Risk framing of U.S. intermodal transportation hazardous spills in news and social media

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ABSTRACT

This study explores how freight companies publicly responded to serious hazardous spills through the systematic analysis of: the social media presence and online influence of all 2,782 carrier companies and all U.S. newspaper coverage of 5,555 serious spills between 2001 and 2012. The study examined the social media presence/influence of the 2,782 transportation companies involved in the serious spills, using Klout influence, TweetReach exposure, and HowSociable magnitude scores. U.S. newspaper coverage of the accidents was coded if stories appeared within five days of each "serious" accident between 2001 and 2012. This data were compared with descriptive secondary data for the same accidents in the US-DOT Pipeline and Hazardous Materials Safety Administration database. Three coders analyzed the entire universe, which consisted of 267 stories in 87 newspapers, covering 54 accidents. This means 95.2% of the 5,555 most serious spills in a decade received no news coverage. Story variables included transportation mode, publication, geographic location, spill impacts, spill damage, accident causes, source types, source attribution, crisis responses, news coverage over time, story play (placement, length, graphics), what was spilled, health effects, risk to public and workers, public safety advice, and blame. Most freight companies had no social media presence. Few companies communicated regularly about anything, through any social media channels. Companies with fewer accidents were more likely to have social media accounts, while those with the most accidents typically had no social media presence. No companies communicated directly about any of the 5,555 spills. This pattern contradicts conventional public relations practice of "getting out in front" of a crisis. Only 22% had a Klout score over 25, 16% had a Twitter account, less than 1% had a Facebook page, only 0.1% had a LinkedIn page, and none had a Youtube account. The companies with higher social media scores had the most damaging and expensive accidents. Train companies typically had higher Klout scores, while trucking companies typically had mid-range Klout scores. Companies with mass explosion hazards or high-threat cargo spills – including radioactive materials and flammable gas – had a very low or non-existent SM presence. Companies with the strongest SM presence were significantly more likely to have accidents involving fatalities, gas dispersion, evacuations, fires, hazardous waste, and closure of major roads. Some companies with dangerous track records had no social media account or did not use them to inform the public about spills. Companies with higher Klout scores were significantly more likely to have accidents involving fatalities and injuries. Companies with higher TweetReach scores were more likely to have accidents involving a fire, explosion, or hazmat fatality. U.S. newspaper coverage of serious transportation spills was almost non-existent. Spills were more likely to be covered when journalists had access to authoritative sources, when the perceived risk to citizens was higher, when someone was blamed, or when the spill involved an unusual chemical or situation. Although the spills posed serious threats including potentially fatal outcomes, invisible risks such as a gas leak, and involuntary exposure, most spills involving fatalities, injuries, toxic inhalation, gas dispersion, fires, explosions, water contamination and environmental damage received little coverage. Spills involving extremely dangerous materials including radioactive materials, poisonous gas, or mass explosion hazards were not more likely to receive coverage. Spills with a stronger visual element such as derailment or objective severity/threat were less likely to receive attention. Access to police, fire/EMS reports did not promote news coverage. High-impact events such as spills causing injuries, evacuations, toxic gas leaks and road closings were not more likely to receive attention. Social amplification of risk appeared to have little, if any, effect on the news coverage. This study raises additional questions about whether the dearth of public communication about freight spills has caused damage beyond the cost of the spills, and how transportation companies should weigh the risk of reputational harm vs. societal benefits of improved communication about spills.

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INTRODUCTION

The risk of hazardous freight spills increases the challenges and potential costs of operating the intermodal network of highways, rails, waterways, airports, and shipping terminals in the U.S. These risks are exacerbated by traffic congestion and aging infrastructure, ultimately jeopardizing American competitiveness in the global economy. Between 2003 and 2012, 161,079 hazardous spills in the U.S. involving highway, air, rail and waterways exceeded $701 billion in cleanup and mitigation (Pipeline and Hazardous Materials Safety Administration, 2013). Social amplification of risk can strongly affect public responses to hazardous spills.

The project examined a decade of risk framing in news coverage about U.S. intermodal transportation incidents involving hazardous materials, as well as freight company brand strength and social media presence. Social amplification of risk has been shown to strongly influence public responses to crises, including these types of accidents. The results of this unique study will be used to expand and refine the principal investigator's outrage-mitigation risk framing model, in order to identify ways to reduce outrage and misinformation in public risk messages following intermodal transportation hazmat incidents.

This study examined all 5,555 hazardous spills classified as "serious" between Jan. 1, 2003 and Dec. 31, 2012 that US-DOT classified as "serious" in the federal Pipeline and Hazardous Materials Safety Administration database. To this secondary data spreadsheet, two types of primary data were appended: social media presence/branding data for each of the 2,782 freight companies and data about news coverage across all of the 5,555 spills. The study examined how information about serious hazardous spills is communicated to the public during different crisis phases (i.e., Coombs, 2007) and how media strategies are used to communicate about spills (i.e., Lez-Herrero & Pratt, 1996).

First, the social media presence and online influence of all 2,782 shipping companies was examined, to highlight the extent that freight companies can communicate directly with the public about serious hazardous spills and how online presence can influence decision-making about how a freight company responds to a hazardous spill. Then all of the newspaper coverage appearing in U.S. media was collected for all of the 5,555 serious spills. Finally, all stories about all accidents between 2001 and 2012 were systematically analyzed using a common code sheet. The social media and content analysis data were added to the original spreadsheet of descriptive secondary data that U.S. DOT had reported about the same accidents in the Pipeline and Hazardous Materials Safety Administration database.

OBJECTIVE

This project is designed to determine what the public learns about serious freight spills directly (via social media) and indirectly (via news media). It explores how freight companies publicly responded to serious toxic spills through a three-part systematic analysis:

1. The social media presence and online influence of all 2,782 freight companies;

2. The extent that U.S. newspaper coverage appeared about the 5,555 serious freight spills between 2001 and 2012;

3. A comprehensive content analysis of all newspaper stories that appeared about the 5,555 accidents during this time period.

