

A Severity Study *in Reverse*: Testing Heinrich's Safety Pyramid

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Introduction: Hypothesis of Study

This factual presentation is the first of its kind in the industry, and is the result of conducting a Severity Study *in Reverse*. We analyzed loss trending results in order to test our hypothesis that there is not a strong correlation between organizational injury frequency rates and single severity events. Several hypotheses has been put forth that other options exist besides the original Heinrich Theory of “frequency leading to severity”, and our detailed analysis of statistical data from clients’ loss frequency results will demonstrate whether there is a direct correlation between client loss frequency and corresponding severity trends. Trends presented have been formulated from actual frequency and severity accident data collected by the PMA Companies. The PMA Companies provides risk management solutions and services, including workers’ compensation and property & casualty insurance, throughout the United States. Headquartered in Blue Bell, PA, the PMA Companies is part of Old Republic International’s family of companies. Old Republic International Corporation (NYSE: ORI) is one of the nation’s 50 largest publicly held insurance organizations.

The original theory proposed by H.W. Heinrich and expanded upon in the “Overview of Heinrich’s Safety Pyramid,” was presented in the early 1930s and further modified over the next 25 years. Heinrich presented a model in his 1931 book (*Industrial Accident Prevention: A Scientific Approach*), which became known as Heinrich’s Law (and was often depicted in a safety pyramid). This model purported that in a workplace, for every accident that causes 1 “major injury”, there are 29 accidents that cause “minor injuries” and 300 accidents that cause “no injuries”. Subsequently, because many accidents share common root causes, addressing more commonplace accidents that cause no injuries can prevent accidents that cause injuries.

Since Heinrich’s original safety pyramid theory was revealed, the “frequency breeds severity” thought process has morphed into many variations of this idea. Safety practitioners often place fatalities or disabling injuries at the “top” of Heinrich’s Pyramid and propose that by reducing the frequency of minor events, an organization can reduce the frequency of severe events. The safety profession is filled with consultants who promote various versions of the “pyramid” and as a result, the theory has been copied, or accepted as a universal thought.

In this study, we investigate whether there is any statistical evidence from our clients’ loss trending results that demonstrates a direct correlation between client loss frequency and

corresponding severity trends. Thus, we conducted an analysis of whether frequency *alone* is enough to indicate an increased risk for a severe event. Furthermore, if a client was performing better than expected from a frequency perspective (when compared to the actuarial predicted frequency rates), we analyzed if there was any less of a concern regarding the potential for increased severity exposure or were there other factors that also required consideration. The results of this type of analysis provided information as to whether or not a possible “indirect” relationship between frequency and severity exists.

In addition, our study compares the results and conclusions to those made by other published researchers, in particular Mr. Fred Maneule, PE, CSP, regarding the present day applicability of Heinrich’s conclusions. Mr. Maneule published in “The Challenge of Preventing Serious Injuries” (Professional Safety, April 2006), a BLS Statistical Table comparing the percentages of “Days Away from Work” (DAFW) Cases (frequency measure) to the “Number of Days Lost” (severity measure).

A comparison from “one day lost through thirty-one or more lost work days” for two calendar years (1995 and 2001) was made and results outlined in the table below:

Percentage of Days Away From Work (DAFW) Cases (1995 and 2001 Year Comparisons), Number of Days Lost (1 day through 31 or more days), Private Industry

	1	2	3-5	6-10	11-20	21-30	31 +
1995	16.9	13.4	20.9	13.4	11.3	6.2	17.9
2001	15.4	12.7	19.8	12.6	11.1	6.3	22.0
Change from 1995	-8.9	-5.2	-5.3	-6.0	-1.8	+1.6	+22.9

Source: BLS¹

As outlined above, this table indicates the following information:

- The decreases in percentages of the first four DAFW categories listed (1, 2, 3-5, and 6-10 days) were significant,
- The decrease of 1.8% and increase of 1.6%, in the 11-to-20 and 21-to-30 days categories, respectively, were not as significant, *and*

The 23% increase (from 1995 to 2001) for the 31-or-more DAFW category is significant.

Overview of Heinrich’s Safety Pyramid

The results of our study were compared and contrasted with theories derived from H.W. Heinrich, who by most accounts, is the original theorist on accident causation. Heinrich’s 80-year old theory has influenced several generations of safety practitioners to focus their efforts on frequency as the primary way to discuss (and attempt to impact) severity. Since being introduced in 1931, Heinrich’s Safety Pyramid Theory continues to be a part of the daily vernacular of many safety professionals. Additionally, Heinrich’s study influenced other researchers to take related approaches in ultimately reaching similar results and modeling these conclusions after his safety pyramid concept (e.g., Bird, 1969 and Tye/Pearson, 1974-75 Studies).

Upon the examination of a variety of accident frequency and severity safety pyramids, it is apparent that numerous versions have been developed since Heinrich's original premise was researched and published, creating a common nomenclature among many safety professionals that "frequency breeds severity". Our highly empirical presentation will assist safety professionals with examining their severity potential in an entirely new light.

The safety profession has undergone significant advancements since Heinrich's original studies were conducted and introduced. These changes include, but are certainly not limited to, the advent of OSHA, along with other federal and state safety regulatory agencies, organizational and behavioral related studies and changes in management/employee relations, etc., which have contributed to reductions in overall accident frequency. However, the reduction in accident severity has not been as evident.

