Analysis of Crane and Lifting Accidents in North America from 2004 to 2010

by

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ABSTRACT

Cranes are the fundamental machinery used during lifting operations, and are crucial to the construction industry. Several key construction processes would be impossible without cranes and the benefits they provide. Cranes are often massive pieces of equipment capable of causing significant damage to both property and human life. Because of their importance to the construction industry, and their potential to cause harm, the safe and correct use of these machines is imperative. This study documents 75 recent accidents involving cranes in North America, systematically cataloguing them into detailed categories. Comprehensive data sets have been compiled for each of the 75 incidents. Each data set includes: the date and location of the incident, crane type and capacity, a review of the responsible parties, conditions during the accident, causative factors, and the outcome of the accident. Cataloguing of these incidents is based off of forensic engineering reports from licensed engineers who are well established in the field, input from industry experts, photos, research of consensus industry safety standards and regulations, and any other available documents. Upon being catalogued into a database, these accidents have been statistically analyzed for patterns. Patterns in these crane accidents are then used to identify areas where increased safety standards and regulations are needed. The study reviews the importance of careful lift planning and offers data to be used to improve crane design, industry safety standards, and lift coordination.

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1. INTRODUCTION

Cranes are the fundamental machinery used during lifting operations, and are crucial to the construction industry. Several key construction processes would be impossible without cranes and the benefits they provide. Cranes are often massive pieces of equipment capable of causing significant damage to both property and human life. Because of their importance to the construction industry, and their potential to cause harm, the safe and correct use of these machines is imperative. **Figure 1.1** shows an example of what can happen if lift planning and execution are not carefully thought-out and properly coordinated.

Crane accidents represent a significant danger to workers and bystanders alike. Safety standards have been a continuous work in progress. Recently organizations such as ASCE, ASME, and OSHA have begun to produce more detailed written guidelines for crane and rigging safety. OSHA organized a Cranes & Derrick Advisory Committee (C-DAC) in July 2002 to assist in updating OSHA 1926.550 to address the advancements in the crane industry, and to align with current ASME B30 committee requirements. Their goal was to create a new set of regulations for cranes, OSHA 1926.1400, and also to support and advance certification programs such as the National Commission for the Certification of Crane Operators (NCCCO). On November 14, 2010, OSHA 1926.1400 became law, although its crane operator

Figure 1.1: Crane stability failure after crawler punches through a surface. (Haag Engineering Co.)

certification requirement does not go into effect until November 14, 2014. Initial requirements for "qualified" riggers and signal persons were also included in the original C-DAC document. While certification is not yet a federal requirement, some localities such as Washington (State) require documented qualifications and/or certifications for all personnel working with cranes.

A string of high profile crane accidents in 2008 increased public awareness of crane-related hazards, and prompted Engineering News Record to devote its cover story to the topic of crane collapses and inconsistent lifting practices and safety provisions. (Hampton 2008) Since then, crane collapses have continued to occur frequently, but public interest has once again regressed towards general apathy. However, the same risks associated with cranes that were present in 2008 remain in place today.

Organizations such as NCCCO (National Commission for the Certification of Crane Operators) have made strides towards providing affordable standardized rigger certification exams, but there remains limited political movement towards requiring riggers to be certified.

1.1 PROBLEM STATEMENT

Each year, hundreds of costly accidents occur involving the use of one or more cranes. The resulting financial and human cost of these accidents is great, and the delays they create can put added pressure on schedule deadlines, exacerbating safety conditions on construction sites. **Figure 1.2** (next page) shows an example of the devastating effects a crane accident can have on the environment around it. An increased understanding of the factors and trends in crane accidents is needed in order to provide guidance for safety standards. Greater clarity on this subject would enable the continuation of safer working conditions for those in the industries that use cranes and derricks. Currently, the statistical analysis of crane accidents is still thin, and provides limited insight into the factors behind crane accidents.

There is a need for a study that delves deeper into the causative factors of crane accidents. Previous studies have used a limited list of factors. This study will significantly expand the number of classification categories used to create statistical outputs. Additionally, patterns in crane type and lifting capacity need to be analyzed. Finally, a study of the responsibilities of the parties involved in crane accidents is a crucial step towards identifying the individuals who need the most instruction in crane safety and their role in lifting operations.

Figure 1.2: A tower crane collapses in Bellevue, Washington. (Haag Engineering Co.)

2. LITERATURE REVIEW

This study attempts to provide some statistical conclusions about the causes and details of crane-related accidents. A number of previous studies have attempted to provide empirical conclusions about crane-related incidents in the U.S. construction industry.

Beavers et al. (2006) provided a statistical review of crane related fatalities in 2006. The study's source data covers the years 1997-2003, drawing from the United States Occupational Safety and Health Administration's (OSHA) Integrated Management Information System (IMIS) using a series of search keywords. The IMIS database provides summary reports about each of their catalogued incidents. These summaries can be terse however, and to further support their data, the authors obtained each chosen case study's full OSHA report file. By obtaining the full case files, the 2006 Beavers et al. study was based on a more complete set of data than similar studies that preceded it.

Their ultimate goal was to provide a study "classifying recent fatal events by proximal cause, contributing physical factor, project end use, construction operation, existence of an employer safety and health program, OSHA citations, and various other factors." The authors have provided the most comprehensive statistical data on this subject to this date. However, it should be noted that the basis for this study relied on the investigative skills of OSHA personnel who had a focus on determining what parts of the regulations were violated strictly in the employer-employee relationship. OSHA's investigators do not have the technical expertise to determine the specific cause of many accidents. Also, the OSHA reports typically address all observed violations that occurred during an accident, whether those violations caused or contributed to the incident or not. Finally, OSHA only gets called to an accident when there are multiple serious injuries, fatalities, a worker blows the whistle, or an OSHA official is already on site.

Saruda et al. (1999) published a study that also drew from OSHA investigation records. Their data was based upon the previously mentioned IMIS summary reports, and covered 502 deaths occurring in the years of 1984-1994.

Shepard et al. (2000) completed a study very similar to Saruda et al., analyzing over 500 OSHA crane fatality situations spanning the years 1985-1995.

Hinze and Bren (1996) analyzed OSHA reports, concluding that cranes were involved in a large number (38%) of fatal electrocutions involving heavy equipment in the U.S. construction industry.

A 2009 paper by Shapira and Lyachin sought to identify and analyze the factors that contribute to safety of a specific type of construction crane known as a tower crane. Their study relied on the input of an expert panel, shunning statistical data. The authors note:

> *Statistics on construction accidents involving tower cranes could have been a reliable source of information for this kind of study. In reality, however, statistics suitable to serve the purposes of this current study hardly exist—for tower or mobile cranes. First, crane accidents are commonly reported only in cases of fatalities or severe injuries (Fair 1998). Therefore, numerous cases simply do not make it into the statistics, even if they are reported within the construction company. These cases, which may involve injuries or "only" cost damages, constitute the majority of crane related accidents.*
>
> *But even when statistics and accident records are at hand, they usually provide information on the circumstances, nature, outcomes, symptoms, and even proximal causes and contributing physical factors of accidents; only very rarely do they go all the way in providing the root causes of the accident investigated (Häkkinen 1993; Hinze et al. 1998; Abdelhamid and Everett 2000; Neitzel et al. 2001; Beavers et al. 2006).*
>
> *As Hammer (1989) stated: "Accident statistics . . . do not answer questions about what causes accidents . . . They do not indicate relationships between causes and effects." He adds that "even where accident and injury statistics can be useful, they are often incomplete, inaccurate, and therefore incorrect."*

Several of the flaws in statistical data on crane accidents noted by Shapira and Lyachin can be found in the studies mentioned above. The previous studies suffer from all relying on the same data: OSHA reports. OSHA does not cover workers in the public sector or those who are self-employed. These reports are limited in their jurisdiction, detail, and most importantly, only include accidents that result in fatalities or multiple injuries. These reports are also often inconsistent, having been compiled from multiple sources using different reporting methods and terminology. Additionally, previous studies have ignored accidents that did not result in a fatality.

This current study attempts to improve on previous studies by addressing their shortcomings. The source data will be more complete, using engineering reports, photographs, videos, witness depositions, company safety documents, and the inputs of several industry experts to arrive at its conclusions. The categorization of crane accidents will be more comprehensive, attempting to draw stronger relationships between cause and effect. While previous studies have focused primarily on failure modes and proximal causes, this study will put an additional emphasis on identifying the human parties responsible for the incident. Another significant difference between this study and previous statistical analyses is that this study analyzes crane-related accidents of all types of loses – from fatalities to incidents only resulting in loss of property and/or delays in schedule. The cases are also more recent than those utilized in previous studies, allowing for conclusions that are up-to-date and relevant to the industry in its current state.

