SCENARIO: CHLORINATED ORGANOPHOSPHATE FLAME RETARDANTS CAUSE BODILY INJURY AND CONSTITUTE PRODUCT POLLUTION

BEST PRACTICES IN SCENARIO DEVELOPMENT AND USAGE: PRESENT AND FUTURE

Scenario Development and Methodology Workshop

6 September 2017

Suggested best practices for casualty-clash scenario development

- **Identification of scenarios should be guided by science**
  - Centered around irreducible, common denominators of potential mass litigation
- **Deploy ground-up models of loss that speak to specific injuries/damages and their arrival time**
  - Building scenarios by scaling historical events has limited use if damages differ
- **Recognize that allocative risk has no analogue in property catastrophe modeling**
  - Distinct from both the frequency and severity of casualty catastrophes, can be analyzed modularly to understand industry and company exposure

What if the “next asbestos” were literally the next asbestos?

- Asbestos litigation: over $100 billion and growing
  - Mesothelioma a signature disease
  - Latency: long timeline between exposure and disease onset of the disease
  - Highly ubiquitous material, used in a wide variety of products
  - Generated concomitant property damage losses because used in structural materials, which sometimes required removal and replacement
- Chlorinated organophosphate flame retardants (ClOPFRs) are but the latest in a long line of risky chemicals that replaced asbestos
  - Following phase out of PBDEs *c.* 2004, ClOPFRs became dominant flame retardant chemicals in consumer products
  - Exposure is now ubiquitous and increasing

Science shows exposure to some ClOPFRs may cause bodily injury

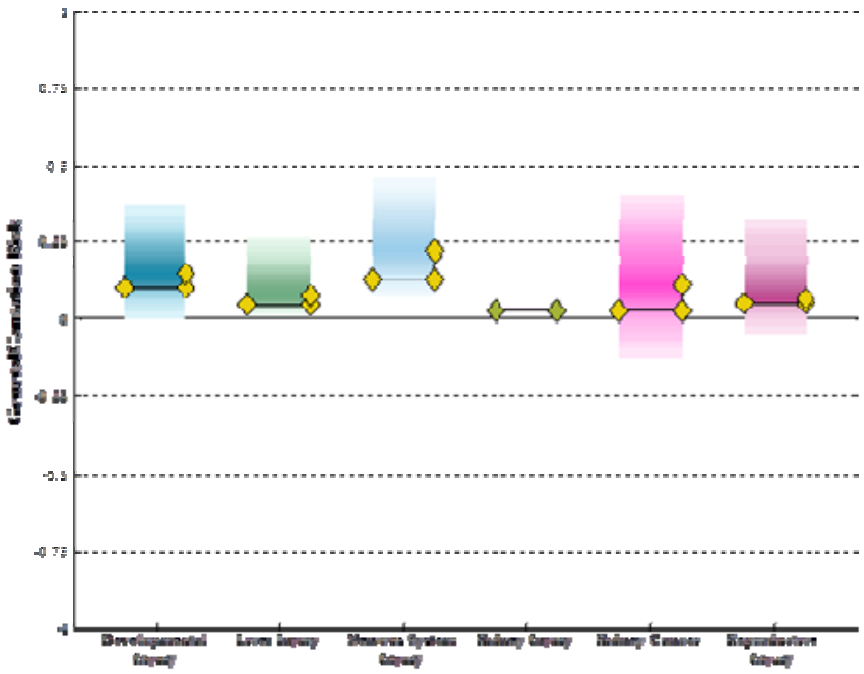
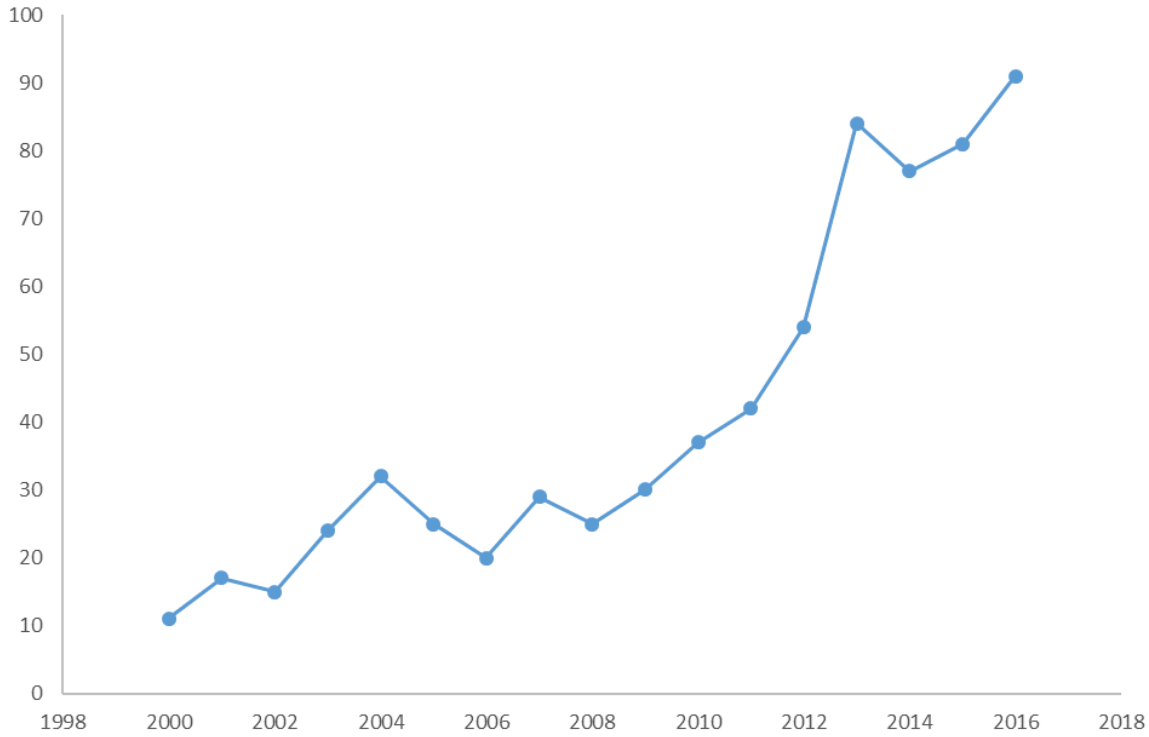