The Study: An Overview

We have presented below two examples of perhaps more familiar scenarios where an "indirect relationship" of frequency and severity trends could also exist.

1. A neighborhood with a "high frequency of petty crime" does not always correlate directly with "neighborhoods associated with violent crime". There can be different factors influencing serious crime rates or "severe" crime events.
2. A more developed example comes from considering patient death rates at nationwide hospitals. As an example of a possible indirect relationship between frequency and severity, the relationship between "high medical errors at hospitals" and "high patient death rates" at these hospitals might not be a *dependent* relationship, as other factors need to be considered. One such factor could be more terminally ill patients are going to be transferred from community hospitals to city or specialist hospitals, thus resulting in an *independent* relationship between the frequency of patient errors ("minor" events) and fatalities ("severe" events).

These are two anecdotal examples, but each conveys the "behind the scenes" thought process during this study.

Additionally, three primary reasons for conducting and presenting this "*PMA Companies Actuarial Predictive Frequency and Severity Rate Study*" are to:

1. Test the principles/theory of a long held belief in the safety profession that frequency breeds severity (a single severe event) against the experience of PMA's workers' compensation clients.
2. Test our hypothesis that there is not a strong correlation between organization injury frequency rates and single severity events. This theory is based on our experiences as safety practitioners and literature review. It is our belief that exploring new theories related to severity potential can advance the effectiveness of safety professionals in protecting the lives of their employees.
3. Determine if there are any new perspectives that can guide safety practitioners in evaluating and communicating the severity risk potential to organizational leadership and to develop more clear strategies in the area of severity potential reduction.

The Study: Practical Expectations

For the safety practitioner, the researchers expect this study will:

1. Increase the understanding and awareness of severity exposures.
2. Change the nature of the dialogue with organizations, executives, and leadership team members regarding their internal severity potential.
3. Increase the conviction level of safety professionals regarding severity.

Clarify the mission of safety professionals in both areas of overall frequency reduction, as well as, severity (potential trigger events) reduction.

The Study: Methodology and Analysis Approaches

Methodology:

This research included a thorough analysis of the severity outputs of over **150,000 accidents**. The methodology utilized during our research includes:

Nominal Values: Assigned to the Actuarial Predicted Benchmark Report (+ / -) to determine if client performance was better (below actuarial predicted frequency rates) or worse than (above actuarial predicted frequency rates) expected in the years of the study.

Positive Values: Assigned to accounts performing worse than expected (above actuarial predicted rates).

Negative Values: Assigned to accounts performing better than expected (below actuarial predicted frequency rates).

Application of Values: The Nominal, Positive, and Negative Actuarial Values in our presentation are similar to, but not identical to Bureau of Labor Statistics, Standard Industrial Classification comparisons.

Trigger Events: An analysis of “events” was conducted for related trends for 1, 2 and 3 years following a client’s trigger event, defined as a total incurred of \$250,000 or greater.

The data presented from our study will provide a high level overview of client trending results. The results will demonstrate whether the majority of clients were performing better than expected or worse than expected during the years leading up to the “trigger event”. We will present a comparison of both Lost-time and Medical Only Deviation results and our conclusions as to whether the results support Heinrich’s theories [or our hypothesis].

Analysis:

The analysis performed in our study allowed for the evaluation of our clients’ historical frequency trends. This evaluation was instrumental in determining whether a “direct correlation” existed between loss frequency trending and an associated severity/trigger event. This data also led to conclusions regarding whether previous loss frequency trends *alone* are enough to result in an increased risk for a severe/trigger event or, are there other extenuating factors safety practitioners

need to consider, indicating a “less than direct” relationship between frequency and a “trigger event”.

During this research, three primary filters were applied to our study over 1, 2, and 3-year periods that were designed to analyze whether increasing client frequency trending breeds severity (trigger event). The filters applied included:

Filter One: Account performance in the year of the trigger event.

This initial filter used in our study was based on “*account performance*” in the year the “trigger event” occurred. The question was posed, “Was the client performing better than projected by actuarial or worse than projected by actuarial prior to the associated trigger event?” Both Lost-Time Frequency Deviation and Medical Only Deviation Trending were analyzed and associated results and conclusions will be presented.

Filter Two: Account performance for the two and three-year periods preceding the trigger event.

The second applied filter compared clients with poor actuarial predicted performance (above projections) with those clients with better than predicted actuarial performance over a *two consecutive year period*. The results of this comparison will be revealed during this presentation.

Filter Three: Indications of incremental frequency trends (both lost-time and medical only frequency deviation results) over the *three consecutive year period* leading up to the trigger event. Subsequently, this filter identified account performance for the three years leading up to the trigger event.

We will reveal the conclusions of this analysis and the percentage of clients that actually demonstrated increased frequency in the three years leading up to the “trigger event” for either **lost-time or medical only** deviation claims.

A final comparison will be made regarding the percentage of clients where **both lost-time and medical only** accidents increased during the three year period leading up to the trigger event.

NOTE: This is the most direct application of Heinrich’s Frequency breeding Severity Theory.

Additional Analysis: Analysis of related client trending results by leading industries (SIC codes), trends associated with specific accidents causes and trending by job descriptions was also conducted and our conclusions will be confirmed.

Bibliography

1. “The Challenge of Preventing Serious Injuries, BLS Table”, by Fred A. Manuele, CSP, PE, published by ASSE’s Professional Safety, April 2006.