3. METHODOLOGY

A collection of case files involving crane-related incidents was reviewed, and a sample of 75 cases was selected. The selected incidents occurred in 27 U.S. states with one occurring in Mexico. These case files contained detailed engineering analysis of crane-related accidents, ranging from minor property damage to multiple fatalities and massive property loss. The case files were obtained from Haag Engineering Co. These forensic engineering reports were completed by the same team of licensed professional engineers, using a consistent methodology for each case.

From these engineering reports, the author compiled a "data profile" for each individual case. As a selection method, the 75 most recent (by date of incident) complete data profiles were chosen. A summarized data profile for all 75 case studies can be found in Appendix A.

3.1 GENERAL INFORMATION

Each case file was given a number and noted with the following general information:

- Date of Incident
- Location of Incident
- Type of Crane (Manufacturer, Classification, Model, Capacity)
- Any Pertinent Crane Attachments Present
- Any Pertinent Alterations or Modifications

The general information has allowed the author to analyze trends in crane type and lifting capacity.

3.2 RESPONSIBLILITIES

The case files were then analyzed for responsible parties/entities. The following categories were addressed:

- Site Supervisor
- Lift Director
- Rigger
- Operator
- Service Provider
- Owner/User
- Signal Person
- Manufacturer
- Other

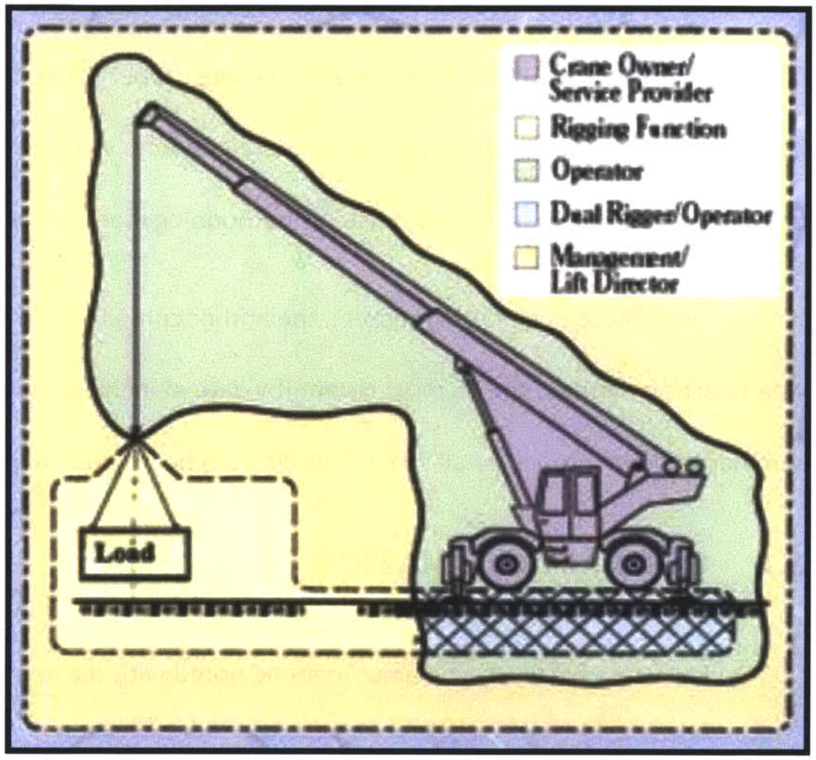

Figure 3.1: Zones of Responsibility (ASCE No. 93)

The allocation of responsibilities for crane safety is outlined in the ASCE (American Society of Civil Engineers) Manuals and Reports on Engineering Practice No. 93, *Crane Safety on Construction Sites*. **Figure 3.1** (ASCE No. 93) shows a visual representation of the zones of responsibility for each party. The engineering reports used the ASCE No. 93 report and subsequent ASME B30.5-2007 standard to allocate responsibility to the involved parties. It is understood that the ASCE No. 93 standards describe responsibilities for crane operations on construction sites that have been defined as far back as the early 1980's. (Dickie 1982) The ASME (American Society of Mechanical Engineers) B30.5: *Mobile and Locomotive Cranes* is based off of these same early standards.

Care was taken to determine if an engineer believed that a certain party was either a primarily responsible party to the accident or simply secondarily. A primarily responsible party has been defined as a party who failed in their responsibility in such a way that, without their breach of responsibility, the accident would not have occurred. A secondarily responsible party has been defined as a party whose breach of responsibility exacerbated the accident, but it would have occurred regardless due to other factors. The responsible parties were then catalogued as such, either "primary" or "secondary". It should be noted that multiple parties can be considered primarily responsible. Multiple parties can also be considered secondarily responsible. It is also possible that one entity may be filling the role of multiple parties. For example, the crane operator may also be acting as the lift director under certain conditions.

3.3 CONDITIONS, OUTCOMES, AND CAUSATIONS

A broad list of accident classification categories was created using the cumulative input of a range of subject matter experts. A glossary of crane and rigging terms was also consulted in the creation of this list. (SC&R 1997) The list attempts to provide a blanket of potential conditions during the accident, physical outcomes, and causations of the accident. These classifications are not mutually exclusive. Cases were checked for every category, and the categories that were present during each accident were identified. Definitions for accident classification terms are listed below:

Operational Aid -- Accessories that provide information to facilitate operation of a crane or that takes control of particular functions without action of the operator when a limiting condition is sensed.

Operational aid override -- The operator performed some type of action to circumvent the device. (Inserting a "penny" has been a typical LMI override maneuver.)

Operational aid improper set up -- The operator did not input the necessary or correct information/configuration into the system, resulting in incorrect output.

Operational aid not used -- The device was never turned on.

Operational aid not present -- The device was not installed on the crane.

Operational aid malfunction -- A portion or function of the aid was not registering. Errors or glitches occur when device is properly set up. The device does not function altogether.

Safety Devices -- Accessories designed to limit unsafe operation.

Safety device override -- The operator performed some type of action to circumvent the device.

Safety device not used -- The device was never turned on.

Safety device not present -- The device was not installed on the crane.

Safety device malfunction -- A portion or function of the aid was not registering. Errors or glitches occur when device is properly set up. The device does not function altogether.

Physical Issue -- A physical component of the crane contributed to the accident.

Manufacturing Issue -- An issue present before crane is ever operated in the field.

Manufacturing design -- A design flaw in the crane or one of its components.

Fabrication/Manufacturer Assembly -- Faulty component or initial assembly error. Includes substandard welds.

Structural Issue -- A structural failure of the boom or other component when it has not been overloaded.

Fatigue -- Fatigue failure of material.

Corrosion Structural Issue -- Corrosion of metal component(s).

Aging -- General deterioration of structural components not attributable to any acute cause.

Mis-Use -- Physical mis-use that was not in conformance with standard operating procedures.

Overload Physical Issue -- The crane experienced structural failure due to excessive weight.

Physical Abuse -- The crane experienced structural failure due to abuse such as shock loading or impact from objects/equipment.

Damage From Previous Use -- Pre-existing damage contributed to the mechanical/structural failure of the crane.

Broken Chords – Chords were previously broken, deformed, or degraded.

Deflected Boom – Boom was previously plastically deformed.

Broken Connection – A connection was broken before operation.

Mechanical Failure of Component -- Component failure not attributed to a manufacturing issue.

Hydraulic Cylinder – A hydraulic cylinder failed.

Brakes – The brake system on the crane failed.

Outriggers – The outriggers failed.

Electrical System – The electrical system failed.

Engine – The crane engine failed.

Wire Rope – A physical failure of the wire rope.

Load Line – The load line wire rope experienced a physical failure.

Hoist Line – The boom hoist line wire rope experienced a physical failure.

Line Shock Load -- Wire rope is compromised from shock loading. Includes fractured rope and birdnesting.

Line Corrosion -- Wire rope is used that has been compromised by corrosion.

Line Crushing -- Wire rope has been crushed. May be caused by crane drum or other physical abuse.

Line Excessive Wear -- Wire rope has been compromised by excessive wear.

Wrong Wire Rope for the Application -- The incorrect wire rope was used.

Other Physical Issue – Any other pertinent mechanical/physical problem.

Crane Stability -- The crane loses stability.

Soil (Mobile Crane Stability) -- The underlying soil contributed to the loss of stability.

Loose Soil -- Soil was not sufficiently compacted, leading to crane movement.

Prior Trench Excavation -- Previous earthwork destabilized crane set-up area.

Outrigger Instability -- Stability issue due to outrigger set-up.

Improper Cribbing or Mats -- Inadequate cribbing or mats are used or they are improperly set-up.

Outrigger Punches through Hard Surface -- Outrigger punches through surface such as a mat or pavement.

Outriggers Not Extended -- Outriggers are only partially extended during lift or not extended at all.

Outriggers Not Level -- The crane is not level due to improper use of outriggers.

Foundation (Tower Crane Stability) -- The tower crane foundation contributes to the loss of stability.

