Safety Data Analysis

Make it Actionable

Heli–Expo Rotor Safety Challenge '15

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$$\sum T = \sum \frac{t_i^3 - t_i}{12}$$

where t is the number of scores for a given rank.

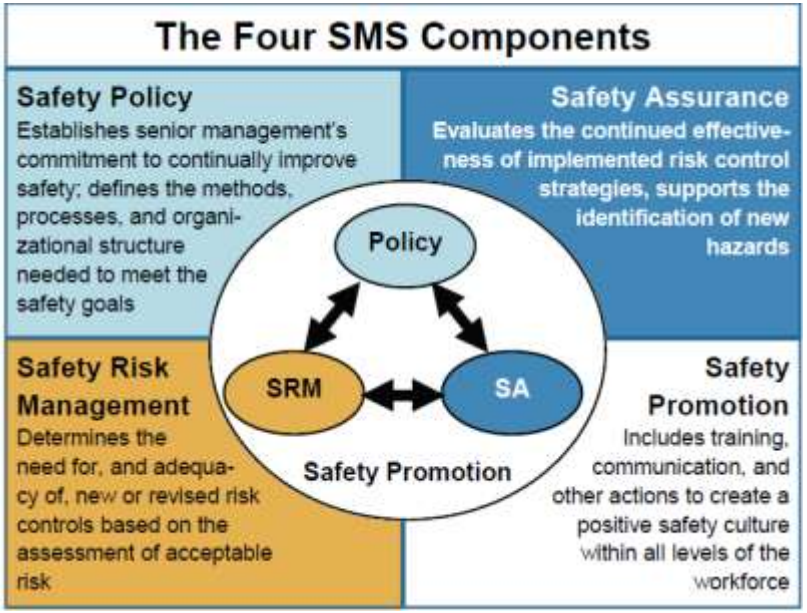
If, for example, there are two scores of rank 4, three scores of rank 2, and four scores of rank 1, then $t_i = 2$, 3, and 4. This correction factor is incorporated into the equation for the Z transformation.

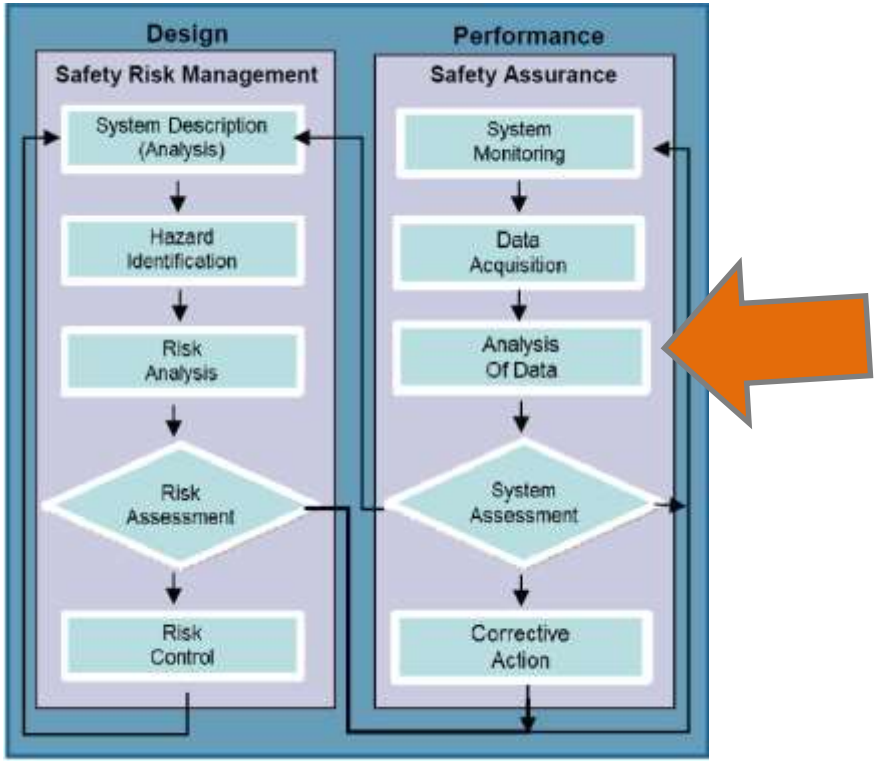
$$Z = \frac{U - \frac{n_1 \times n_2}{2}}{\sqrt{\left(\frac{n_1 \times n_2}{(n_1 + n_2)^2 - (n_1 + n_2)}\right)\left(\frac{(n_1 + n_2)^3 - (n_1 + n_2)}{12} - \sum T\right)}}$$