Figure 1. General Causation Risk scores and seven-year projections for TDCPP and TCEP bodily injury hypotheses.

- Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) and Tris(2-chloroethyl) phosphate (TCEP)
  - California's Proposition 65 list
  - European Chemical Agency listed TCEP as SVHC in 2010
- Praedicat analyzed over 200 peer-reviewed, scientific articles on TDCPP and TCEP
  - Research active, but does not yet consistently link these chemicals to harms
  - Hypotheses on: developmental injury, liver injury, nervous system injury, kidney cancer, and reproductive injury

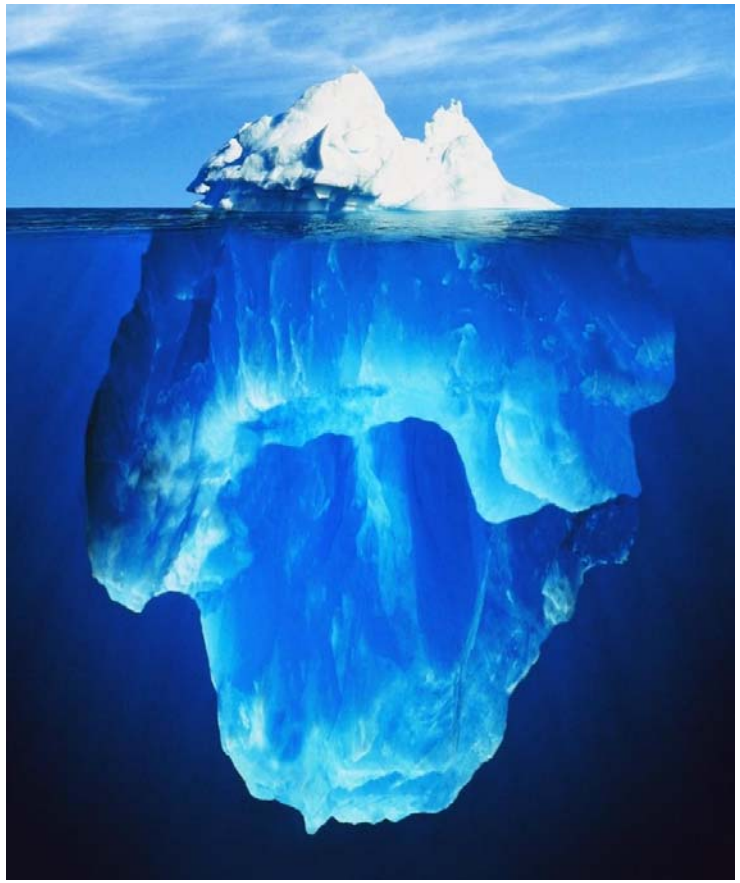
Research attention to ClOPFRs continues to grow