Tie Ins (Tower Crane Stability) -- The lack of use or the improper installation or design of tower crane tie-ins leads to instability.

Absence of Brace -- No brace is installed where one is needed.

Installation Error -- Brace is not installed correctly, leading to reduced stability.

Operator Set-Up -- Crane is not safely positioned or configured for a lift.

Level -- Crane in not level.

Ground Contact -- Crawlers not extended, tires do not clear ground, one (or more) outriggers do not contract ground, etc.

Overload Stability -- The crane loses stability due to excessive weight.

Wrong Counterweights -- The wrong counterweight configuration is used, leading to a loss of stability.

Load Miscalculated -- The magnitude of the load is miscalculated.

Load Chart Misread -- The operator misreads the load chart or enters the incorrect data into the LMI.

Operator Error -- The operator performs a maneuver that takes the crane from within capacity to over capacity.

Lost Load -- The crane loses stability due to the sudden loss of a load.

Floating Foundation/Surface -- The floating surface becomes unstable/moves causing instability of the crane.

Load -- A load that did not exceed the capacity of the crane, but which ultimately caused an accident.

Placement -- Placing a load on framing or other platform that could not support the load.

Load Stability -- The load shifts or is swung such that it causes instability of the crane.

Load Falls Apart -- The load is too fragile, unstable, or not properly bundled. The load may lack the necessary brackets or connection plates.

Crane Operation -- Improper operations of the crane by the operator.

Stuck Load -- The operator pulled on a stuck load that overloaded the crane, or buckled the boom, or overturned the crane, or caused some type of dynamic loading when released.

Manual Violation -- The operator set up or operated the crane in a manner that was in direct violation of the operator's manual.

Inadvertent Operator Movement -- The operator moved/pulled the wrong lever.

Excessive Speeds -- The operator created dynamic loading by moving or swinging the crane too fast.

Maintenance -- The lack of maintenance which was a contributing factor to the accident.

Inspection/Certification -- Inspection/certification records are an issue. The inspector failed to properly inspect the crane in accordance with national standards.

Expired/Non-Existent -- Inspection records are expired or missing. Inspection did not occur.

Inspection Errors -- Crane with issue(s) passes inspection. A missed item (issue) contributes to the accident.

Corrosion Maintenance -- Corrosion left unchecked, resulting in decreased performance.

Mechanical Parts Maintenance -- Crane components neglected, resulting in decreased performance.

Structural Integrity Maintenance -- Displaced, bent, or broken members not repaired.

Critical Lift -- Critical lift planning was flawed. "Any lift utilizing multiple cranes is always a critical lift. Other criteria would be the weight of the equipment to be lifted as compared to the allowable lift, the swing area of the lift, the overall risk, difficulty, or complexity of the lift, toxicity of the product being lifted, and other considerations at the discretion of the producer of the lift plan." (ASCE)

Lift Planning -- Factors and decisions leading up to, and during, the lift.

Site Controls -- The controlling contractor interfered with ingress or egress; some site issue that was not in control of the operator.

Wrong Weight Planning -- The lift director provided the wrong weight.

Plan Issues -- The lift plan had one or more errors and/or omissions which caused or contributed to the accident.

Conditions Changed From Plans -- A site condition varied from what was originally planned for.

Rigging -- The type and/or configuration of the rigging that secures the load and attaches to the hook causes or contributes to the accident.

Rigging Failure -- Some part of the rigging physically failed during the lift.

No Softeners -- Rigging failed due to being cut by a sharp edge due to the lack of softeners.

Tag Lines -- Tag lines, or the lack thereof, led to the loss of control of the load.

No Tag Line -- Tag line not used.

Tag Line Tangles -- Tag line tangles on an object or person, causing the load to shift or the person to be dragged.

Not Balanced -- The load becomes unbalanced at some point during the lift.

CG is Unknown – The load center of gravity is unknown, leading to a rigging failure.

Rigging Not Secured – The rigging was not secured, leading to an unbalanced load.

Wrong Type of Rigging Used -- Some combination of rigging components led to failure.

Crane Travel -- Traveling the crane while not performing a lift or traveling in a partially erected or configured manner.

Off Site Travel -- Travel while not on a job site.

On Site Travel -- Traveling while on a job site.

Road Travel -- Accident occurred while traveling on a road.

Bridge Impact -- Crane impacts a bridge or tunnel while traveling or being transported.

Tip Over -- Crane tips while traveling.

Improper Boom Securement -- Boom not secured causing it to fall off or be otherwise damaged.

Upper Crane Not Locked – House lock not engaged. Upper crane swings, causing crane to tip.

Outriggers Not Set Up For Travel -- Outriggers are not extended just above grade.

Unauthorized Operator -- Rigger or non-operator personnel moves the crane.

Engineering Issues -- An engineer involved in the lift plan design performs an improper design. Also includes support condition design (tower crane foundation/tie-ins).

Wind -- Wind contributes to the accident.

Ice -- Ice contributes to the accident.

Fog -- Fog contributes to the accident.

Lightning -- Lightning contributes to the accident.

Boom Impact -- The boom comes into contact with a stationary object, causing it to collapse or drop its load.

Operator Caused Boom Impact -- The operator swings into a stationary object that is in clear view.

Spotter Caused Boom Impact -- A designated spotter used to ensure proper clearance does not do his job and the boom contacts a stationary object.

Blind Pick Signal Issues -- Either hand, hard-wired, or wireless communications cause or contribute to the accident. The operator has no visibility of the load for all or a portion of the lift. He relied on bad signals.

Assembly -- An accident occurred during or because of the erection of the crane.

Assembly in Accordance -- Erection was in accordance with the manufacturer's specifications.

Assembly Not in Accordance -- Erection was not in accordance with the manufacturer's specifications.

Disassembly -- An accident occurred during or because of the dismantling of the crane.

Disassembly In Accordance -- Dismantling was in accordance with the manufacturer's specifications.

Disassembly Not in Accordance -- Dismantling was not in accordance with the manufacturer's specifications.

Change of Configuration -- An accident occurred during or because of the changing of the configuration of the crane.

Jumping a Tower Crane – An accident occurs while jumping a tower crane.

Erecting a Jib – An accident occurs while erecting a jib.

Attaching a Man Basket – An accident occurs while attaching a man basket.

Change of Wire Rope -- Accident occurred during or because of the changing of wire rope.

Worker Contact -- A worker is struck by the load, crane, or parts of either that fall as a result of an accident.

Load Falls -- The load either comes free during a lift or falls due to crane failure/collapse. Employee is located in the fall zone.

Hit By Part of Crane -- Any part of the crane, either during normal operations or as a result of an accident, strikes a worker/bystander.

Load Drifts -- Load is lifted and drifts from its original location. Common to pin a worker against a stationary object.

Snagged By Rope -- A worker becomes entangled in a wire rope. May result in becoming trapped in a winch.

Wrong Weight -- In some manner, the load being lifted is greater than previously determined.

Wrong Weight Provided -- The weight of a load is provided by an outside source that is incorrect.

Operator Wrong Weight -- The operator either does not ask how much the load weighs, or performs an incorrect calculation.

Demolition -- The cubic foot estimate is incorrect.

Power Line Contact -- Part of the crane or load comes in contact with electric power lines.

Operator Caused Power Line Contact -- The operator swings into a power line.

Boom Contacts Power Line -- The boom contacts the power line.

Load Line Contacts Power Line -- The load or the load line contacts the power line.

Rigger Caused Power Line Contact -- Rigger pulls the load or the load line into the power line. Rigger contacts energized crane or line.

Site Supervisor Power Line Contact -- Controlling contractor does not appropriately identify or abate the hazard prior to the use of cranes.

Radio Wave -- Radio wave interference or electrical charge from wireless tower.

Crane Safety -- Training and planning to anticipate dangers and educate workers.

No Crane Safety Plan -- Employees not educated on general crane safety.

No Crane Lift Plan -- No lift plan is made.

No Critical Lift Plan -- No lift plan is made for a critical lift.

Heat/Hazmat -- Failure to consider the effects of heat or hazardous material.

Commercial -- Commercial Construction

Industrial -- Industrial, Manufacturing, or Refineries

Highway -- Road, Bridge, or Highway Construction

Residential -- Residential Construction

Marine -- Port, Barge, Off-shore

Of these categories, some are considered sub-categories of others. Every category is first analyzed as a percentage of all 75 cases. For example “corrosion maintenance” (as defined above) was identified in 3 out of 75 cases, or 4% of all cases. However, further analysis shows that “maintenance problem” was identified in 11 out of 75 cases (14.7%). “Corrosion maintenance” is considered (by the author) a subcategory of “maintenance problem,” and therefore, “corrosion maintenance” was identified in 3 of the 11 cases with a “maintenance problem,” or 27.3%. This provided the author with the ability to draw conclusions based off of the information that maintenance problems were present in 14.7% of cases, and that corrosion maintenance problems accounted for 27.3% of those maintenance problems.