$$Z = \frac{U - (n_1 \times n_2)/2}{\sqrt{[(n_1 \times n_2)(n_1 + n_2 + 1)]/12}}$$

Where U is the smaller of the two values.

Why?





- What does the data analysis step entail?
- I have pieces of an SMS, do I have data?
  - Yes, probably
- Uh, ok, now what?

What am I talking about- Part II?
- Learn the Lingo-

- **"Trend Analysis"** collecting information and attempting to spot a pattern, or trend, in the information. In some fields of study, the term "trend analysis" has more formally-defined meanings.
- **"Big Data" –** Don't worry about this…(at least for now).
- **"Analytics" -** Use of math and statistics to derive meaning from the data.
  - Descriptive: Means (avgs), standard deviations
    - Measures found in dashboards /scorecards – Tell you what is happening , not why.
  - Predictive: in stats world this means a regression (past data modeling future outcomes)… In safety, "predictive" is slightly different
  - Prescriptive: Use of data to advise behavior under certain conditions.
  - Inference: Given partial data, what conclusions can be drawn about the source of the data? (hypothesis testing, conf intervals).

What will Trend Analysis do for me?

Informed Decision Making

Validating “tribal knowledge” within your operation

Provides Objectivity

Or, will you be moving garbage at the speed of light….?

A few things we have learned:

- **Lift times & occurrence of errors**
- **Correlations between damage events & quarter**
- **Compliance changes with new management**

Where do You Begin?

Do you have data?

- Reliability - How accurate is the data you have (are people reporting safety events with 100% consistency?)
- Limitations – What conclusions can you draw?

Yes, I do!

- What questions do you want to ask of the data?

No, I don't…

- Start collecting it!
- What questions do you want to ask?

Ideas for data sets:

- How often are events occurring?
- What do these events cost?
- Can we do risk assessments on this data?

Basic Methods; What would'ya say you're doing here

Useful Tools:

- Software
  - Excel (maybe w/ data analysis pkg)
  - Or

Ar

Logcard	Cost	Class	Deductibl	Deductibl	Net Ins Re	Brief	Coded Cal	Preventable	Rotor in Motio
RO-005831	$102,709.00	A				Engine Dmg during MX- No AIDMOR	13	1	0
	$10.00	E				Ground cable left attached	15	1	1
LC-029432-13	$14,285.00	D				Clam door dmg-looked up part l523m1001	10	1	0
	$163,998.00	A				FOD-engine	4	1	1
RO-002299-13	$260,431.00	A				RO from Shaw - Overtorque	2	1	1
LC-047025-13	$600.00	E				Door hinges broken-gust caught door. -no	10	1	0
	$15,000.00	D				Hard landing-cost is deductible	7	1	1
RO-004134	$113,362.00	A				Overtemp	1	1	1
LC-084984-13	$117,163.00	A				RAMCO incident - Overtemp	1	1	1