SCOPE

This study explores how freight companies publicly responded to serious hazardous spills through the systematic analysis of the social media presence and online influence of freight companies and all of the U.S. newspaper coverage about any of the 5,555 serious spills reported by USDOT between 2001 and 2012. The project examined the social media presence of the 2,782 transportation companies involved in these serious spills using social media presence data, as well as Klout influence, TweetReach exposure and HowSociable magnitude scores.

USDOT categorized all of these spills as "serious" based on costs, amount of toxic releases, fatalities, injuries, environmental damage and other severe health impacts. The data were compared with descriptive secondary data for the same accidents reported in the US-DOT Pipeline and Hazardous Materials Safety Administration database. The universe consisted of 267 stories in 87 newspapers, covering 54 accidents. The coverage that was analyzed did not include stories published later than five days following each spill in the database or stories from non-newspaper media sources such as television and radio news transcripts, magazine articles, blog reports, etc.

METHODOLOGY

Social media analysis. The original research question for the social media analysis (phase 1) was "Are transportation companies more likely to communicate with the public about hazardous spills, if they already use social media?" Initially, Twitter was chosen as a platform for vetting the freight companies because it is a common way citizens that follow breaking news such as hazardous spills. Coders collected and examined all available tweets, via http://topsy.com, a website allows for real-time searches of the social web. However, Topsy searches revealed that none of the freight companies posted any tweets about serious hazardous spills. In light of this discovery, a new research question was developed to examine the social media presence of these companies, highlighting one dimension of their preparedness to inform the public.

An original analysis method was then developed to measure the social media presence and online brand strength of all freight companies. The social media presence/influence of the 2,782 transportation companies involved in the 5,555 serious spills was examined using three scores: Klout influence, TweetReach exposure, and HowSociable magnitude scores. The Klout score is a company's overall social media influence, based on its presence on Twitter, Facebook, Wikipedia, LinkedIn, and YouTube (score<25 = little or no presence). The TweetReach exposure score reflects the number of company tweets, follower counts, and retweets. The How Sociable magnitude score reflects a company's level of social media activity, on a scale of 1 to 10 (0 = no activity).

The social media analysis measured brand strength using company influence scores, social media participation, company tweets, Twitter followers, impressions (reach) scores, company stock prices before and after the incident, and brand magnitude (exposure) scores. Contextual data identified whether each company had a public presence on social media and whether each company communicated within three months after an incident.

This contextual data identified whether each company had a public presence on a wider variety of social media sites including Twitter, Facebook, Wikipedia, LinkedIn, and YouTube. This data was used to examine social media presence and reputational threat of all companies involved in the 5,555 hazardous freight spills.

Content analysis. The systematic news analysis examined the indirect communication between transportation companies and public audiences via the news media, about the most serious transportation accidents over the 10-year period. The news media analysis (phase 3) used two sampling strategies to obtain a comprehensive sample.

In examining news presence (phase 2), search terms for all 5,555 serious transportation spills that were listed in the US-DOT database were used to search the Lexis-Nexis full-text U.S. newspapers database. This process identified news coverage of accidents that appeared within 5 days of each incident, 2001-2012. Newspaper stories were chosen as the unit of analysis, since they typically provide the most comprehensive coverage of events. Two different keyword combinations were used for each search, to ensure comprehensive vetting (date, city, carrier company, mode of transportation, what was spilled).

The first round of searches used the name of the transportation company, location, date of the accident, and the common name of the chemical spilled as search terms, to identify all stories covering any of

the 5,555 the accidents. The Lexis-Nexis news database was used to vet all 5,555 incidents in the serious accidents database, to identify all incidents that received news coverage within 5 days of each incident. The coders performed three different keyword combination searches for each spill:
Used three different keyword combinations per search:

- Accident date + city + company
- Accident date + city + mode of transportation
- Accident date + (spill! or accident!) + what was spilled

An article qualified if it mentioned a hazardous freight spill within the first paragraph, was not an opinion piece, and was not part of a round-up of briefs. A second Lexis-Nexis search used more generic search terms, not including company names or chemical names. This search yielded an 191 additional stories, indicating that most stories included little identifying information about the accidents or who was involved. In a third search reliability check, coders searched for stories for the top 10 accidents in various categories (most expensive accidents, most fatalities/injuries, highest quantity of chemicals released, etc.). This procedure did not yield additional stories.

This three-step comprehensive vetting process yielded only 267 stories in 87 newspapers, covering only 54 accidents. This means 95.2% of 5,555 serious spills in a decade received no news coverage. The average number of stories per spill was only 0.05. The average number of stories per covered accident is 4.9. If every accident had received that much coverage, the universe would have been 27,466 stories.

An in-depth coding instrument then was developed to analyze all stories. It was designed to identify patterns in reputation management, risk framing, and crisis communication messages. Story variables included transportation mode, publication, geographic location, spill impacts, spill damage, accident causes, source types, source attribution, crisis responses, news coverage over time, story play (placement, length, graphics), what was spilled, health effects, risk to public and workers, public safety advice, and blame.

All stories that reported any of the 5,555 accidents were analyzed. Thus, the content analysis was performed on the entire universe of stories, not a sample. Three coders performed an in-depth content analysis of all stories found. More than half the stories were double-coded for inter-coder reliability. The news analysis was based on five hypotheses:

- **H1**: Spills characterized by greater perceived risks (severity or seriousness) are more likely to receive news coverage.

- **H2**: Most hazardous spills will be covered because they are visually interesting.

- **H3**: Since reporters are expected to choose stories based on traditional news values (including timeliness, impact, prominence, conflict/controversy, unusualness and proximity), spills characterized by traditional news values will receive more news coverage.

- **H4:** Spills will receive more coverage when newsrooms have access to police, firefighter or EMS reports about the accidents.

- **H5**: Reporters will rely on officials for spill information more than freight company representatives or other non-official sources.

FINDINGS

Online presence analysis

Most freight companies had a virtually non-existent online presence. Only 22% of shipping companies had a Klout score over 25 (with scores ranging from 3 to 96), 20.4% had a Twitter account, 13% had a HowSocial score of 1 or more (indicating any type of social media presence), 4.6% had a Wikipedia page, 2.5% had a Facebook page, 0.5% had a LinkedIn page, and none of the companies had a YouTube account. The average number of tweets among all companies was 600. Among companies that did have a Twitter account, only 41.8% had a TweetReach score (indicating any level of Twitter activity).