3.4 DATA COMPILATION

A case file that included the general information, the party responsibility information, and the conditions, outcomes, causation category information was considered a complete data set.

Microsoft Access was utilized to compile the 75 data sets. From the compiled database, various statistical tables have been generated using Microsoft Excel, providing insight about trends in these crane-related accidents.

3.5 DATA SOURCES

Data was collected from accident files compiled at Haag Engineering Co. The authors/compilers of these files are licensed professional engineers with extensive knowledge and expertise in the crane and construction industries; as well as members on national consensus organizations of standards (ASME B30) and certification (NCCCO). They followed the same methodologies for every case file that they compiled and analyzed. These files range in size and detail, but typically contain engineering reports carefully documenting the incident, photographs, depositions, crane manufacturer information, and safety documents. Additional relevant documents and media are included in the files on a case-by-case basis. Only cases that had sufficient detail to create complete, consistent data profiles were used in this study. The source data files cover crane-related accidents from 1986 through 2010, however, only the 75 most recent cases were used for this study (October 2004 to October 2010).

A number of industry subject matter experts were consulted to help create the list of causation, condition, and outcome categories to be used in classifying the individual crane cases.

4. STUDY RESULTS

The results of this study are reviewed below:

4.1 RESPONSIBILITIES

Table 4.1 shows the number of times (count) that each party breached their responsibility for the crane lift. The responsible parties can be observed in **Table 4.1** in descending order of frequency. **Table 4.1** does not take into consideration whether the party was considered "primarily" or "secondarily" responsible. It should be noted that the responsible parties are not mutually exclusive (often multiple parties did not fulfill their responsibility), and therefore, the count does not total 75.

Table 4.1: Responsibilities

Party	Count (out of 75)	Percentage
Operator	32	42.7%
Lift Director	29	38.7%
Site Supervisor	22	29.3%
Rigger	21	28.0%
Owner/User	10	13.3%
Signal Person	9	12.0%
Manufacturer	6	8.0%
Other	6	8.0%
Service Provider	4	5.3%

The table shows that the operator failed in his responsibility to some extent in 32 out of the 75 cases studied, or 42.7%. The operator was the most frequently responsible party, followed closely by the lift director. The site supervisor and rigger were the next two most frequently cited parties.

Rounding out the parties were the owner/user, signal person, manufacturer, other, and service provider.

Table 4.2 gives an expanded look at the responsible parties by distinguishing between times when a party was determined at "primarily" or "secondarily" responsible. Again, the responsible parties were not mutually exclusive, and the total count will not sum to 75.

Table 4.2: Responsibilities—Expanded Look

Party	Count (out of 75)	Percentage of All Cases	Percentage of Category
Site Supervisor	22	29.3%	-
Site Supervisor Primary	16	21.3%	72.7%
Site Supervisor Secondary	6	8.0%	27.3%
Lift Director	29	38.7%	-
Lift Director Primary	23	30.7%	79.3%
Lift Director Secondary	6	8.0%	20.7%
Rigger	21	28.0%	-
Rigger Primary	19	25.3%	90.5%
Rigger Secondary	2	2.7%	9.5%
Operator	32	42.7%	-
Operator Primary	24	32.0%	75.0%
Operator Secondary	8	10.7%	25.0%
Service Provider	4	5.3%	-
Service Provider Primary	3	4.0%	75.0%
Service Provider Secondary	1	1.3%	25.0%
Owner/User	10	13.3%	-
Owner/User Primary	8	10.7%	80.0%
Owner/User Secondary	2	2.7%	20.0%
Signal Person	9	12.0%	-
Signal Person Primary	6	8.0%	66.7%
Signal Person Secondary	3	4.0%	33.3%
Manufacturer	6	8.0%	-
Manufacturer Primary	3	4.0%	50.0%
Manufacturer Secondary	3	4.0%	50.0%
Other	6	8.0%	-
Other Primary	5	6.7%	83.3%
Other Secondary	1	1.3%	16.7%

Table 4.2 provides insight into the typical relative importance of each party's breach of responsibility. For example, when looking solely at primarily responsible parties, the crane operator is now only implicated in 32% of the 75 accidents. The lift director is primarily responsible for 30.7% of the 75 accidents. The comparison of 32% versus 30.7% represents a smaller difference between the two parties than when "primary" and "secondary" were lumped.

The "Percentage of Category" column of **Table 4.2** allows for some analysis of the weighted importance of each party's lapse of responsibility. The manufacturer had a 50% primary to 50% secondary distribution of their breach of responsibilities (a 1-to-1 ratio). This 1-to-1 ratio was the lowest among the parties, implying that when the manufacturer does err, the consequences are less frequently catastrophic. The highest percentage of primary breaches was the rigger (90.5%). The rigger's 19-to-2 ratio implies that even though they are not the most frequently responsible party, when they do err, the result is usually disastrous.

4.2 CRANE TYPE

The type of crane involved in each accident was recorded. **Table 4.3** displays the type of cranes found in this study, descending from most frequent to least frequent. **Figure 4.1** provides a graphical representation of **Table 4.3**. The most commonly involved crane was the lattice crawler crane type that was involved in 18 of the 75 case studies (24%). Cranes that have wheels or crawlers represented 69% of all the cranes involved in accidents. The most common non-mobile crane was the tower crane, which was involved in 12 of 75 cases (16%).

Table 4.3: Crane Type

Crane Type	Count (out of 75)	Percentage
Lattice Crawler	18	24.0%
Hydraulic Truck	14	18.7%
Tower	12	16.0%
Lattice Rubber Tire	6	8.0%
Overhead Crane	5	6.7%
All Terrain	4	5.3%
Rough Terrain	3	4.0%
Pedestal	3	4.0%
Custom	1	1.3%
Telehandler	1	1.3%
Custom Mega Crane	1	1.3%
Gantry	1	1.3%
Log Boom Crane	1	1.3%
Stiffleg Derrick	1	1.3%
Side Boom Pipelayer	1	1.3%
Gin Pole Truck	1	1.3%
Truck Mounted Boom	1	1.3%
Mounted Marine Dredger	1	1.3%

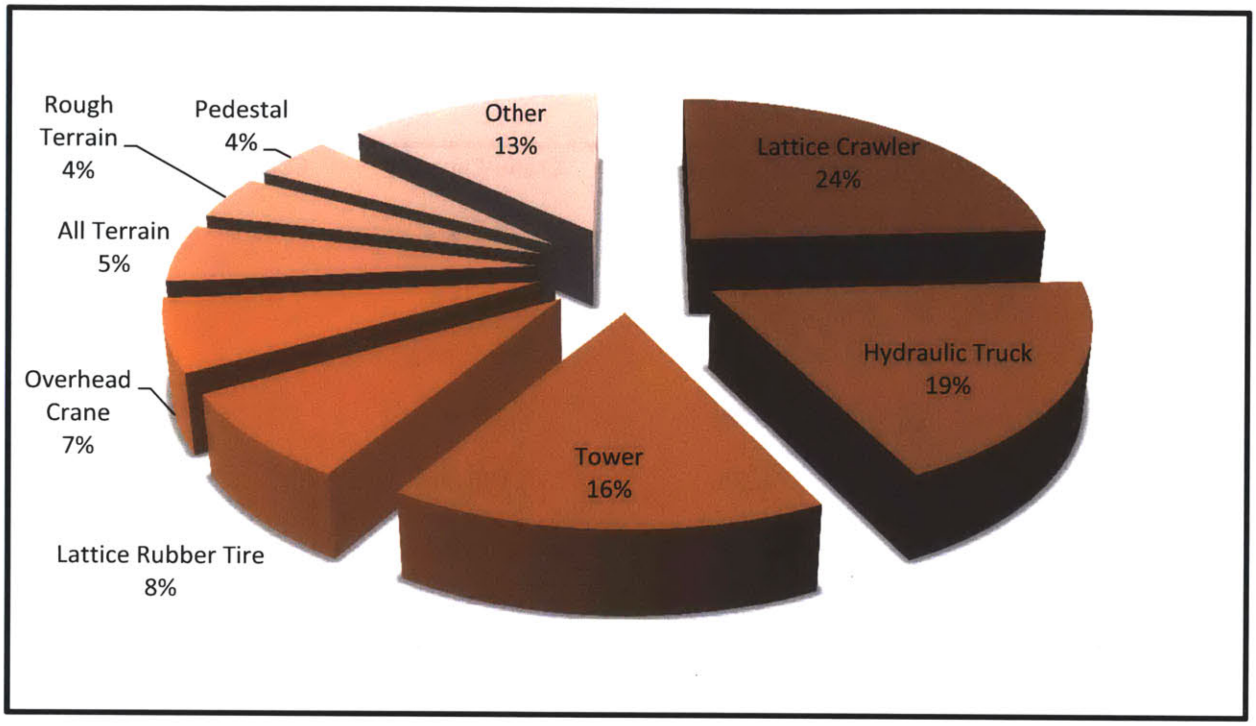

Figure 4.1: Crane Type

4.3 CRANE CAPACITY

The maximum rated capacity of each crane involved in the case studies was documented. The maximum rated capacity represents the highest load that is allowed when the crane is at its ideal configuration. These rated capacities have a safety factor built-in. There were four case studies in which information on the crane capacity was unavailable.