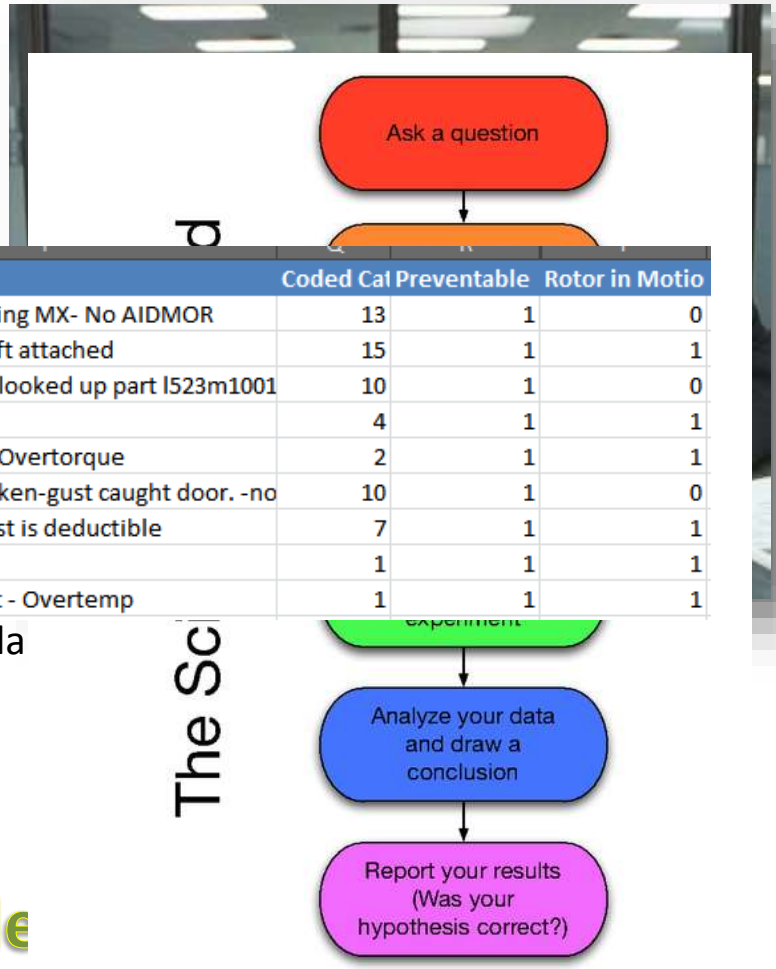
  - You can work with numbers (avgs, standa
- You've gotta' normalize.
  - Hours, transport, t/o & landing

Methods:

- Document your steps!!

- Make your process replicable

- You have to have a control group….



Safety Analysis: Most Helicopter Accidents Occurring in U.S. West and South

SOURCE: UNITED STATES HELICOPTER SAFETY TEAM MAY 12, 2014

FORT WORTH, TX – As part of its ongoing accident analysis, the United States Helicopter Safety Team (www.USHST.org) has categorized U.S. civil helicopter data by U.S. state for the period of 2008 through 2013. It continues to see the West and the South as ground zero for the majority of accidents. Fatal accidents, for the most part, also follow this western and southern trend.

Total U.S. Helicopter Accidents by State – 2008 through 201

1.	California	109	5.	Alaska	31
2.	Texas	91	6.	Washington	29
3.	Florida	65	7.	Oregon	27
4.	Arizona	49	8.	Louisiana	25

Fatal U.S. Helicopter Accidents by State – 2008 through 2013

1.	Texas	16	5.	Florida	5
2.	California	14	6.	Pennsylvania	5
3.	Arizona	9	7.	Alaska	5
4.	Louisiana	6	8.	Missouri	5

Problems with this data set…

- Inaccurate conclusions
- Reporting Method is Important!!
- Limitations of data

Apples to Apples?

Standardizing: Correcting for exposure or differences in measures

Annual Accident Rate (Per 100,000 Flight Hours) = $\frac{\text{Number of Accidents}}{\text{Number of Flight Hours}}$ X 100,000

Annual OSHA Recordable Rate (Per 200,000 Exposure Hours) = $\frac{\text{Number of Events}}{\text{Number of Exposure Hours}}$ X 200,000

Annual OSHA Lost Time Rate (Per 200,000 Exposure Hours) = $\frac{\text{Number of Events}}{\text{Number of Exposure Hours}}$ X 200,000