Freight companies with higher social media scores had the most damaging accidents, in terms of total cost. Only 22% of companies had a Klout score over 25, only 16% had a Twitter account, less than 1% had a Facebook page, 0.1% had a LinkedIn page, and none had a Youtube account. The train companies typically had higher Klout scores, while trucking companies typically had mid-range Klout scores. Companies with mass explosion hazards or high-threat cargo spills – including radioactive materials and flammable gas – had a very low or non-existent SM presence.

Companies with the strongest social media presence were significantly more likely ($p<.05$) to have accidents involving fatalities, gas dispersion, evacuations, fires, hazardous waste, and closure of major roads. Some companies with dangerous track records did have social media accounts – but did not use them to inform the public of spill hazards. Companies with higher Klout scores were significantly more likely to have accidents involving fatalities and injuries. Companies with higher TweetReach scores were significantly more likely to have accidents involving a fire, explosion, or hazmat fatality. Table 1 shows the low or non-existent social media presence of 10 companies with the most accidents.

Table 1: Social media presence of 10 freight companies with the most hazardous spills

	# Accidents	Klout score	TweetReach	HowSocial
1. Univar Corp.	75	45	0	0
2. Marathon Petroleum	62	0	0	0
3. Ferrell Gas	60	0	0	0
4. Austin Powder	41	0	0	0
5. Ecolab	41	0	0	0
6. CHS	39	49	0	0
7. Hess Corp.	29	44	0	0
8. Motiva Enterprises	29	89	0	0
9. Magellan Pipeline	27	0	0	0
10. Olin Corp.	25	0	0	0
Ave. for these companies	42.8	22.7	0.0	0.0
Ave. for all companies	5,555	53.3	27,821	0.5

Table 2: High-visibility freight companies by major impact: Klout and Twitter

Accident Characteristics	% of spills	Klout score: 50+	#Tweets (100,000+)	#Twitter followers (1,000+)
Damage over $500,000	81.4	20.6	11.7	12.0
Environmental damage	13.6	1.5	1.6	1.7
Evacuation	18.9	2.3	*2.3	*2.1
Explosion	3.3	0.4	0.3	0.3
Fatalities	2.0	0.3	*0.1	**0.1
Fire	10.0	1.2	**1.0	**0.9
Gas dispersion	13.7	**1.3	2.1	**2.4
Hazmat waste	3.3	**0.2	2.1	0.5
Injuries	7.7	0.5	1.3	1.2
Major artery closed	36.9	**4.0	5.2	5.1
Radioactive waste	0.1	0.0	0.0	0.0
Spillage	90.4	11.3	13.1	12.1
Toxic inhalation	1.8	*0.2	0.2	0.2
Vehicle left road/track	27.9	3.6	4.1	**4.3
Vehicle overturn	32.2	**3.5	4.5	4.6
Water/sewer damage	8.6	1.1	*0.9	1.0

* p<.05, ** p<.01

Table 3: High-visibility freight companies by major impact: HowSocial and TweetReach

Accident Characteristics	% of cases	HowSocial magnitude score: 2+	TweetReach exposure: 20,000+	Ave % higher-viz companies
Damage over $50,000	81.4	11.6	13.1	15.2%
Environmental damage	13.6	1.7	*1.8	12.5%
Evacuation	18.9	2.9	2.7	14.8%
Explosion	3.3	0.4	0.4	12.1%
Fatalities	2.0	0.1	**0.1	5.0%
Fire	10.0	1.2	**1.2	12.0%
Gas dispersion	13.7	2.5	**2.7	18.2%
Hazmat waste	3.3	0.3	0.6	13.6%
Injuries	7.7	0.8	*1.5	10.4%
Major artery closed	36.9	5.0	6.0	14.9%
Radioactive waste	0.1	0.0	0.0	0.0%
Spillage	90.4	11.6	14.6	14.5%
Toxic inhalation	1.8	0.1	*0.2	5.6%
Vehicle left road/track	27.9	4.9	4.8	17.4%
Vehicle overturn	32.2	5.4	5.2	16.5%
Water/sewer damage	8.6	1.1	1.2	13.4%

* p<.05, ** p<.01

Media hypothesis tests

H1: Perceived risk. The hypothesis asserting that accidents characterized by perceived severity or seriousness are more likely to receive more coverage was *not supported.* Among the serious accidents in the DOT database that received scant news coverage were toxic inhalation, gas dispersion, fires, explosions, water contamination, environmental damage, evacuations, closure of major arteries, and spills that incurred over $100,000 in damage. Other impacts that received scant coverage included fatalities, injuries, and hospitalizations. Specific hazardous releases that received no news coverage included radioactive materials, mass explosion hazards, infectious substances, chemicals that are spontaneously combustible and chemicals that are dangerous when wet. Hazardous releases that received scant coverage included poisonous gases and materials, as well as flammable gases and liquids.

Within stories that did appear, risks were frequently mentioned. Overall, the coverage framed citizens at greater risk of exposure than workers. Stories mentioned a risk of hazardous exposure to residents in 46.8% of the stories vs. 37.1% for on-site workers. Specifically, 34.1% of the stories mentioned moderate or serious risk for residents vs. only 7.9% for workers; 12.7% mentioned low risk for residents vs. 29.2% for workers, and 10.5% framed the risk for residents as safe or non-existent vs. 7.9% of workers.

H2: Visuals. The hypothesis predicting that hazardous spills will be frequently covered because of their visual appeal was *not supported.* A high percentage (77%) of the stories included no photo, map or other graphic. Most of 23% of the stories that did have a visual element only provided one image. Rail accidents were twice as likely as highway spills to receive any visual coverage and to include more than one image.

H3: News values. The hypothesis asserting that spills characterized by traditional news values will receive more news coverage was *partially supported.* In general, reporters choose stories based on traditional news values (including timeliness, impact, prominence, conflict/controversy, unusualness and proximity). The news values inherent in serious transportation spills include impact, conflict, and unusualness. Evacuations, hazardous gas leaks, injuries, road closings, etc. affect many people (impact). Various parties may assign blame for accidents (conflict, controversy). Although most high-impact accidents were barely covered, attribution of responsibility (blame) appeared to drive much of the news coverage. Assigning blame for spills was mentioned in only 15.7% of the stories.