Figure 2
PubMed Article Counts for TDCPP or TCEP Papers

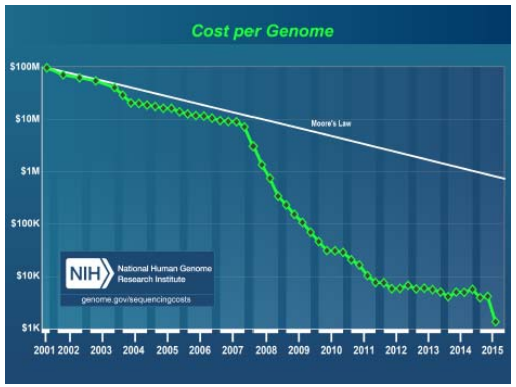


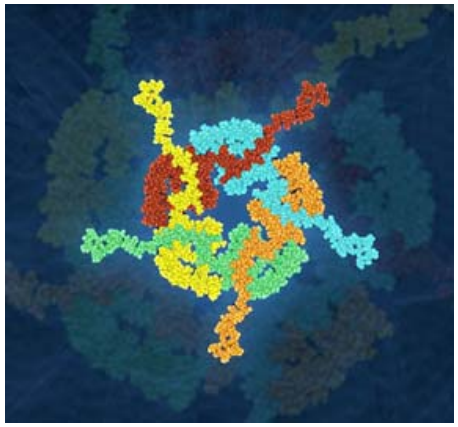
Potential latent bodily injuries from ClOPFRs create a long tail of liability risk

- When diseases take decades to develop, companies may face lawsuits alleging injuries or damages arising from exposures that happened many years ago
  - Occurrence forms respond to long-tail liability claims
- Science suggests exposure to ClOPFRs could lead to latent claims like these
  - Kidney cancer may take 30 years or more to develop
  - Typical onset of mental impairment is 25 years or more from exposure
- We explicitly account for disease latency in our model and use this information to generate a time-path of bodily injury claims and losses for our scenarios



Scientific advances continue to improve medicine's ability to determine the specific causes of disease

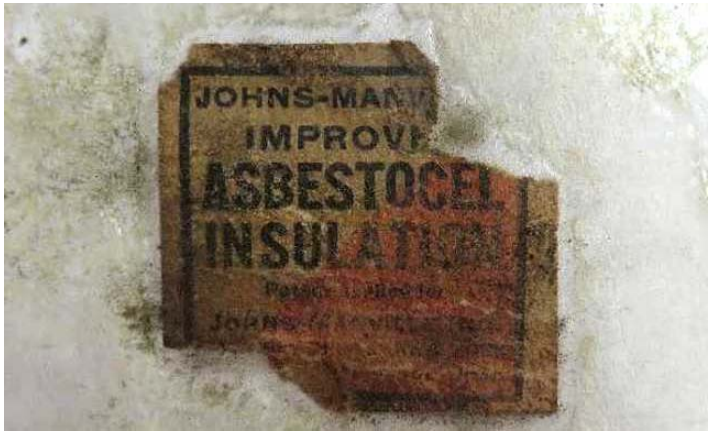




- Genomics brings causes of cancer into clearer view
  - Cost to sequence a human genome decreased from ~$10 million to $1000 over last decade
  - An entire human genome can now be sequenced in about 26 hours
- Neurobiological research has also improved in identifying the biomolecular causes of neurological disease
  - Parkinson's Disease: strongly linked with dysregulation of α-synuclein. Suggested connection between pesticide-related Parkinson's disease and mitochondrial dysfunction
  - Alzheimer's Disease: new treatments evolving based on better understanding of exactly how amyloid plaques cause oxidative stress