Example…

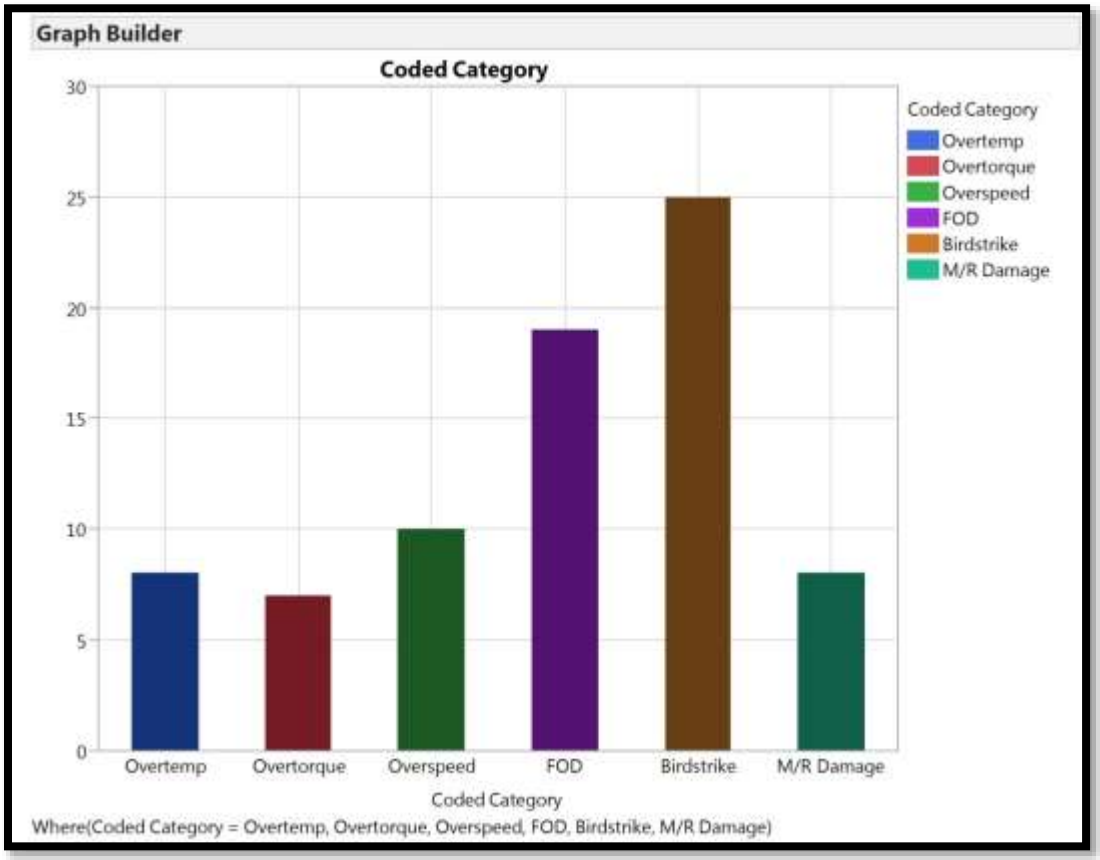
Annual Accident Rate (Per 100,000 Flight Hours) = $\frac{3}{20{,}750}$ X 100,000 = 14.56

Annual OSHA Recordable Rate (Per 200,000 Exposure Hours) = $\frac{2}{200{,}000}$ X 200,000 = 2.0*

Walkthrough- Steps 1

- Let’s assume your data is collected, you have a hypothesis.
- First, create a graph/plot – Get a big picture

From coded data, what events are occurring with the highest frequency?