Most people are familiar with petroleum products such as gas, oil and diesel but unfamiliar with the other hazardous substances (unusualness). A high percentage (79%) of stories covered accidents involving non-petroleum spills (lesser-known chemicals). The chemicals reported most frequently in the stories included chlorine (14.8%), followed by propane (10.2%), ethanol (9.7%), diesel fuel (6.7%), and ammonia (6.2%). By comparison, the top five chemicals across all accidents were gasoline (14.7%), crude oil (8.2%), diesel (7.7%), hydrochloric acid (3.0%), and sodium hydroxide (also known as lye or caustic soda, 2.9%). Only diesel spills were covered at a rate comparable to the rate across all accidents. A few stories (4.2%) only used referred to what was spilled using vague language like "chemical," "chemical spill," "acid," "explosive," "solvent," "flammable liquid," or "hazardous material."

While 55% of the covered accidents were derailments vs. 45% trucking accidents, across all accidents there were five times more truck spills than train spills. Thus, the perceived unusualness of derailments elevated the coverage of these spills.

In addition, the accidents that did receive coverage were not located in the cities or states where most spills actually occurred. According to the news coverage, the top five states where spills occurred were South Carolina, the site of the Graniteville chlorine disaster (16.5% of the coverage), followed by Utah (7.9%), Connecticut (7.5%), California (6.0%), and Pennsylvania (6.0%). In comparison, the top five states in the US-DOT database were all populous states: Texas (11.4% of the spills), followed by California (5.3%), Florida (4.5%), Ohio (4.5%), and Pennsylvania (4.3%).

Four of the top five cities in the news coverage were small cities or rural towns: Graniteville, SC (pop. 2,600), followed by Bridgeport, CT (pop. 147,000); Lafayette, LA (pop. 124,276); New Brighton, PA (pop. 5,961) and Columbus, OH (pop. 822,000). By contrast, all top-five cities in the accident database had populations over 600,000: Memphis, TN (pop. 653,000); Houston, TX (pop. 2.2 million); Columbus, OH (pop. 822,000); Tampa, FL (pop. 353,000); and Baltimore, MD (pop. 622,000). Overall, newspapers were more likely to cover serious freight spills in smaller towns than in metropolitan areas. Of the 74 cities that were covered, only 11% were major cities.

Table 4: Top 10 Locations of Serious Hazardous Freight Spills, 2001-2012 (USDOT data)

Rank	Top 10 states	% of cases	Top 10 cities	% of cases
1	Texas	11.5	Memphis, TN	1.2
2	California	5.4	Houston, TX	1.0
3	Florida	4.6	Columbus, OH	0.6
4	Ohio	4.5	Tampa, FL	0.6
5	Pennsylvania	4.3	Baltimore, MD	0.6
6	Louisiana	4.0	Dallas, TX	0.5
7	Illinois	3.6	Kansas City, MO	0.5
8	Tennessee	3.3	Woodstock, VA	0.5
9	North Carolina	3.1	High Springs, FL	0.4
10	New York	2.8	New Brighton, PA	0.4

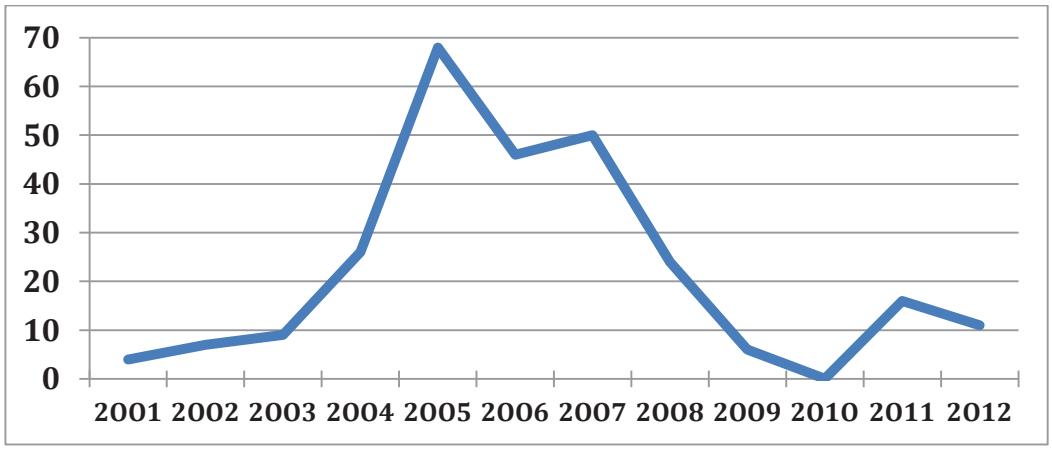
H4: Access to official reports. The hypothesis asserting that spills will receive more coverage where newsrooms have access to daily police, firefighter or EMS reports was *not supported.* Fire or EMS reports were filed for 1,684 of the accidents (30% of all accidents), but less than 3% of these accidents received any coverage. However, fire/EMS reports were filed for 19% of the spills that did receive coverage. Similarly, police reports were filed for 1,966 (35%) of all accidents, but only 2.3% of these accidents received any news coverage. Also, 17% of all covered accidents were documented in police reports. These findings indicate that although media organizations have access to fire or police reports for at least a third of the accidents that happen, the coverage was not driven by them. Few reporters appear to utilize these reports.

H5: Access to officials. The hypothesis predicting that reporters will rely on officials more than transportation company representatives was *supported.* Although fully attributed sourcing is standard practice among American reporters, nearly a third (31%) of the spill stories used unnamed sources. The most common named interview sources were law enforcement officials (39%), firefighters (25%)

federal agency officials (24%), environmental agency representatives (15%) elected officials (14%), public health officials (4%), and military officials (0.4%). Unofficial sources included witnesses, victims and other citizens (24%), freight company representatives (18%), technical experts (7%), doctors and other health care workers (6%), shipping company representatives (5%), freight drivers/operators (3%), local business owners (2%) and lawyers (2%).