Table 4.4: Crane Capacity Ranges

Capacity	Count	Percentage
1-25 Ton Total	19	25.3%
30-75 Ton Total	18	24.0%
80-230 Ton Total	19	25.3%
250+ Ton Total	15	20.0%
Unknown	4	5.3%

Table 4.5: Crane Capacity

Crane Capacity	Count	Percentage	Crane Capacity	Count	Percentage
40 Ton	7	9.3%	3 Ton	1	1.3%
200 Ton	6	8.0%	4.5 Ton	1	1.3%
50 Ton	5	6.7%	6 Ton	1	1.3%
230 Ton	5	6.7%	7 Ton	1	1.3%
300 Ton	5	6.7%	10 Ton	1	1.3%
20 Ton	4	5.3%	16 Ton	1	1.3%
Unknown	4	5.3%	45 Ton	1	1.3%
25 Ton	3	4.0%	65 Ton	1	1.3%
250 Ton	3	4.0%	90 Ton	1	1.3%
5 Ton	2	2.7%	100 Ton	1	1.3%
8 Ton	2	2.7%	110 Ton	1	1.3%
30 Ton	2	2.7%	165 Ton	1	1.3%
75 Ton	2	2.7%	440 Ton	1	1.3%
80 Ton	2	2.7%	455 Ton	1	1.3%
150 Ton	2	2.7%	850 Ton	1	1.3%
600 Ton	2	2.7%	1100 Ton	1	1.3%
1 Ton	1	1.3%	2500 Ton	1	1.3%

Table 4.4 displays the crane capacity ranges divided into roughly quartiles. Of note, a full quarter of the studied accidents involved cranes that could lift no more than 25 tons. **Table 4.5** shows all of the involved cranes' capacities, listing them by most frequent to least. By tracking the maximum rated capacity of the cranes in the case studies, the author was able to obtain a general estimate of the

size of the lifting operation. Most cranes were not configured for a maximum rated load, and therefore were lifting or expecting to lift a load less than the shown capacities. In fact, the largest crane in the study, a 2,500 ton mega, or "super heavy-lift" crane, did not have a load on the line at the time of its collapse.

Figure 4.2 is a bar graph plotting the number of cranes by their maximum rated capacity. The bar graph provides a visual distribution from which clusters of crane capacities can be identified.

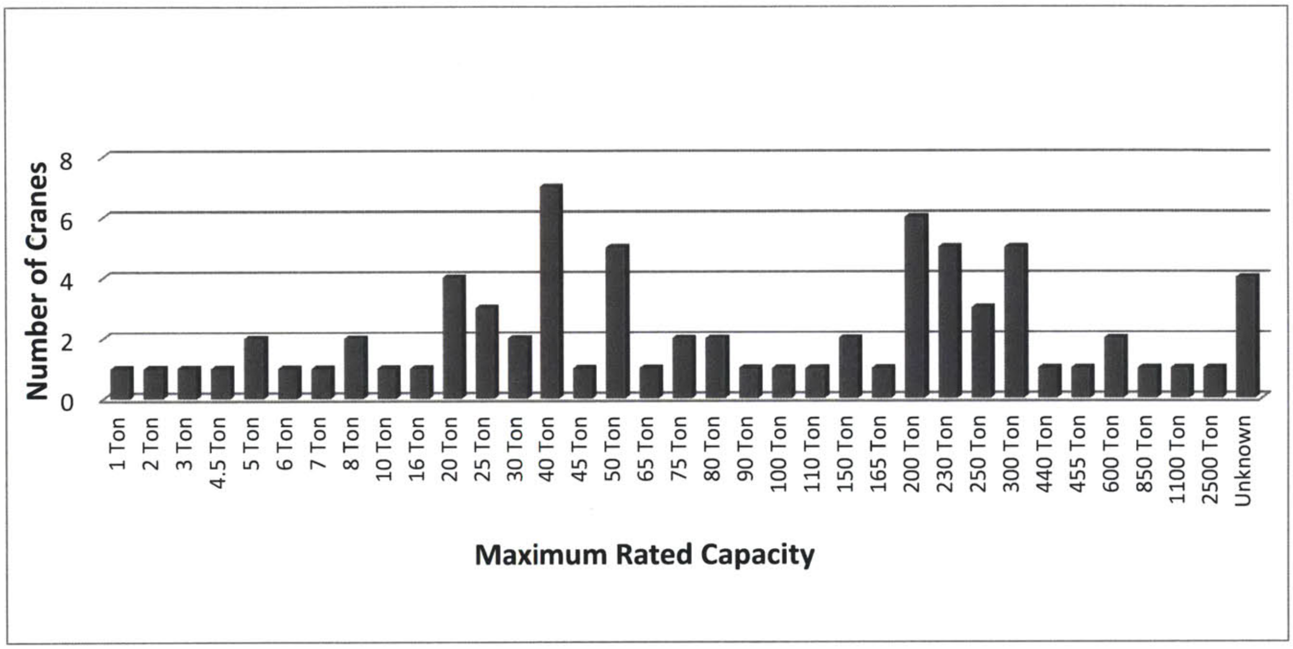

Figure 4.2: Cranes Sorted by Maximum Rated Capacity

There are two noticeable clusters of cranes. Twenty-two of the seventy-five cranes were rated within the range of 20 to 50 ton. Nineteen of the seventy-five cranes counted in the study were within the range of 200 to 300 ton. The two clusters are notably different in relative lifting scale. The first cluster appears to be the cranes commonly used in "lighter" lifting operations for general construction use, while the second cluster represents the most commonly used cranes in "heavier" lifting operations.

4.4 CONDITIONS, OUTCOMES, AND CAUSATIONS

The conditions, outcomes, and causations portion of the data sets represented the largest and most detailed area of information in this study. The primary categories will be reviewed below.

4.4.1 TYPE OF WORK

The "type of work" categories were intended to provide an insight into the nature of the work sites where crane accidents are most common. **Table 4.6** shows the five categories of work sites, and provides the percentage of the 75 case studies they represented. Work sites being used for commercial construction were the most common locations for crane accidents. Commercial construction sites were the location of 46.7% of the case studies reviewed in this study. Industrial (industrial, manufacturing plants, or refineries) work sites were the second most common location for crane-related incidents, comprising 33.3% of the case studies. Marine (port, barge, off-shore) work sites were the location of 10.7% of the accidents, and highway and residential rounded out the locations with 6.7% and 2.7% respectively.

Table 4.6: Work Site Type

Commercial	46.7%
Industrial	33.3%
Highway	6.7%
Residential	2.7%
Marine	10.7%

4.4.2 OPERATIONAL AIDS AND SAFETY DEVICES

Case studies were reviewed to determine whether the improper use or failure of an operational aid or safety device contributed to the accident in question. The engineering reports directly identified this problem in 12 out of 75 cases. **Table 4.7** identifies the operational aids and safety devices in question and details how they were deficient in the accident.

The most commonly cited device was the Load Moment Indicator (LMI) or equivalent device. In seven of the case studies, the LMI was either overridden, improperly set-up, or not used. The most common Safety Device cited was the Anti-Two Block Device (A2B) which prevents the operator from pulling the load line all the way to the sheave on the tip of the boom, keeping the load block from contacting the boom/sheave/upper block, which can create life-threatening forces in the hoist line. The A2B device was overridden or defective in 3 of the 75 case studies. The Lattice Boom Hoist Disconnect Device, or "boom kick out," was cited in one case study. The "boom kick out" sets a boom angle safety limit such that the device disengages the boom hoist power source to prevent the boom from passing the angle limit.