Property damage losses could substantially increase ClOPFR losses

- Compensation possible under product liability theories
  - Courts have held installation of an inherently harmful product can constitute PD either at the time of installation or when harmful substances are released from the product
  - Similar to asbestos litigation related to schools, plaintiffs could contend that ClOPFRs create unreasonably dangerous and inherently harmful products
- More controversial: nuisance
  - As in some lead paint litigation, plaintiffs might claim that materials containing ClOPFRs constitute a public nuisance and require recompense for abatement
  - Unclear implications for coverage under commercial general liability and excess casualty policies



Litigation over ClOPFRs appears unlikely, but it would have significant implications

VARIABLES / *News & Features*

Replacement for Worrisome Flame Retardants Raises Its Own Concerns

Nudged to abandon one harmful flame resistant chemical compound, industry flocked to another that may be no better, and scientists are concerned.

Flame Retardant Roulette: Swapping One Toxic Compound for Another

FLAME RETARDANTS

Exposure to TDCPP Appears Widespread

PERSONAL HEALTH

Could the Dust in Your House Make You Gain Weight?

The chemicals in our household dust may prime our bodies to gain more weight.

San Antonio Statement on Brominated and Chlorinated Flame Retardants

doi:10.1289/ehp1003089

Danish testing finds suspected EDCs in pushchairs

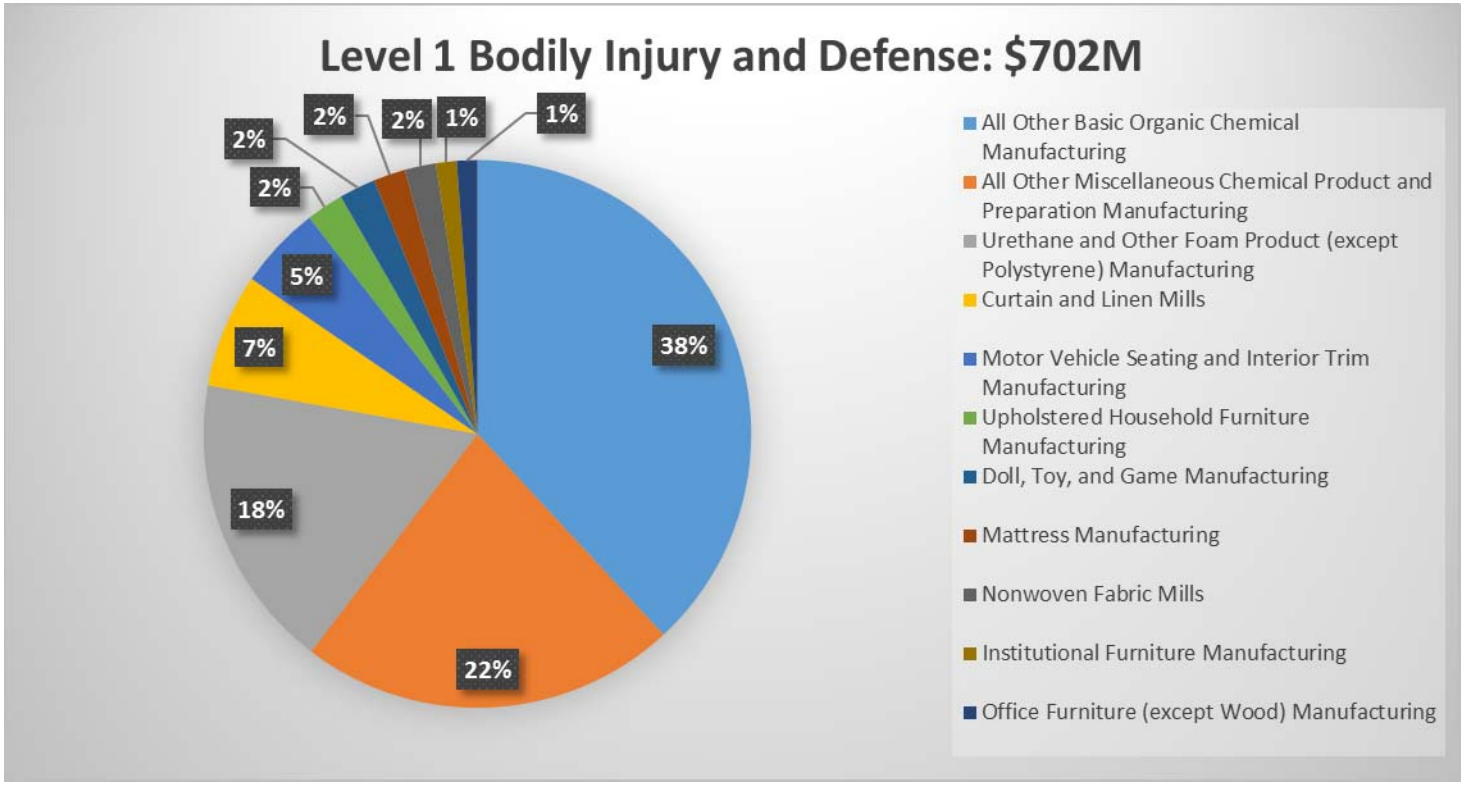
Carcinogenic substances also detected

- Public concern over exposure to ClOPFRs has reached sufficient levels to warrant investigation of the potential severity of associated litigation