Story characteristics. The number of stories per covered incident ranged from 1 to 12, with an average of 4.8 stories per accident. A total of 328 stories covered 267 accidents, representing only 4.8% of the 5,555 serious accidents in the 11-year period. Most (53.9%) of the covered incidents received three or fewer stories. Coverage frequency peaked in 2005 due to extensive coverage of the deadly Graniteville, SC, chlorine tanker disaster but fell off sharply after 2007. This sharp drop also may be tied to the 2008 economic crash that hurt many U.S. newspapers.

FIGURE 1: Frequency of freight spill stories over time



The average story length was 474 words. The stories contained at least 20 words and 1,683 words at the most. Most stories were standard length: 3.7% were 50 words or less, 6.7% were 51-100 words, 48.3% were 101-500 words, 32.6% were 501-1,000 words, and 7.9% of the stories exceeded 1,000 words. Overall, nearly a third (31.1%) of all stories included some kind of image. Nearly a quarter (23.2%) of the coverage included at least one photo, and the highest number was five. In addition, 7.9% of stories included between one and three maps or other graphics.

Transportation modes. Highway spill stories accounted for 121 (45.2%) of the articles, and these covered spills represent 2.7% of all spills. Derailments and other train spills received 141 stories (52.8% of the coverage), representing 16.4% of all train spills. Only 1.1% of the stories reported aircraft spills, and no watercraft accidents were covered. In contrast, across all accidents, 81.3% were highway spills, 15.4% were rail accidents, and 2.6% were aircraft accidents. Thus, while highway accidents were five times more common than train spills, the newspapers covered six times more railway spills than trucking spills.

Crisis response phases. Stories often mentioned at least one phase of crisis response in reporting spills, particularly when a spill was covered beyond the first day. The coverage mentioned the emergency response phase in 58.8% of the stories, followed by cleanup (40.4%), recovery (31.8%), and preparedness (25.5%) phases. The frequent mentions of these activities may be partly linked to the

newsworthiness of the costs. According to the US-DOT data, across all accidents the average cost of cleanup per spill was $57,237, and the average emergency response cost $24,071. The highest cost of cleanup for a spill was $19.0 million, while the highest cost of emergency response was $19.8 million.

Impacts. All major spill impacts were reported disproportionately in the stories, as compared to the rate of these impacts across the actual accidents. More than a third (35.5%) of stories reported a major road closed, which is comparable to the 37.2% rate across all accidents. More than a third of the stories (34.5%) reported a fire, a rate three times higher than the 10.1% fire incidence across all the accidents. Similarly, 23.9% of the stories reported an explosion, while US-DOT reported an explosion rate of only 3.4% across all accidents. These figures indicate that the newsworthiness and visual element of fires and explosions attracted disproportionally more media attention than the actual rate of these events. The less obvious impacts of spills were covered at about the same rate as those reported by US-DOT: 8.9% of the stories reported environmental damage, while the actual rate was 13.6% across all accidents. Similarly, 7.1% of the stories reported water contamination, while US-DOT reported that 8.6% of the spills caused water contamination. While 7.9% of the covered incidents reported a gas leak, the government data indicates that 13.8% of the accidents involved a gas leak.

Evacuations. More than a quarter, 25.8% of the stories, mentioned evacuations, which was comparable to the 19.4% rate across all accidents. Most stories estimated the number of evacuees as 1,000 or fewer. The average number of people evacuated, according to the news, was 699 people, a rate 17 times higher than the US-DOT average (39.8 people per spill). Stories reported a maximum of 10,000 evacuated, the same maximum reported by US-DOT. According to the federal data, people evacuated for up to 84 days (2.6 hours on average). While the number of actual evacuations did increase over time, the number of covered evacuations fell off after 2007.

However, there was a significant correlation between the number of actual evacuations and the number of covered evacuations over time. Although 41.4% of the stories reported an evacuation, only 6.5% of all stories provided evacuation advice, including the evacuation radius from the accident site, alternate routes to escape the site, what citizens should take with them and for how long, etc. Similarly, while 14.5% of the stories reported a gas leak, only a quarter of stories (3.6%) provided advice about how citizens should shelter in place or get medical help.

Health impacts. The average number of injuries per covered accident was 10.3, up to 300 injuries per story, and the average number of people hospitalized per covered accident was 18.4. Up to nine fatalities were mentioned in stories, and the average number of deaths per fatality story was only 1.6. Nearly a quarter (22.1%) of covered accidents had at least one injury, and the same number (22.1%) had at least one hospitalization. Most (59.3%) of those stories reported four or fewer injuries. Only 3.4% of stories reported 20 or more injuries. Although the number of actual injuries and fatalities increased over the decade, the number of covered injuries and fatalities sharply decreased after 2007. However, there was no correlation between the number of actual injuries or fatalities and the number of covered injuries or fatalities over time.

More than a third (38.9%) of stories mentioned specific actual or potential health problems associated with exposure, aside from generic injuries or fatalities. In all, 16.1% mentioned burns, 10.5% mentioned vehicular injuries, 9.7% mentioned skin irritation, 5.1% mentioned neurological issues, and 0.4% mentioned cancer.

Table 5 shows that coverage of rail accidents mentioned more specific health concerns than truck accidents, even though there were five times more truck accidents. However, most of the health issues mentioned in railway coverage appeared in the Graniteville chlorine leak coverage.

TABLE 5: Specific health problems by transportation mode, as reported in news stories

Health impacts	Highway	Rail	Air	TOTAL
Vehicular injuries	3	1	0	4
Neurological effects	1	1	0	2
Cancer	1	0	0	1
Burns	12	7	0	19
Skin irritation	1	10	0	11
TOTALS	18	19	0	37

Accident causes. An explanation of how the spill cause or problem was discovered appeared in 13.9% of the stories. Coverage was more likely to attribute accidents to driver error than mechanical failure, and human error appeared to drive the frequency of coverage. Overall, 34.5% of the covered accidents attributed the spills to the freight driver's actions, nearly five times the 7.4% rate of all spills attributed to human error. In the stories, the driver collided with or reacted to a car (24.7% of stories), was speeding or violated another traffic law (4.5%), driver was drowsy or distracted (2.6%), reacted to an animal or debris (1.5%), had a collision with a sharp object (0.7%) or was inexperienced (0.4%). The news coverage reported that 0.7% of the accidents were caused by collision with a sharp object, while 1.6% of all the accidents cited this cause. For all accidents, 28.1% of the spills involved a vehicle leaving the roadway.