Table 4.7: Operational Aids & Safety Devices

Operational Aid & Safety Device	12 of 75	16.0%	
Operational Aid	**Count**	**Percentage of All Cases***	**Percentage of Category***
Load Moment Indicator(LMI)	7	9.3%	-
Boom Angle or Radius Indicator	0	0.0%	-
Boom Length Indicator	0	0.0%	-
Crane Level Indicator	0	0.0%	-
Drum Rotation Indicator	0	0.0%	-
Wind Speed Indicator	0	0.0%	-
Other Operational Aid	1	1.3%	-
-	4	Operational Aid Override	50.0%
-	3	Operational Aid Improper Set Up	37.5%
-	1	Operational Aid Not Used	12.5%
-	1	Operational Aid Not Present	12.5%
-	0	Malfunction	0.0%
Safety Device	**Count**	**Percentage of All Cases***	**Percentage of Category***
Anti-Two Block Device (A2B)	3	4.0%	-
Lattice Boom Hoist Disconnect Device (Boom Kick Out)	1	1.3%	-
Proximity Warning Device	0	0.0%	-
-	2	Safety Device Override	50.0%
-	0	Safety Device Not Used	0.0%
-	1	Safety Device Not Present	25.0%
-	1	Malfunction	25.0%

* Not Mutually Exclusive

4.4.3 PHYSICAL ISSUES

A "physical issue" was defined as "a physical component of the crane contributed to the accident." The definition of the category allows for a large number of physical factors to be included. In all, a "physical issue" was identified in 25 out of 75 cases. **Table 4.8** (continued on next page) shows the physical factors considered, identifying their presence as a percentage of all 75 cases, as well as a percentage of the 25 cases with a "physical issue." The factors are not mutually exclusive, and it was common for a case study to have multiple "physical issues."

The three most common issues were "structural issue," "mis-use," and "overload physical issue." Each of those three categories was identified in 8 cases studies (not necessarily the same 8 studies). The next most common "physical issue" was a "manufacturing design" error, which was present in 4 of the 75 cases. Six factors tied for the next most commonly identified issue, each being found in 3 of the 75 case studies.

Table 4.8: Physical Issues and Factors

Physical Issue	25 of 75		33.3%
Category	**Count**	**Percentage of All Cases***	**Percentage of Physical Issues***
Manufacturing Design	4	5.3%	16.0%
Fabrication/Manufacturer Assembly	0	0.0%	-
Structural Issue	8	10.7%	32.0%
Fatigue	1	1.3%	4.0%
Corrosion Structural Issue	3	4.0%	12.0%
Aging	3	4.0%	12.0%
Mis-Use	8	10.7%	32.0%
Overload Physical Issue	8	10.7%	32.0%
Physical Abuse	1	1.3%	4.0%

Table 4.8: Physical Issues and Factors (Continued)

Category	Count	Percentage of All Cases*	Percentage of Physical Issues*
Damage From Previous Use	3	4.0%	12.0%
Broken Cords	0	0.0%	-
Deflected Boom	0	0.0%	-
Broken Connection	0	0.0%	-
Other Previous Damage	3	4.0%	12.0%
Mechanical Failure of Component	3	4.0%	12.0%
Hydraulic Cylinder	3	4.0%	12.0%
Brakes	0	0.0%	-
Outriggers	1	1.3%	4.0%
Electrical System	0	0.0%	-
Engine	0	0.0%	-
Other Mechanical Component	2	2.7%	8.0%
Wire Rope	2	2.7%	8.0%
Load Line	1	1.3%	4.0%
Load Line Shock Load	0	0.0%	-
Load Line Corrosion	0	0.0%	-
Load Line Crushing	1	1.3%	4.0%
Load Line Excessive Wear	0	0.0%	-
Load Line Wrong Rope for Application	0	0.0%	-
Hoist Line	1	1.3%	4.0%
Hoist Line Shock Load	0	0.0%	-
Hoist Line Corrosion	0	0.0%	-
Hoist Line Crushing	0	0.0%	-
Hoist Line Excessive Wear	1	1.3%	4.0%
Hoist Line Wrong Rope For Application	0	0.0%	-
Other Physical Issue	0	0.0%	-

* Not Mutually Exclusive

4.4.4 CRANE STABILITY

Crane stability issues were one of the more common causes of crane accidents found in this study. Cranes experienced stability problems in 21 of the 75 case studies examined (28%). Stability problems in both mobile and tower cranes were considered. Overloading of the crane was the most common factor involved with crane stability, present in 10 of the 75 case studies (13.3%) or 47.6% of the 21 cases that experienced crane instability. Of those ten overload stability instances, operator error was cited in eight of them. The load was miscalculated in three of the overload scenarios, and the load chart was misread four times.

The next most frequent cause of crane instability was "operator set-up." Outrigger instability was cited 3 times (twice there was insufficient cribbing/matting, and once the outriggers were not extended). The wrong counterweights were utilized twice out of the 75 cases.

There were two instances of a tower crane experiencing instability. In both cases, the incident involved the tie-in bracing. During one of those occasions, the crane was in the process of climbing while the brace was improperly rigged. This caused a chain of events that resulted in the crane collapsing.

Table 4.9 (next page) shows all of the crane stability factors cited in the compiled data sets.

Table 4.9: Crane Stability Issues

Crane Stability Issue		21 of 75		28.0%	
Category	**Count**	**Percentage of All Cases***	**Percentage of Stability Issues***	**Percentage of Category***	**% of Sub-Category***
Soil (Mobile Crane Stability)	4	5.3%	19.0%	-	-
Loose Soil	1	1.3%	Loose Soil	25.0%	-
Prior Trench Excavation	0	0.0%	Prior Trench Excavation	0.0%	-
Outrigger Instability	3	4.0%	Outrigger Instability	75.0%	-
Improper Cribbing or Mats	2	2.7%	-	Improper Cribbing or Mats	66.7%
Outrigger Punches Through Hard Surface	0	0.0%	-	Outrigger Punches Through Hard Surface	0.0%
Outriggers Not Extended	1	1.3%	-	Outriggers Not Extended	33.3%
Outriggers Not Level	0	0.0%	-	Outriggers Not Level	0.0%
Foundation(Tower Crane Stability)	0	0.0%	0.0%	-	-
Tie Ins (Tower Crane)	2	2.7%	9.5%	-	-
Absence of Brace	0	0.0%	Absence of Brace	0.0%	-
Installation Error	1	1.3%	Installation Error	50.0%	-
Operator Set-Up	6	8.0%	28.6%	-	-
Overload Stability	10	13.3%	47.6%	-	-
Wrong Counterweights	2	2.7%	Wrong Counterweights	20.0%	-
Load Miscalculated	3	4.0%	Load Miscalculated	30.0%	-
Load Chart Misread	4	5.3%	Load Chart Misread	40.0%	-
Operator Error	8	10.7%	Operator Error	80.0%	-
Lost Load	1	1.3%	4.8%	-	-
Floating Foundation/Surface	0	0.0%	0.0%	-	-

* Not Mutually Exclusive

4.4.5 LOAD

The load itself (independent of rigging) cannot be disregarded as a major causative factor in lifting operations. The load was cited in 14 of 75, or 18.7% of cases as directly contributing to the incident. In 4 of those 14 cases, "load placement," or placing a load on framing or other platform that could not support the load caused an accident. Twice, the load simply fell apart, creating dangers for the personnel working around the crane. **Table 4.10** shows the frequency of load related incidents documented in the case studies.

Table 4.10: Load Related Issues

Load	14 of 75	18.7%
Load Issue	**Count**	**Percentage of Load Issues**
Placement	4	28.6%
Load Stability	4	28.6%
Load Falls Apart	2	14.3%
Other	4	28.6%

4.4.6 CRANE OPERATION

Analysis of the responsibilities of the various parties involved in crane lifts showed that crane operators were at least partially responsible in 42.7% of the cases.

4.4.7 RIGGING

Table 4.11 displays the frequency of various rigging issues. Rigging problems contributed to 15 out of 75 accidents (20.0%). Of these 15 incidents, the rigging physically failed 5 times (33.3% of rigging issues). Three of those failures involved slings (twice with synthetic slings and once with wire rope slings). On one occasion that the synthetic slings failed, riggers failed to use softeners, and a sharp edge of the load cut the slings. The other two rigging physical failures involved hooks.

Twice, the failure to use tag lines was cited as contributing to the crane accident. The most common rigging failure involved unbalanced loads. Eight of the fifteen rigging problems (53.3%) were the result of an unbalanced rigging configuration. Five times the rigging was not properly secured, allowing the load to become unbalanced in the process of the lift. On four occasions, the improper "pick points" were used, and the load was unbalanced from the start. Once, the center of gravity of the load was unknown and the workers failed to attach the rigging in the proper place (also resulting in an "improper pick points used citation).