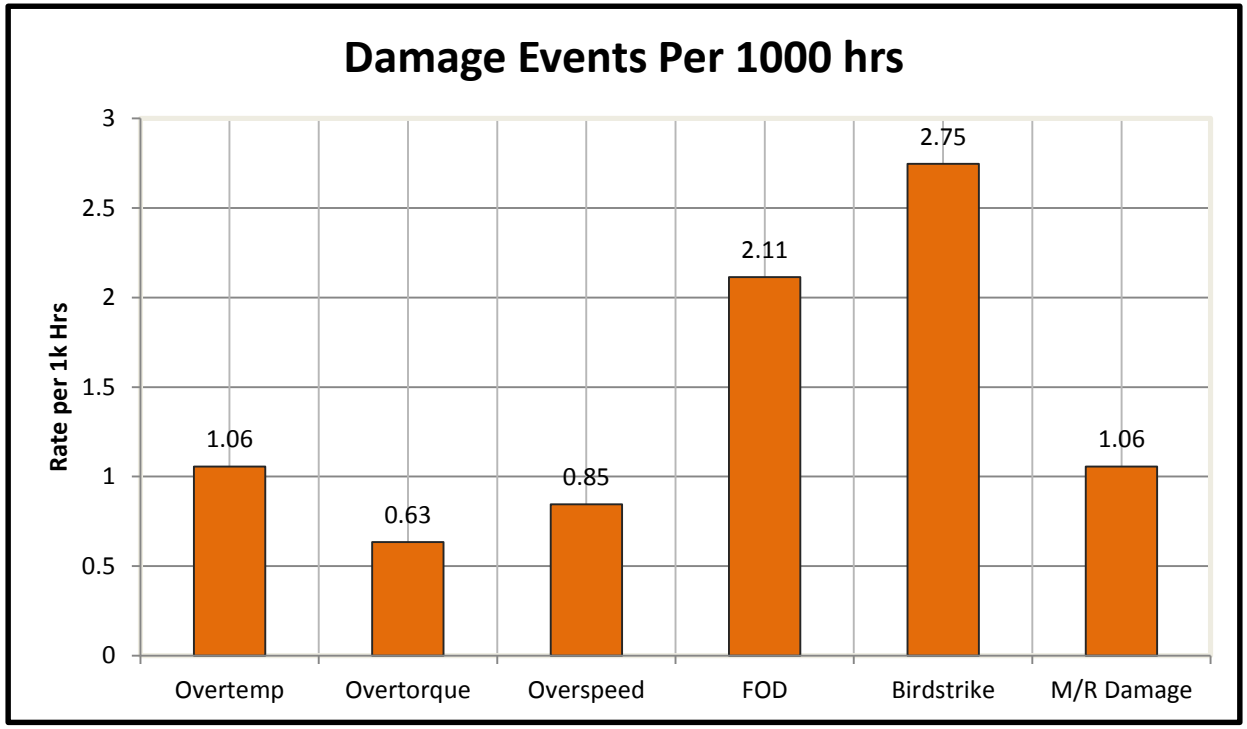


Walkthrough- Step 2

-Data corrected for exposure?

-Now what?

