



Comparing the Heinrich Triangle Theory to Real World Data of a Modern Drilling Contractor

Micah Backlund – CSP
HSE Manager
Helmerich & Payne IDC

Heinrich Refresher

Who was Heinrich?

Herbert William Heinrich

born in Vermont in 1881

Trained as an engineer

Served as a Naval officer
Lieutenant¹

Major

Worked for Travelers

Published the first edition of
Scientific Approach to Industrial
Accidents published in 1941,

He is recognized as a pioneer
an advocate for utilizing statistics in order to prevent injuries

Occupational Safety and
Health Administration





Heinrich's Rules

Accident Causation Model – 88:10:2

88 percent of accidents are caused by unsafe acts of persons

10 percent of unsafe mechanical or physical conditions

2 percent of accidents are unpreventable

Foundation of a Major injury – 300:29:1

(similar accidents)

300 will produce no injury

29 will produce a minor injury

1 will produce a major injury



Cases Reviewed

Claimed to have reviewed an estimated 75,000 cases in total ²

- 12,000 from insurance records
- 63,000 from plant records

There is no data available for review, outside of Heinrich's writings

Definition of an Accident

"An accident is an unplanned and uncontrolled event in which the action or reaction of an object, substance, person or radiation results in personal injury or the probability thereof." ²



Accident Causation Model

Accident Causation Model – 88:10:2

88 percent of accidents are caused by unsafe acts of persons

10 percent of unsafe mechanical or physical conditions

2 percent of accidents are unpreventable

There are multiple concerns around the 88:10:2 model

1. By focusing on the acts of people we lose sight of *system failures*.
2. It is very difficult (if not impossible) to manage all *acts of all people*.
3. *Individuals tend to be blamed* for causing accidents with no further investigation as to other (and probably more important) causes.



Review of Heinrich's Foundation of a Major Injury

Foundation of a Major injury – 300:29:1 (similar accidents)

300 will produce no injury

29 will produce a minor injury

1 will produce a major injury

There are multiple concerns around the 300:29:1 model

1. It was originally published without the rationale behind it.
2. Heinrich's language changed continually with each revision.
3. There is a lack of documentation of the original data set.
4. The model was improperly promoted as predictive.
5. Current data does not support the model.



Heinrich's Definition

“ A major injury is any case that is reported to insurance carriers or to the state compensation commissioner. A minor injury is a scratch, bruise, or laceration such as is commonly termed as a first-aid case.”

There is a real struggle even today to capture all minor injuries even today. How could have Heinrich accurately captured all of these injuries almost 100 years ago?



A Closer Look at Heinrich's Model

Originally Heinrich did not qualify or explain the rationale of the 300:29:1 model.

By the fourth edition of "Accident Prevention: A Scientific Approach" he qualified the model with the idea that the model only applied to similar accidents with similar causes involving the same person.

"The natural conclusion follows, moreover, that in the largest injury group – the minor injuries – lies the most valuable clues to accident causes." - Heinrich ³



Review of Heinrich's Foundation of a Major Injury

Evolving Language

Heinrich adjusted the language from edition to edition, with some of the changes being significant.

- In the 1st edition he mentions that there was a study conducted of no-injury accidents, *“there were few existing data on minor injuries – to say nothing of no-injury accidents.”*
- by the 4th edition he references a study conducted that followed over 5,000 cases.

Case Documentation

Why would Heinrich only reference the study of >5,000 cases 28 years after the original print?

There has been no valid data identified to support the creation of the model.



Review of Heinrich's Foundation of a Major Injury

Implied Predictability

Heinrich indicates that the model can be used as a PREDICTIVE tool

“The total of 330 accidents all have the same cause.”³

In multiple versions of the publication, there are indicators that unsafe acts must occur multiple times before a major injury occurs.

- *“keep in mind that a careless act occurs approximately 300 times BEFORE a serious injury occurs”* – Heinrich – 1st edition³
- *Keep in mind that an unsafe act occurs several hundred times BEFORE a serious injury results”* – Heinrich – 3rd edition⁴



Dataset Information

The data reviewed was from 2010-2015, from a large drilling contractor's operations.

A total of 63,231 reports were included in the data set.

The reports were prepared by multiple sources including:

- Front line Supervisors reports
- Field Safety employees
- Workers Compensation Records
- OSHA documentation

All reports were reviewed/approved by a supervisor and/or Field Representative for quality control.



Real World Data – Methodology 1 – Ratios

Ratios	2010	2011	2012	2013	2014	2015	Average
Major Injury	1	1	1	1	1	1	1
Minor Injury	35	34	33	29	19	21	29
No Injury	75	77	82	71	44	49	59

Model 1

Major injury FTL/LTI/RWC
Minor Injury MTO/FAP/FAR
No Injury Actual Negative Events / Near Misses



Real World Data – Methodology 2 – Ratios

Ratios	2010	2011	2012	2013	2014	2015	Average
Major Injury	1	1	1	1	1	1	1
Minor Injury	15	15	16	15	10	11	12
No Injury	33	34	41	39	23	27	27

Model 2

Major injury OSHA Recordable Injuries
Minor Injury First Aids
No Injury Actual Negative Events / Near Misses



Real World Data – Methodology 3 – Ratios

Ratios	2010	2011	2012	2013	2014	2015	Average
Major Injury	1	1	1	1	1	1	1
Minor Injury	5	5	6	6	6	4	5
No Injury	38	32	30	42	43	30	36

Model 3

Major injury OSHA Recordable Injuries / First Aid by Professional
Minor Injury First Aids
No Injury Actual Negative Events / Near Misses



Real World Data – Evaluation of Different Models

	Model 1	Model 2	Model 3	Heinrich's model
Major Injury	1	1	1	1
Minor Injury	29	12	5	30
No Injury	59	27	36	300

Model 1

Major injury FTL/LTI/RWC
Minor Injury MTO/FAP/FAR
No Injury Actual Negative Events / Near Misses

Model 2

Major injury OSHA Recordable Injuries
Minor Injury First Aids
No Injury Actual Negative Events / Near Misses

Model 3

Major injury OSHA Recordable Injuries / FAP
Minor Injury First Aids
No Injury Actual Negative Events / Near Misses



Missing Documentation

Heinrich's research into the 300:29:1 model is undocumented.

Heinrich himself recognized that accident prevention is handicapped by the lack of statistics.

Our own data set is incomplete due to under reporting of accidents.

It is very likely that some events were not included in Heinrich's data.

It is difficult to evaluate Heinrich's theories because of the lack of supporting documentation.



Move Beyond the Triangle

Heinrich's theories have been valuable.

We have to recognize that the causes of the major injuries are not necessarily the same causes as the accidents.

By focusing on the causes of minor accidents we may not eliminate major accidents.

Reporting requirements and processes have only improved since Heinrich created his axioms.

Modern reporting expectations will only continue to improve the accuracy of accident and injury statistics.

As safety professionals, we should stop managing based on statics and treat each accident as a unique event with unique precipitating causes.