Table 4.11: Rigging Problems

Rigging		15 of 75		20.0%	
Rigging Issue	**Count**	**% of all Cases***	**% of Rigging Issues***	**% of Sub-Category***	**% of Sub-Category**
Rigging Failure	5	6.7%	33.3%	-	-
Slings	3	4.0%	-	60.0%	-
Wire Slings	1	1.3%	-	-	33.3%
Synthetic Slings	2	2.7%	-	-	66.7%
Shackles	0	0.0%	-	0.0%	-
Hooks	2	2.7%	-	40.0%	-
Spreader Bars	0	0.0%	-	0.0%	-
Equalizers	0	0.0%	-	0.0%	-
No Softeners	1	1.3%	-	-	-
Tag Lines	2	2.7%	13.3%	-	-
No Tag Line	2	2.7%	-	100.0%	-
Tag Line Tangles	0	0.0%	-	0.0%	-
Not Balanced	8	10.7%	53.3%	-	-
CG is Unknown	1	1.3%	-	12.5%	-
Improper Pick Points Used	4	5.3%	-	50.0%	-
Rigging Not Secured	5	6.7%	-	62.5%	-
Wrong Type of Rigging Used	0	0.0%	0.0%	-	-

* Not Mutually Exclusive

4.4.8 CRANE TRAVEL

Crane travel was counted in 2 of the 75 case studies (2.7%). Both of these were cases when the crane was traveling on-site. In one case, the operator did not have the outriggers properly set for travel. In the other, the jerky movements of a crawler crane, combined with its near vertical boom configuration, contributed to a stability failure.

4.4.9 WEATHER

Of the four weather conditions considered, only one, wind, was mentioned as a causative factor in the forensic engineering reports. Wind was cited in 8 of the 75 cases (10.7%). While ice, fog, and lightning could potentially be troublesome for crane lifts, it appears they are not usually a factor in accidents. Weather results can be seen in **Table 4.12**.

Table 4.12: Weather Issues

Weather	8 of 75	10.7%
Weather Type	**Count**	**Percentage of Weather Incidents**
Wind	8	100%
Ice	0	0.0%
Fog	0	0.0%
Lightning	0	0.0%

4.4.10 LIFT PLANNING

Poor lift planning was frequently cited in the engineering reports as a causative factor in crane failures. Only "worker contact" was a more commonly identified category. **Table 4.13** shows that lift planning issues were noted in 32 of the 75 case studies (42.7%). Of the 32 cases that involved lift planning problems, 15 of them revolved around unresolved "site controls." Generic "plan issues" were identified in 15 cases as well. Often these problems were centered on changes that occurred during the lift and the plan was not updated. In five lifts, the wrong weight was used during lift planning.

Table 4.13: Lift Planning

Lift Planning	32 of 75		42.7%
Lift Planning Issue	**Count**	**Percentage of All Cases***	**Percentage of Lift Planning Issues***
Site Controls	15	20.0%	46.9%
Wrong Weight Planning	5	6.7%	15.6%
Plan Issues	15	20.0%	46.9%

*Not Mutually Exclusive

4.4.11 WRONG WEIGHT

Proceeding with the wrong weight can be extremely dangerous and occurred in 5 of the 75 case studies (6.7%). The "wrong weight" category is an extension of the "lift planning" category. **Table 4.14** shows that 80% of the time, the wrong weight was provided by either the site supervisor or the lift director. Only once, 20% of the "wrong weight" occurrences, did the operator himself miscalculate the load that he was about to lift.

Table 4.14: Wrong Weight

Wrong Weight	5 of 75		6.7%
Wrong Weight Issue	**Count**	**Percentage of All Cases***	**Percentage of Wrong Weight Issues***
Wrong Weight Provided	4	5.3%	80.0%
Operator Wrong Weight	1	1.3%	20.0%
Demolition	0	0.0%	0.0%

*Not Mutually Exclusive

4.4.12 WORKER CONTACT

The most frequently cited category in this study was "worker contact." Worker contact is particularly dangerous in lifting operations due to the size of the equipment and heft of the loads being moved. **Table 4.15** shows that workers were contacted by the crane, load, or wire rope in 35 out of the 75 cases (46.7%).

In 16 out of the 35 instances that a worker, or in some cases workers, were contacted, they were hit by part of the crane itself. Often workers were contacted by part of the crane as it crashed to the ground, while other times they were struck by the crane while it was moving. In another 12 instances, the load fell from (or with) the crane and struck a worker on its way to the ground. In six case studies, the load drifted while on the load line and struck a worker, often pinning them against another object or structure. In two cases, workers were snagged by a wire rope, severing limbs and resulting in fatalities both times.

Table 4.15: Worker Contact

Worker Contact	35 of 75		46.7%
Type of Worker Contact	**Count**	**Percentage of All Cases***	**Percentage of Worker Contact***
Load Falls	12	16.0%	34.3%
Hit By Part of Crane	16	21.3%	45.7%
Load Drifts	6	8.0%	17.1%
Snagged By Rope	2	2.7%	5.7%

*Not Mutually Exclusive

4.4.13 POWER LINE CONTACT

The final category analyzed in this study was crane contact with power lines. **Table 4.16** shows the results from the cases included. Only 2 of 75 (2.7%) involved a crane contacting a live power source. In both cases, the operator erred, moving the crane too close to the power lines, eventually contacting them and energizing the crane. In one of the cases, the site supervisor did not ensure that the lines were either powered down, or matted. In that case, the power line created fires on the crane that the operator and a rigger tried to extinguish, but they touched the crane while doing so and were both electrified. A second rigger was also injured in that accident. In the other case, the operator was operating the crane in an area where he should not have been and inadvertently backed into the power line. Only one case resulted in a fatality.

Table 4.16: Power Line Contact

Power Line Contact	2 of 75		2.7%
Type of Power Line Contact	**Count**	**Percentage of Power Line Contact***	**Percentage of Sub-Category***
Operator Caused Power Line Contact	2	100.0%	-
	2	Operator Caused Boom Contacts Power Line	100.0%
	0	Operator Caused Load Line Contacts Power Line	0.0%
Rigger Power Line Contact	1	50.0%	-
Site Supervisor Power Line Contact	1	50.0%	-
Radio Wave	0	0.0%	-

5. DISCUSSION OF RESULTS

The analysis of the responsible parties provides important insight into understanding the human error contribution to crane accidents. The operator, lift director, and site supervisor were the three most frequently cited parties. Typically, those are the primary parties involved in the lift planning. Considering that 42.7% of the examined case studies were categorized as having "lift planning" issues, it is apparent that many lifting operations were likely doomed before they even began due to human error in the pre-lift stages. The frequency of lift planning related accidents is evidence that further safety procedures should be put in place during the planning phase of a lift. Requiring multiple opinions and peer review of lift plans would be a solution for reducing the number of lifts attempted with poor planning. The majority of the lift planning issues arose during the actual lift. In each instance, rather than stopping the lift and evaluating the change in condition, the lift was continued, ultimately resulting in an accident.

The operator was cited in 32 of the 75 case studies as a responsible party, the most frequently cited party in the study. It should be noted that of those 32 cases, they were found primarily responsible in only 24. However, their high frequency of responsibility citations further emphasizes the need for operator certification and qualification.

Riggers were the fourth most commonly cited party in the study, found responsible in 28% of the cases. Rigger errors had the highest "primarily to secondarily responsible ratio," suggesting that their mistakes are often catastrophic when made. The relatively high frequency of their errors, combined with the tendency for those errors to be significantly important is evidence that riggers need to be carefully trained. Rigger certification should be promoted throughout the industry. Rigger certification requirements would ensure that the worker has demonstrated knowledge of the principles of safe rigging techniques. Programs offering both rigging and operating certification would be a way to increase safety standards in the industry and potentially reduce the cost of certification by streamlining the process.

At the time of this publication, NCCCO has implemented both Rigger Level I and Rigger Level II certification. Currently, Lift Director certification is under development which will require the candidate to demonstrate knowledge in crane operations, rigging, signaling, responsibilities, and lift planning and execution.

Also notable in the responsibilities analysis is the Owner/User. The owner/user/renter of the crane was found responsible in 13.3% of the case studies. Typically this was the result of a lack of maintenance of the crane or improper/lacking inspection or certification. Owners/users/renters of cranes must realize that these are precision pieces of equipment that must be carefully looked after. An owner's neglect of a crane can put many unsuspecting workers in harm's way.

Mobile cranes were involved in the majority of the crane accidents. This finding is not surprising due to the commonness of mobile cranes. However, it is worth noting that mobile cranes have a greater number of factors that can go wrong during a lift, especially when the lift involves crane travel. Workers, owners, and those responsible for risk management should be aware of the potential dangers associated with mobile cranes.

An analysis of the maximum rated capacity of the involved cranes shows that a high number of accidents, 25.3%, involved cranes with a relatively low rated capacity (1 to 25 tons). There may be a tendency for workers to become complacent or let their guard down during lifts involving these cranes due to a perception that a lighter lift is a safer lift. Historically, smaller cranes have been operated by less experienced operators or personnel with no operating experience. Cranes with a lifting capacity of 250+ tons accounted for 20% of the accidents in this study. Workers need to be educated that accidents frequently occur during smaller lifts, and that vigilant safety is necessary at all times during lifts of all sizes. In fact, evidence from this study would suggest that crane accidents frequently occur when there is no load being lifted at all. The largest crane in this study (2,500 ton rated capacity) collapsed while setting up auxiliary counterweights while there was no load on the line.

