaked tailgate requires big hammer.
- Broken (automated arm) camera leads to spills.

Cost of Hidden Factory

- Spilled can during lift.
- Truck & Driver $120/hr
- 3 minutes $6
- 11 spills/day $66/day
  ...$17,160/yr

$17,160/yr .. for every route!

This Is a Small Hidden Factory

- But it may run 9 times per day.
- And wastes 5 minutes each time.
- 45 minutes per day.
- This Hidden Factory costs are $23,400/yr.
Who is Most Productive?

1. Joe: Has earliest route completion
2. Bill: Gets highest payloads
3. Mike: Makes the most lifts

We Don’t Know …Yet

To Find Out, We Need To:

• Compare apples to apples
• Measure against similar units
  – Tons
  – Hours
  – Lifts
• Adjust for conditions
  – Weather
  – Terrain
  – Demographics
• Identify Hidden Factories

Production Rates

1. Total Tons
2. Total No. Routes
3. Total Miles
4. No. Lifts
   – Miles per Route
   – Tons per Route
   – Hours per Route
   – Lifts per Route
   – Lifts per Mile
   – Tons per Hour
   – Lifts per hour
   – Pounds/lift (lifts/ton)
   – Tons / LF or TS trip

TIP

• Variation almost always indicates inefficiency
Need to Fix my Routes

- Collection managers will often refer to the need to streamline or “optimize” their routes.

- But, it’s more than just a route

It’s More than the Route

- It Breaks down to:
  1. Start-up, including pre-trip inspection
  2. Drive to start of route
  3. Individual lifts
  4. Drive to Transfer Station or Landfill
  5. Return to Route …or to Yard
  6. Shutdown Procedure

Individual Lifts

A. Target the can
B. Decelerate
C. Grab
D. Lift
E. Dump
F. Re-set
G. Identify next can
H. Accelerate

...Target the can

What’s the Big Deal?

A. Grab
B. Lift
C. Dump
D. Reset

Cycle Time

- Let’s Assume: 950 customers (lifts) per day
- Save 9 seconds per lift
- That’s 2.63 hours per day
...every day, 5 days per week at $120/hour
Potential Savings: $82,000 per year (per route)
It's More than the Route

- It Breaks down to:
  1. Start-up, including pre-trip inspection
  2. Drive to start of route
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  4. Drive to Transfer Station or Landfill
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Drive to LF or TS

- Scale Process
- Wait in Line
- Spotter
- Position to Dump
- Dumping Process
- F. Clean-out
  - G. Exit Site

What's the Big Deal?

F. Clean-out

- Let’s Assume: 2 clean-outs per day
- Our Studies: Each one takes 4-20 minutes
- That's 0.13-0.67 hours per day

...every day, 5 days per week at $120/hour

Potential Savings: $4,160 to $20,800 per year (per route)

Other Factors

- Weather
- Traffic
- Delays at landfill or transfer station
- Inaccessible bins or cans
- Wrong machine(s)
- Poorly-maintained machine(s)
Cause & Effect Diagram

- Also referred to as fish-bone diagram
- Forces detailed thinking about root causes to problems
- Brings team together for solution

![Fish Bone Diagram Example]
Not All Cans are Used …But Every One is Lifted!

Hidden Factory

What are Your Goals?
• What are your goals?
• Generate Profit?
• Divert Recyclables?
• One or the other …both?

MRF

What Are You Targeting?
Newspaper, Cardboard, Glass, Plastics, Greens, Wood, Metals?

Why?
To Optimize Pickline

Ask these questions:

- How much target material crosses belt per day?
- What is the cost : benefit to obtain it?
- Is there a better process to obtain it?
  - Reduce belt speed
  - Open bags
  - Full bulky items first
  - Minimize “pick” time (ergonomics)
  - Provide cleaner feed stock

Point of Diminishing Return

How Many on the Pickline?

- Production is high with a few people...because they can pick the high-grade
- As more people are added, they must compete
- Material becomes more difficult to find
- Need to balance the line

Target High-Grade Loads

- Don’t clutter up the operation with marginal loads
- Focus on high-grade
- What about this one?
Know the Waste Stream
- Before you can start a recycling program, you've got to know your waste stream.

How Much Diversion?
- Is this 40-cy roll-off load worth sorting?

Worth Sorting?
- Here is the load dumped on the floor
  - Guess how many tons diverted...
  - 8.1 tons (90%)

Activity Sampling - Pickline
- Sample of worker pulling OCC from pickline
  - Pulling OCC only 56% of the time
Transfer Stations

At every facility, material flows through a series of processes. Each process has its own production rate. You can think of your operation as a pipeline, composed of varying diameter pipes.

Theory of Constraints

• At every facility, material flows through a series of processes.
• Each process has its own production rate.
• You can think of your operation as a pipeline, composed of varying diameter pipes.

It’s Like a Pipeline

• Each step in the process has its own production rate and cost.
• Must have an understanding of these to optimize the overall process.

Unloading Area

1) Unloading Area
2) Floor Sort
   a) Loader
   b) Laborers
3) Re-Direct Material
4) Initial Conveyor
5) Bulky Pick
6) Bag Opener
7) Fibers
8) Plastic
9) Glass
10) Metal

93 tons per hour
**Floor Sort Production**

- 17.8 tons per hour

  1. Unloading Area
  2. Floor Sort
     a. Loader
     b. Laborers
  3. Re-Direct Material
  4. Initial Conveyor
  5. Bulky Pick
  6. Bag Opener
  7. Fibers
  8. Plastic
  9. Glass
  10. Metal

**Re-Direct Material**

- 58.5 tons per hour

  1. Unloading Area
  2. Floor Sort
     a. Loader
     b. Laborers
  3. Re-Direct Material
  4. Initial Conveyor
  5. Bulky Pick
  6. Bag Opener
  7. Fibers
  8. Plastic
  9. Glass
  10. Metal

**Initial Conveyor**

- 30.4 tons per hour

  1. Unloading Area
  2. Floor Sort
     a. Loader
     b. Laborers
  3. Re-Direct Material
  4. Initial Conveyor
  5. Bulky Pick
  6. Bag Opener
  7. Fibers
  8. Plastic
  9. Glass
  10. Metal

**Know Your Costs**

- 93tph
  - 17.8tph (Floor Sort Production)
  - 58.5tph (Re-Direct Material)
  - 30.4tph (Initial Conveyor)

- $2.15/ton
- $7.80/ton
- $1.16/ton
- $0.85/ton
Data Table for Mass Diagram

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<th>PROCESSED</th>
<th>ON THE FLOOR</th>
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Mass Diagram

- Put the results into a chart (graph)

Wrap Up
Any Questions or Comments?

Fatal work injuries and hours worked, by gender of worker, 2013*

- Fatal work injuries: 4,405
- Hours worked: 260,127,180,000

A disproportionate share of fatal work injuries involved men relative to their hours worked in 2013.

*Data for 2013 are preliminary.
Male v. Female

- Males work 57% of hours
- And have 93% of fatalities
  
  ...why?
  1. Type of job?
  2. Aggressiveness?
  3. ...something else?

The Age Factor

- After early 20's risk continues to increase

Operating Costs