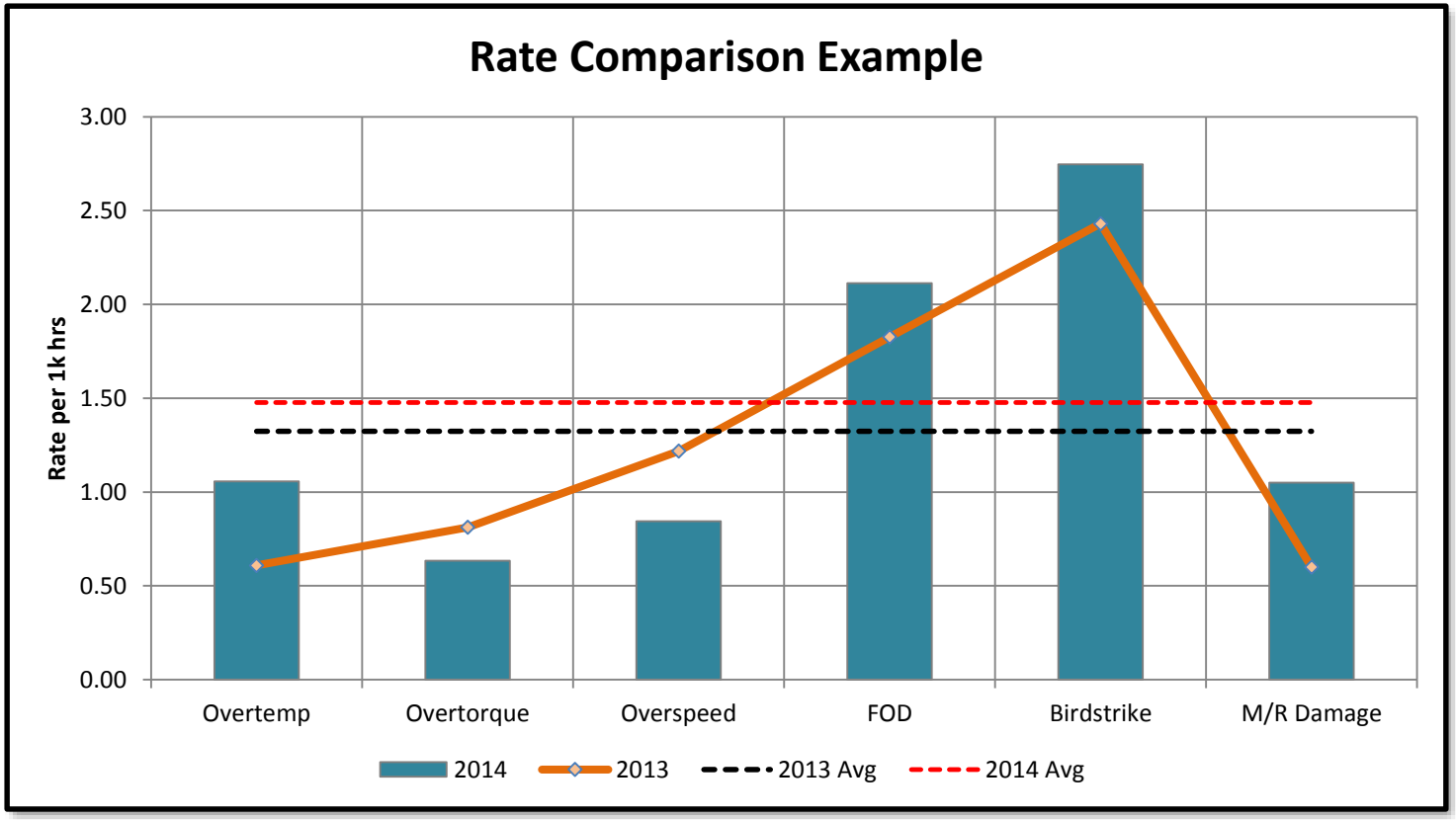
- Does it look accurate?