  - According to our frequency model, the scientific literature is not expected to reach a strong enough consensus to support mass litigation over these chemicals in the next seven years
- Despite strong confidence in these results, scenarios such as this one address model uncertainty and other unmodeled parameters by allowing decision-makers to understand their overall exposure to potential severe events for stress-testing and capital management
  - To facilitate this analysis, we describe our scenarios in terms of three levels, moving from the most credible to the most extreme outcomes
  - Bodily injury and property damage losses are reported separately in case users find one type of loss more credible than another

ClOPFRs litigation and potential bodily injury and property damage

- Level 1: In seven years, scientific evidence mounts and shows exposure to ClOPFRs causes kidney cancer and mental impairment
  - Manufacturers cease using ClOPFRs in their products
  - Exposure studies confirm ClOPFRs ubiquitously persist at high levels in household dust, and leach from existing products for many years
  - Science can specifically identify cases of kidney cancer and mental impairment caused by exposure to ClOPFRs
- Level 2: Regulatory bodies respond to bodily injury litigation by banning the use ClOPFRs and calling for abatement in some settings
  - Owners of some consumer goods contaminated with ClOPFRs file lawsuits, claiming bodily injury, property damage, or both
  - Workers with credible exposure whose claims were too weak in L1
- Level 3: All remaining potential litigants from all other settings we have profiled in our data file claims
  - Consumers or workers with very low exposure: least credible