Mechanical issues accounted for a quarter (25.8%) of covered spills. While 9.7% of the stories cited a defective or broken component, this was cited as the cause of 4.2% of all accidents. While 3.7% of stories cited an open valve as the problem, only 0.9% of all accidents were caused by this issue. Within the news coverage, 9.4% attributed accidents to overheating or mechanical fire, 1.5% to aged or deteriorated equipment, 1.1% to inadequate equipment maintenance, and 0.4% to equipment vandalism. The most common causes of fatal accidents were tanker/container breaches (34.1% of all spills), malfunctions of valves, piping or fittings (11.4%), and problems caused by the hazardous materials being transported (9.8%).

Blame. Stories rarely implied culpability on the part of the freight company, the shipping company, or a third party, even though many of these serious spills did eventually prompt litigation. Only 1.9% of the stories reported threatened litigation. Although conflict is a traditional news value that often sparks coverage, assigning blame for spills was mentioned in only 15.7% of the stories. The most common ways this blame was framed, when it did appear, was to blame the freight company for an unintentional accident (18.7% of the stories) or to blame a third party for an unintentional accident (12.7% of stories).

Other references to assigning responsibility included blaming the freight company for a preventable or intentional accident (4.9%), conveying the freight company's apology, compensation, or other assistance to victims (4.5%), conveying that the freight company assumes minimal or low responsibility for the accident (1.9%) or that the freight company assumes strong or high responsibility

for the accident (1.1%). Few stories stated that the shipping company (such as Exxon, etc.) assumed no responsibility for the accident (6.7%), but in one story (0.4%) the shipping company did assume some responsibility. Only one story blamed the shipping company for an unintentional accident (0.4%), and only one story blamed the shipping company for a preventable or intentional accident (0.4%).

Stories assigning blame were twice as likely to use named sources than unnamed sources. Spill investigations were mentioned in over a third (37.5%) of the stories, and stories that discussed a spill investigation were significantly more likely to use named sources than unnamed sources.

Cost estimates. Only 17.6% of stories estimated the costs: 5.6% reported damage to the freight company, 4.1% reported economic damage to the local community, and only 3.8% reported total damages. Across all accidents, the average damage estimate was $150,639, and the worst accident caused $27.5 million in damage. It appears that the estimated cost of response and cleanup did not drive the coverage, and these figures usually did not appear in the stories. Across all covered accidents, 26.6% of the incidents involved damage exceeding $500,000, as compared with three times that rate (79.9%) across all accidents. Of the covered accidents, 16.9% issued a police report, compared with 35.1% of all accidents. Similarly, for 18.7% of the covered accidents, a fire or EMS report had been filed, compared with 30.1% filed for all accidents.

TABLE 6: Impacts by transportation mode, for covered spills vs. all spills (USDOT data)

Impacts	Covered Spills				All Spills				Percent of all spills that Received news coverage			
	Highway	Rail	Air	All	Highway	Rail	Air	All	Highway	Rail	Air	All
Hazardous inhalation	2	4	0	6	79	23	2	104	2.5	17.4	0	5.8
Fire	10	11	0	21	456	108	1	565	2.2	10.2	0	3.7
Explosion	7	8	0	15	170	21	0	191	4.1	38.1	0	7.9
Water contamination	3	3	0	6	407	69	0	476	0.7	4.3	0	1.3
Gas leak	17	4	0	21	570	186	14	770	3.0	2.2	0	2.7
Environmental damage	6	3	0	9	662	98	0	760	0.9	3.1	0	1.2
Damage >$500K	33	38	0	71	3682	736	14	4432	0.9	5.2	0	1.6
Major road closure	23	38	0	61	1737	323	19	2079	1.3	11.8	0	2.9
Evacuation	18	36	0	54	665	298	115	1078	2.7	12.1	0	5.0
Fire/EMS filed report	19	31	0	50	1299	370	11	1680	1.5	8.4	0	3.0
Police filed report	14	31	0	45	1627	327	7	1961	0.9	9.5	0	2.3
Hazmat injuries	22	12	0	34	353	83	9	445	6.2	14.5	0	7.6
Hospitalizations	11	8	0	19	187	53	1	241	5.9	15.1	0	7.9
Fatalities	7	7	0	14	111	10	0	121	6.3	70.0	0	11.6

TABLE 7: Hazardous chemical spills that caused health impacts: Stories vs. all accidents

Hazardous Materials Spilled	Total spills / chem	Number of Hazardous Transportation Spills Involving:							
		Fatality incidents		Injury incidents		Evacuation incidents		Hwy closure incidents	
		Stories	All	Stories	All	Stories	All	Stories	All
Ammonia	101		4		36	1	40	2	47
Butane	76				8		35		28
Bleach/chlorine	69		2	1	11		19	1	40
Crude oil products	248		2		2		20	2	61
Diesel fuel	260	1	13	3	1	1	15	2	72
Ethanol	115		1		3	3	61	3	81
Fireworks	2		2		2		2		1
Gasahol	300		22		19		35		78
Gasoline	124	6	61	6	6	11	20	11	79
Heating oil	87		3		1		5	1	38
Hydrochloric acid	45				8	19	77	19	69
Hydrogen peroxide	6					1	3	1	9
Jet/rocket fuel	69		1		2	1	9	1	33
Other fuels	4			13	20			1	2
Molten sulfur	57				2		4	1	7
Other solvents/cleaners	410			1	42	2	130	1	143
Propane	156	7	9	7	42	7	82	7	104
Radioactive materials	4		2		1				
Refrigerants	74		4		3		8		12
Sodium cyanide	4						2		3
Sulfuric acid	70			1	14		9	1	26
Sulphur dioxide	4			2	24	2	3		1
Vinyl chloride	5						5		
TOTALS	2285	14	126	34	247	48	565	54	874