* This data is for illustration only…

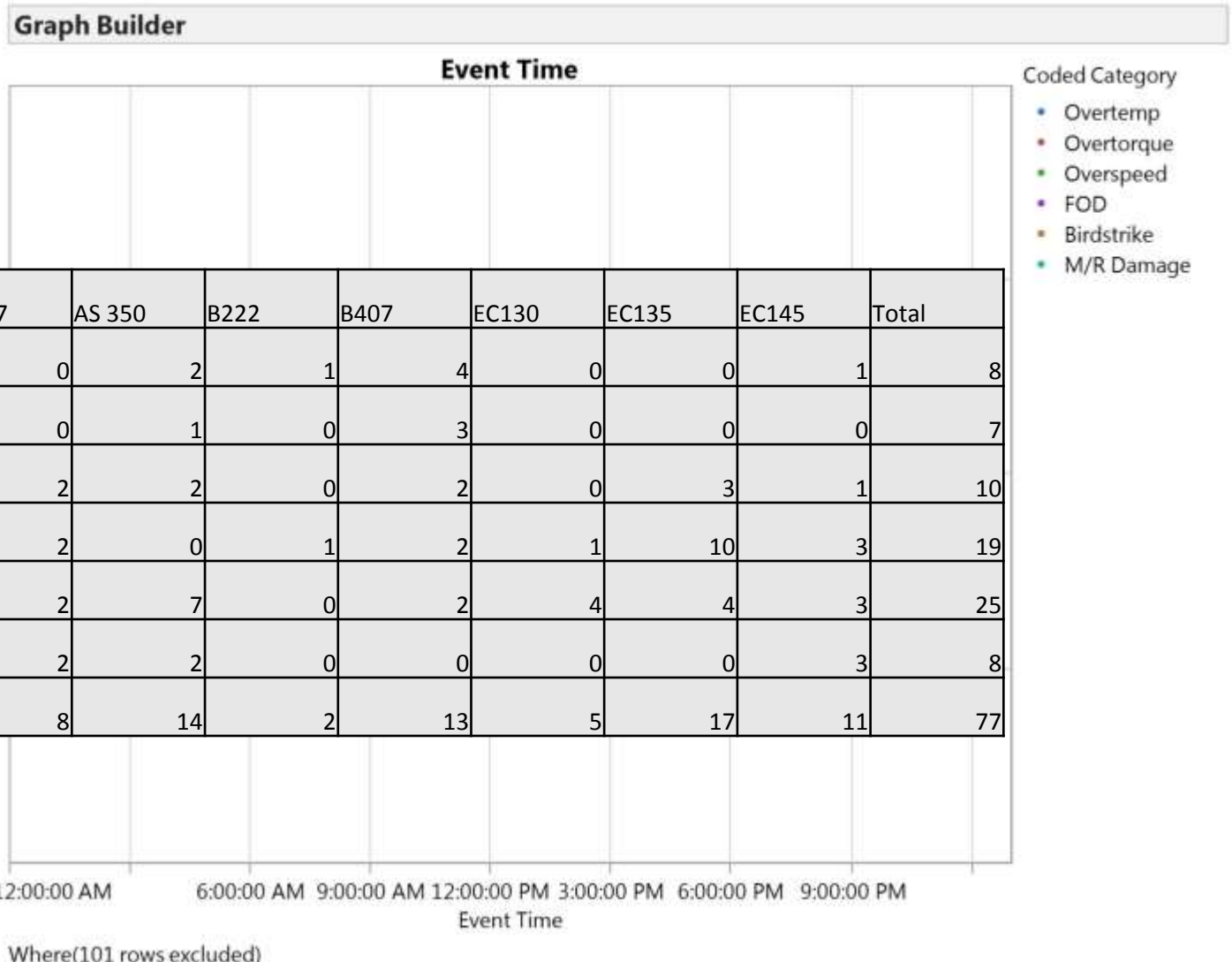
Walkthrough- Step 3

- Comparisons – Add something to hang a hat on…
  - Overall averages?
  - Standard deviations?
  - Other divisions



Walkthrough- Step 4

- Slice up data in a variety of ways:
  - Type A/C
  - Location
  - Time



Category	BK117	AS 350	B222	B407	EC130	EC135	EC145	Total
Overtemp	0	2	1	4	0	0	1	8
Overtorque	0	1	0	3	0	0	0	7
Overspeed	2	2	0	2	0	3	1	10
FOD	2	0	1	2	1	10	3	19
Birdstrike	2	7	0	2	4	4	3	25
M/R Damage	2	2	0	0	0	0	3	8
Total	8	14	2	13	5	17	11	77

Walkthrough- Step 4.5 - Errors

As you go through this process, ensure data is clean.

- Missing data /blank cells- A wrench in your results, (is that FOD?)
- Location & Type are examples