ClOPFRs litigation and potential bodily injury and property damage: results



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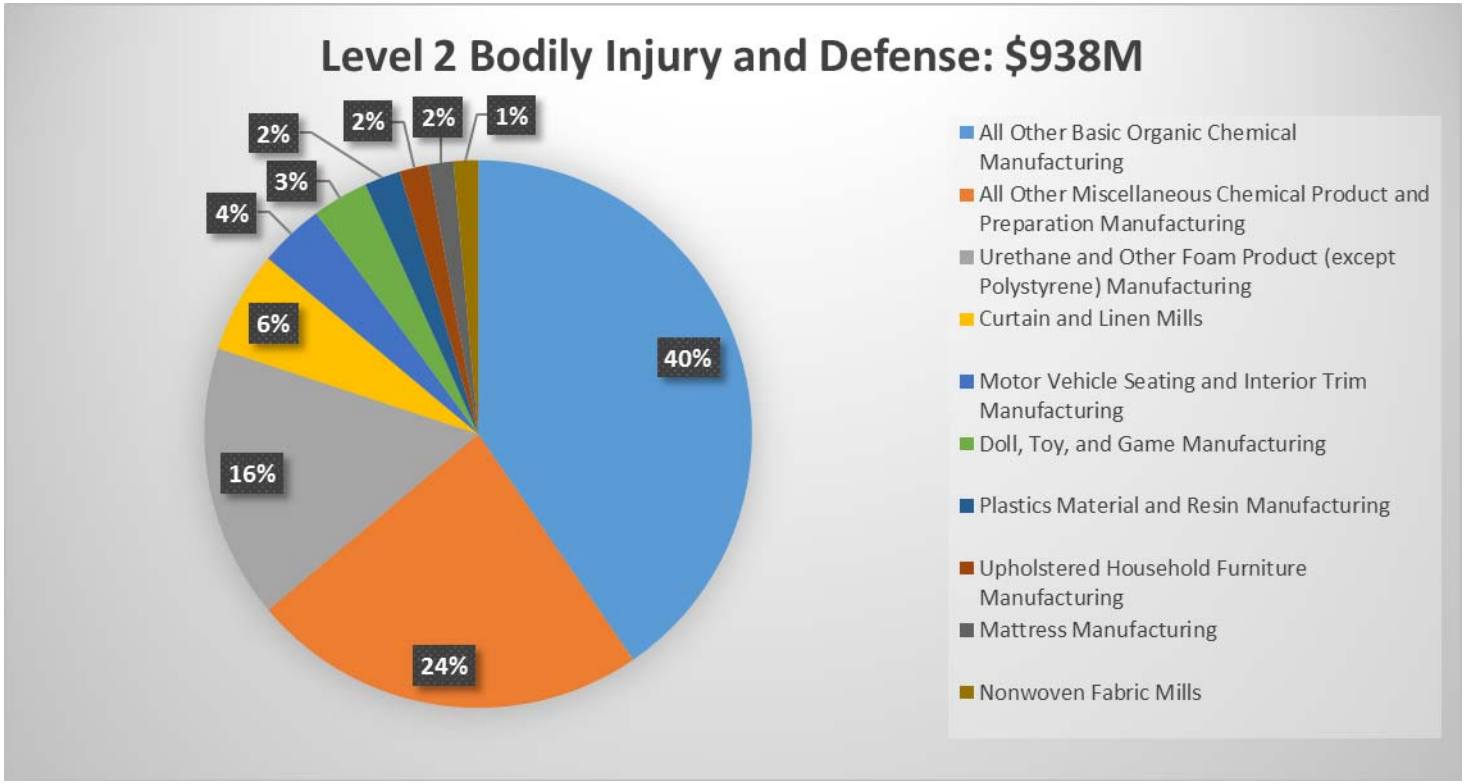