TABLE 8: Hazardous chemical spills that caused major impacts: Stories vs. all accidents

Hazardous Materials Spilled	Number of Spills Involving:									
	Explosion incidents		Fire incidents		Gas leak incidents		Water contam incidents		Envir damage incidents	
	Stories	All	Stories	All	Stories	All	Stories	All	Stories	All
Ammonia		1			7	92		2		9
Refrigerants		1				60				
Butane		9		15		61				
Bleach / chlorine		3		3	1	2		13		
Crude oil products		1		15		4		74		22
Diesel fuel		11	1	39		8		53		60
Ethanol		7	3	48		11	3	3	3	43
Fireworks		2		1						
Gasahol		33		74		41		3		91
Gasoline	7	76	9	171	3	18	3	167	4	23
Heating oil		1		3		1		2	1	17
Hydrochloric acid		2		1		16		10		6
Hydrogen peroxide				5		4		4		
Jet/rocket fuel		3		4		35		7		4
Other fuels						3		10		
Molten sulfur				3		3		3		
Other solvents	1	2	1	22		37		31		29
Propane	7	26	7	32		130				1
Radioactive materials				2						
Sodium cyanide								1		
Sulfuric acid		1		2		2		4	1	4
Sulphur dioxide					2	3				
Vinyl chloride						4		4		4
TOTALS	15	179	21	440	139	535	6	391	9	313

DISCUSSION OF RESULTS

No freight companies communicated about any of the spills, and most of the companies had no social media presence. Few communicated regularly about anything, through any social media channels. Companies with fewer accidents were more likely to have social media accounts, while those with the most accidents typically had no social media presence. No companies communicated about any of the spills through social media sites.

Most companies had low brand strength because they lacked a social media presence. Few communicated through social media, contradicting the conventional corporate PR practice of "getting out in front" of a crisis. Companies with fewer accidents were more likely to have social media accounts, while those with the most accidents typically had no social media presence. Companies with the most accidents were the least likely to have any social media presence. Those that spilled high-threat cargo – including radioactive materials, flammable gas, and mass explosion hazards – were more likely to have no social media presence. Most companies defied the routine PR practice of "getting out in front" of a crisis, rather than hide and allow news organizations to run with the story. Apparently, this occurred because the news media covered very few of the accidents. The next phase will examine this news coverage.

The news coverage was unexpectedly scant. The first sample searches yielded only 76 stories in 41 newspapers, covering only 29 accidents. We coded all the stories in this universe and found that 99.48% of the 5,555 most serious spills in a decade received no news coverage. The few accidents that did receive any coverage only had 2.6 stories on average. If every accident had received that much coverage, the universe would have consisted of 14,443 stories. The second search, which used more generic search times and excluded chemical names and company names, yielded 191 new stories, bringing the total number of stories in the sample to 267. This story sample constitutes coverage of 4.8% of the accidents in the spill sample.

CONCLUSIONS

The findings showed that public communication about serious transportation spills were nearly non-existent over a decade.

Social media. Unlike many other kinds of companies in the U.S., freight companies do not engage in public communications in a crisis. No freight companies communicated about any of the 5,555 spills via social media. Few companies had any kind of social media or other online presence in the first place. Most freight companies had low brand strength, including low or no social media presence. Companies with stronger brand strength were more likely to communicate with the public about accidents, regardless of severity, but only for dramatic incidents such as fatalities, derailments, or explosions.

Freight companies with fewer accidents were more likely to use social media; those with the most accidents often had no social media presence. Companies with low or no social media presence were more likely to have mass explosion hazards or high-threat cargo spills (i.e., radioactive materials and flammable gas). Companies with strongest social media presence were more likely to have spills involving fatalities, gas dispersion, evacuations, fires, hazardous waste, and closure of major roads.

These patterns defy conventional corporate public relations practice. Routine public affairs practice is to "get out in front" of a crisis, rather than hide and allow news organizations to run with the story. A notable exception is British Petroleum, which was very slow in responding to the Gulf oil spill crisis. Eventually, BP did regularly communicate about new developments across several social media platforms.

The social media analysis applied Coombs' Situational Crisis Communication Theory, which anticipates how stakeholders react to a crisis, in terms of reputational threat. This framework recommends that companies match strategic crisis responses to the level of responsibility and reputational threat, by evaluating the crisis type, crisis history, and prior relationship reputation. Poor or nonexistent communication can lead to damages beyond costs of the accident, including litigation, loss of business, loss of confidence in the organization, and physical risks. Failure to directly transmit a public messages when a crisis occurs can lead to social amplification of risk via news media, social media, opinion leaders, and government agencies.

Companies with fewer accidents were more likely to have social media accounts, while those with the most accidents typically had no social media presence. The companies with higher social media scores had the most damaging and expensive accidents. Train companies typically had higher Klout scores, while trucking companies typically had mid-range Klout scores. Companies with mass explosion hazards or high-threat cargo spills – including radioactive materials and flammable gas – had a very low or non-existent social media presence. Companies with the strongest social media presence were significantly more likely to have accidents involving fatalities, gas dispersion, evacuations, fires, hazardous waste, and closure of major roads.

Some transportation companies with dangerous track records did have social media accounts – but did not use them to inform the public about spills. Companies with higher Klout scores were significantly

more likely to have accidents involving fatalities and injuries. Companies with higher TweetReach scores were more likely to have accidents involving a fire, explosion, or hazmat fatality.

News conclusions. U.S. newspaper coverage of serious transportation spills was almost non-existent over the 12-year period. Spills were more likely to be covered when journalists had more access to authoritative sources, when the perceived risk to citizens was higher, when someone was blamed, or when the spill involved an unusual chemical or situation. Factors that appeared to not drive coverage including the visual element of spills, perceived risk/public outrage factors, the objective danger and severity of the spills, and media access to official reports.

The vast majority of spills involving fatalities, injuries, toxic inhalation, gas dispersion, fires, explosions, water contamination and environmental damage received no coverage. Spills involving extremely dangerous substances including radioactive materials, poisonous gas and mass explosion hazards received little or no attention. Spills that had a visual element such as derailment or objective severity/threat were not more likely to receive attention than other spills. Reporter access to police, fire or EMS reports also did not promote news coverage. High-impact events, such as spills causing injuries, evacuations, toxic gas leaks, or road closings were not more likely to receive attention. Social amplification of risk appeared to have little, if any, effect on news coverage.