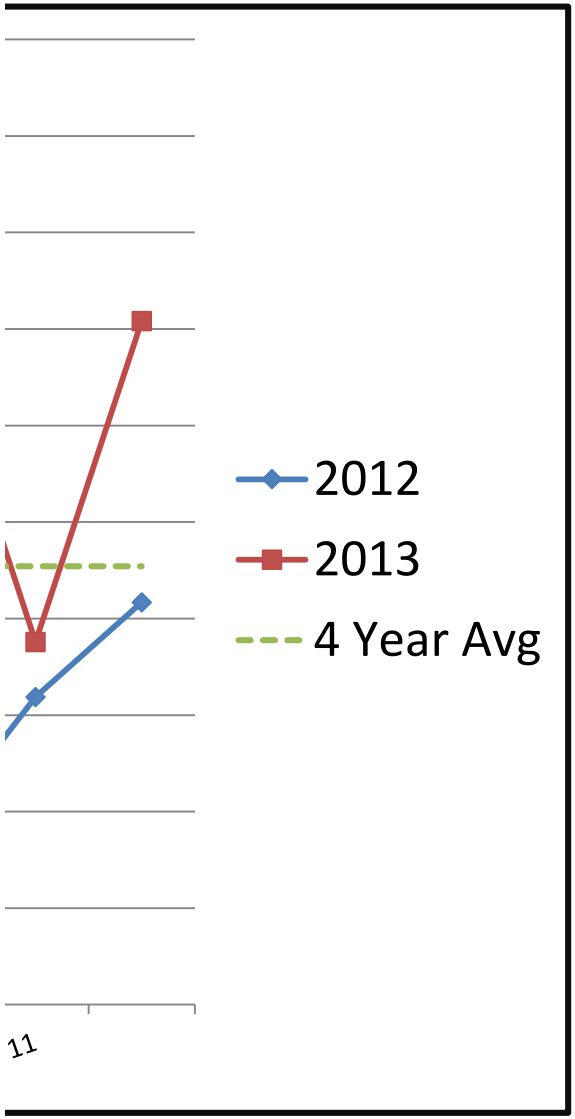
Category	BK117	AS 350	B222	B407	EC130	EC135	EC145	Total
Overtemp	0	2	1	4	0	0	1	8
Overtorque	0	1	0	3	0	0	0	7
Overspeed	2	2	0	2	0	3	1	10
FOD	2	0	1	2	1	10	3	19
Birdstrike	2	7	0	2	4	4	3	25
M/R Damage	2	2	0	0	0	0	3	8
Total	8	14	2	13	5	17	11	77

Contingency Tables :

Region * Preventable Crosstabulation				
Count				
		Preventable		
		Unpreventable	Preventable/HumanErr	Total
Region		2	1	3
	Region 01	2	1	3
	Region 02	5	5	10
	Region 03	3	5	8
	Region 04	7	2	9
	Region 05	6	8	14
	Region 06	5	3	8
	Region 07	2	1	3
	Region 08	8	2	10
	Region 09	5	4	9
	Region 10	2	4	6
	Region 11	3	1	4
	Region 12	5	3	8

* This data is for illustration only…

If you hear hoof beats…



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Data Examples

Investigating the truth of Heinrich's pyramid in offshore helicopter transportation

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Is this assumption accurate?

- Data collected from industrial facilities starting in the late 20's, published in 1931.
- Original paper (1929) only looked at outcomes: no injuries, minor injuries & severe/major injury
- Outcome does dictate event severity.

- Never intended to be a reliable ratio.

Results May Vary

- **Safety Performance Acceptable**
  - **Sustain Operation/Process/Practice**
- **Safety Performance Improving**
  - **Interventions Working**
- **Safety Performance Declining**
  - **Additional Interventions Required**
- **Safety Performance Unacceptable**
  - **Interventions Developed**

You have to create a way to feed data back!

Provide a Means of Tracking & Measuring Safety Performance
Assist in Identifying Systemic Hazards & Unsafe Conditions
Validate/Invalidate the Effectiveness of Interventions & Controls
Reduce Accidents, Incidents, Injuries
Reduce Workers Compensation Claims
Reduce Costs
Reduce Liability
Improve Efficiency & Performance
Improve Safety Culture
Etc…

What to take Away

- Inform yourself and your organization
  - Feed information back to your people
- Think Critically
  - What do you want to know
  - What data is going to answer the questions?
  - What do I do with the results?
- Follow a method
  - Replicate your method
  - Measure against a control group
  - Know the limitations of the data set

- Contact me for additional materials
  - Papers
  - Methods
  - Basic how to's

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