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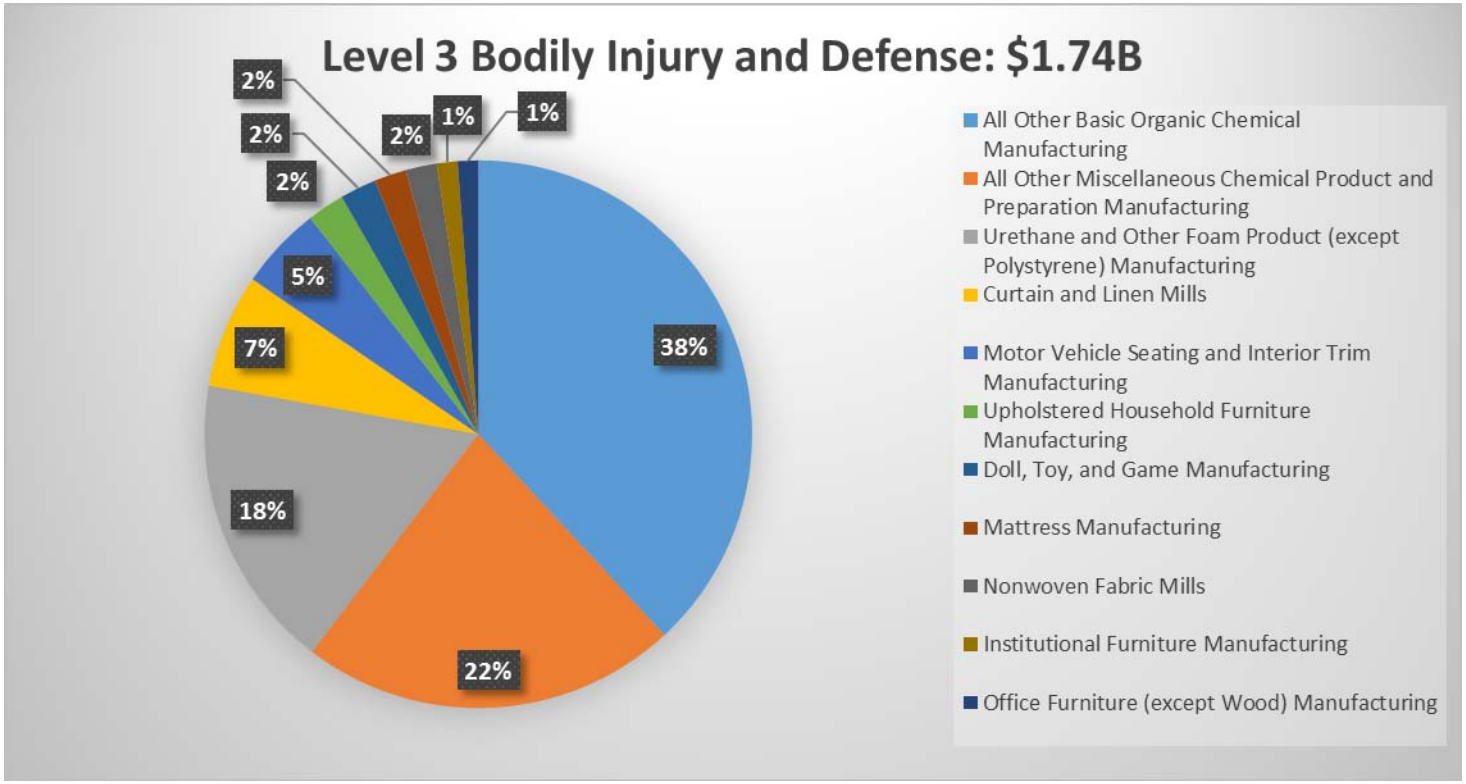

Methodology

Identification of scenario event

- Praedicat mines scientific and regulatory literatures to identify the products and commercial activities that scientists believe could result in harm to health, property, or the environment
  - Focus on Litagion® agents: materials, products, substances, processes, practices, policies, events, or phenomena that could be the common denominator of an actual or potential mass litigation episode." E.g. Asbestos.
- We then map and characterize the potential litigation by groups of lawsuits
  - "Latent mass action" (LMA): Characterized by Litagion agent, plaintiff, harm, exposure setting, and set of defendant types
- Scenarios structured by selecting sets of LMAs per their relative liability risk
  - Liability risk model accounts for both "general causation risk" and "specific causation risk"
  - For scenarios: set global parameters that affect the liability risk of all LMAs while maintaining rank ordering between them
  - Use differences in liability risk to structure the levels of our scenarios

Event severity and time path

- For bodily injury, the severity of an LMA over time is a function of:
  - N of individuals who can demonstrate that they were exposed to a Litagion agent in LMA
  - Fraction of those exposed individuals who suffer the LMA's specified injury
  - Cost of injury
  - Disease latency
  - The strength of the plaintiff's case
  - The cost of negotiating those settlements
- Under development: property damage estimates
  - Two types: fouling (MTBE, mold) or significant risk of bodily injury (lead, asbsestos)
  - Costs for removal and replacement of building materials based on nationally representative data sets on commercial and residential buildings, unit costs ($/sq. ft.)
  - Account for vintage and natural attrition, conditional on assumptions of market removal and mandated abatement times
  - For consumer goods, costs for replacement depend on the replacement value of the goods in existence that contain the Litagion agent
  - For property damage concomitant with bodily injury, losses are a function of bodily injury loss time path

Allocation of losses

- Praedicat's loss allocation model generates loss share distributions at the industry and company level
  - Each LMA in a scenario is connected to a number of distinct types of defendant industries
  - Analysts and algorithmic methods connect companies to these industries
- Allocation driven by defendant industry and company factors
  - Relative ease Litagion agent exposure can be attributed to a particular defendant industry
  - Estimated company market share in defendant industry
  - Certainty of connection between company, defendant industry, and Litagion agent
- Distribution of potential allocation outcomes built around calculated central estimates, drawing on external industry data and global information from our allocation model