The risk of hazardous transportation spills increases the challenges and potential costs of operating the intermodal network of highways, rails, waterways, airports, and shipping terminals. Examining how these accidents are presented to the public could help corporate leaders and policymakers more effectively determine the levels of transportation-related risk that are acceptable and affordable. Examining public risk messages about these incidents also may mitigate potential public outrage after accidents and help transportation leaders identify priorities for response and preparedness.

RECOMMENDATIONS

The findings highlight news routines and reporting strategies used in coverage of serious transportation incidents, as well as significant gaps in public communications about these spills. This project highlights systemic opportunities for improving public communications about serious spills.

First responders, including police, fire department, and EMS responders, should transmit spill reports to local media organizations as soon as they can contain the site. Representatives from these departments, as well as non-local emergency and transportation officials, should provide comments or written statements to media organizations if requested.

When officials blame a freight company for an unintentional or preventable accident, journalists should attempt to get a statement from a company representative. Freight companies should train officials to provide public responses about spills when they are requested. Freight company employees with a better understanding of corporate crisis communication and reputation management could minimize the economic and environmental impact of future hazardous spills in intermodal transportation.

When a freight driver or other operator is blamed, he or she should be given an opportunity for comment when possible. Freight companies should establish a social media presence and post tweets or other brief statements when a major spill occurs. Public relations research suggests this transparency and expressing concern about health and safety can improve the visibility and brand trustworthiness of any type of company.

Journalists need training about how to find and responsibly cover transportation spills. Within spill stories, explanatory content such as risk comparisons, relative risk assessments, explanation of testing/cleanup processes, translation of relevant transportation or risk communication research, and practical advice to audiences should be provided. This kind of explanatory content can mitigate negative responses including litigation. Content that amplifies risk can include speculation, use of unnamed sources, blaming, conflicting reports, vague advice for avoiding exposure to hazards, or false alarms, and failure to acknowledge serious threats. Below is a model of the factors that can contribute to higher and lower levels of public understanding about hazardous transportation spills (Figure 2).

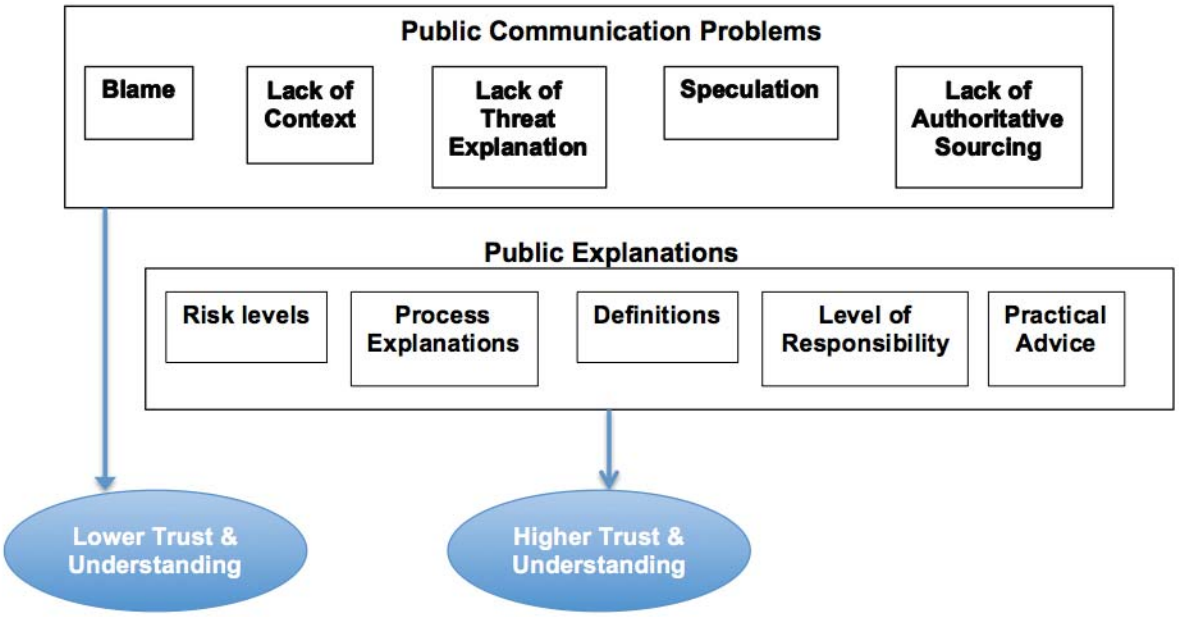


Figure 2: Communication Factors in Public Understanding of Hazardous Spills

Improved public communication about the actual scope and long-term risks of hazardous spills is needed to improve local preparedness and crisis response within communities, as well as within individual freight companies. The findings also could help freight companies mitigate potential public outrage or media sensationalism, and help transportation and emergency response officials identify priorities for hazardous spills emergency response, cleanup and hazard mitigation. Transportation curricula at UTC universities could include a module to train students how to work with the media and directly communicate about different kinds of transportation accidents.

A follow-up study will explore key questions raised by the social media/news media findings through a national survey of state DOT officials, freight operators, and news reporters. This data will be used to contextualize unexpected findings and inform recommendations for both the transportation industry and the media industry in communicating with the public about hazardous spills. The insights also will inform a more effective strategy for evaluating social media and news media "blackouts" public communication about serious transportation spills.

Additional follow-up research could examine how the dearth of public communication about freight spills causes damages beyond the financial cost of the spills and how transportation companies could weigh the risks of reputational harm against the societal benefits of improved communication about spills. Future research also could identify new ways to improve preparedness and response strategies for future hazmat transport accidents for freight companies, first responders, and journalists. These improvements could reduce the high social and economic costs of such incidents.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Chem.	Chemical
DOT	Department of Transportation
H	Hypothesis
Hazmat	Hazardous materials
%	Percent
PR	Public relations
U.S.	United States
USDOT	United States Department of Transportation

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