There has been speculation about whether an over-reliance on new technologies such as operational aids and safety devices has led to careless working practices involving cranes. (ENR 2008) To help provide insight into this question, the author identified case studies where these technologies played a role in the accident. The improper use or failure of an operational aid or safety device was identified in 12 out of 75 cases (16%).

Even though these devices occasionally provide a false sense of security, it seems likely that these devices provide benefits that more than make up for any potential lapse in operation practices. In fact, most accidents involving operational aids and safety devices were the result of an operator choosing not to use them. The best course of action is likely to provide operators with the knowledge that accidents still occur with these devices, and that they are only as helpful as the information that the operator provides them with. It should be stressed in training that these operational aids are not a substitute for safe working practices, careful planning, and a solid understanding of the crane manual and load charts. NCCCO and ASME have both stressed that operator experience and training supersedes the use of operational aids. That is, workers should use their experience and training to plan a lift, and not rely on the device to catch their mistakes.

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The goal of the "physical issue" analysis was to determine what physically goes wrong with cranes during accidents. Cranes experienced structural failures on a number of occasions (usually the boom). The structural failures were caused by overloading and/or maintenance neglect, further emphasizing the importance of proper operation and upkeep of the cranes. **Figure 5.1** shows an example of a structural boom collapse.

Figure 5.1: A collapsed lattice boom. Categorized as a "physical issue." (Haag Engineering Co.)

Manufacturing design errors were fairly uncommon, occurring only 4 times out of 75 (5.3%). It appears that the bulk of physical factors leading to crane accidents originate over time. Mechanical components such as hydraulic cylinders and brakes were contributors to a number of accidents. In those cases, the localized failure of a small component started a chain of events that resulted in a much larger failure. Inspection and certification practices must be thorough, regular, and consistent with industry practices to avoid accidents caused by neglected components.

Stability failures were found to be far more common in this study than in previous statistical data. **Figure 5.2** shows the aftermath of a stability failure of a mobile crawler crane. These failures are particularly dangerous because they have a high tendency to result in the most commonly identified category in this study, "worker contact". Having the wrong information about the load weight and mis-reading the load chart were trends in this category. Ground conditions and outrigger set-up contributed to other stability failures. Again, these issues should have always have been addressed before the lift ever took place. Construction is a field of work that is often under intense pressure to meet time deadlines. Lifting operations cannot be allowed to be rushed. The safety hazards associated with incomplete planning and careless set-up are far too great. OSHA has implemented repercussions that punish supervisors who compromise crane safety in an attempt to save time. Generic lift plans even for small lifts have proven to be extremely helpful. A "check list" of items is used most often to remind the operator of all potential issues, avoiding burdening them with paperwork.

Figure 5.2: Stability failure of a mobile lattice crawler crane. (Haag Engineering Co.)

Crane overloading was responsible for 24% of all the case studies, sometimes resulting in physical failures, while causing stability failures in other cases. Overloading is a preventable scenario that is nearly always caused by human error.

Loads can range drastically in nature. Some loads are massive structures, while others can be small and delicate. The load itself was found in this study to have caused accidents in 14 cases. **Figure 5.3** shows a load-related accident in which a tilt-up wall fell on a crane during the erection process. In some cases, the load fell apart in the process of the lift, creating dangers for workers below. Placing the load on an object or structure that could not support the added weight of the load occurred four times. Once again, this can be narrowed down to a lack of proper preparation and planning.

Figure 5.3: Tilt-up wall falls on crane during erection. (Haag Engineering Co.)

Riggers should understand the concepts of center of gravity and recognize when pick points are inappropriate. A sudden shift in weight of the load can result in shock loading, snapping wire ropes or causing the crane to lose stability.

Rigging troubles occurred in 20% of the 75 incidents. As noted by the analysis of responsibilities, when they occur, rigging lapses are very often a primary cause of an accident. The most frequent rigging error was an unbalanced load. Again this is a human error and should be completely avoidable. Many times the rigging was simply not secured properly. On two occasions, accidents occurred when there was no tag line used, ignoring industry standard practices. Workers acting as the rigger need to have a mastery of rigging techniques and should always adhere to the accepted safety standards.

There were a number of accidents when riggers placed themselves in a direct path of danger. Riggers need to be trained to identify dangerous scenarios and know how to avoid them. The relatively high frequency of rigging and rigger mistakes, combined with the tendency of these errors to have serious consequences, suggests that rigging training and certification is almost as important as operator training and certification.

Worker contact was the most frequently identified category in this study, occurring in 46.7% of all the cases. The frequency of these accidents is alarming due to their nature of causing human harm. Every worker contact occurrence in this study resulted in injury or fatality. Often multiple workers were contacted in a single accident. During crane operations, workers can frequently be placed in extremely dangerous locations. To reduce the frequency of these dangerous scenarios, the number of individuals working near cranes should be minimized whenever possible. As part of the ASME B30.5 responsibilities section, the lift director is responsible for locating all personnel prior to the initiation of a lift. The lift director is the first line of defense against worker contact accidents. A common cause of worker contact was "load drifts." Inherently loads will tend to drift when first lifted due to the dynamic nature of lifting operations. Lift directors must address this issue and make sure that workers are not contacted from an initial load drift.

The percentage of electrical contact is much lower in this study than in the statistics put together from OSHA fatality reports. Only 2 of the 75 case studies involved power line contact. The study by Beavers (2006) found that 27% of all crane related deaths were caused by electrocution. The large disparity between this study and those based on the OSHA fatality records may be due to a number of reasons. One possible reason for the difference may be that the action of contacting a power line has a high percentage of fatalities, especially in comparison to other types of crane accidents. A higher death percentage would increase the percentage of power line contact crane accidents reported by OSHA in comparison to other types of accidents, leading to an over-reporting of power line contact incidents.

The source data of the two studies may provide an explanation for the disparity as well. This study was based off of in-depth forensic investigations. A detailed investigation is typically expensive and may not be pursued if the cause of the accident is readily apparent. Power line contact accidents are typically very obvious to identify, and it may simply follow that fewer of these types of accidents require forensic assistance, leading to an underreporting of power line contact in this study's source data.

It also remains possible that in the time since previous studies [(Suruda 1999), (Shepard 2000), (Beavers 2006)] were published, power line contact awareness has increased, leading to fewer such accidents. Regardless of the frequency of electrical related accidents, it remains true that these types of incidents are extremely dangerous and strict precautions should be made to avoid their occurrence. Site supervisors must take steps to disable, or at a minimum, insulate power lines located anywhere near the vicinity of a planned lift. Crane operators and spotters must also ensure that the crane does not encroach on the designated safety radius distance around the power line.

6. CONCLUSIONS

The large number of categories considered in this study provided a diverse range of data output. The results lend information about the nature of modern day crane accidents and can be used to strengthen crane safety programs and improve industry standards.

Based off of the study results, the author has made the following general observations and recommendations:

- The Operator, Lift Director, Site Supervisor, and Rigger are the four most crucial parties in preventing crane accidents.
- Comprehensive and consistent operator training is essential and should be a requirement. Operator certification should also be a requirement.
- Rigger training and certification is nearly as important as operator training and certification. Rigger errors are usually unforgiving.
- Lift planning is crucial. A large number of accidents could have been avoided if proper pre-lift precautions and plans had been made.
- A quarter of the involved cranes had a maximum rated capacity of 25 tons or less. Workers cannot get lulled into a false sense of safety because the crane is relatively small.
- Most accidents involved more than one responsible party and had multiple factors. Crane safety must be a coordinated effort.

The conclusions above attempt to address the broad topic of crane safety in general. The "Discussion of Results" chapter analyzed some of the more specific information that can be extracted from this study's results. This study was meant to aid organizations such as ASME and OSHA in their efforts to produce more detailed written guidelines for crane and rigging safety. It is the author's hope, that by increasing the scope and detail of available statistical data available on crane accidents, safety guidelines can be more focused on the common causes of crane accidents. Employers who use cranes can also benefit from this study by using the results to form better crane safety and training programs.

National safety standards are an important part in moving forward in the industry. This study supports the idea that a uniform certification process would be of great benefit to the industry. The OSHA 1926.1400 law on operator certification that goes into effect in 2014 will help clear up a patchwork of ordinances across the country. Certification acts as a check on in-house training which can be incomplete or inconsistent. The results of the "responsibilities" analysis of this study suggest that national crane operator and rigging certification requirements will help reduce the number of crane accidents.

6.1 LIMITATIONS OF RESULTS

The forensic investigations of the crane accidents were all conducted by individuals other than the author. The conclusions in this report rely on the expertise and reports of persons other than the author. There is a possibility that other individuals could interpret the source data differently and arrive at different results.

There was a limited amount of peer review in this study. Some case files included a number of industry expert opinions that arrived at the same conclusions. Other case files relied solely on the opinion of one or two engineers.

The assignment of "primary" and "secondary" to the responsible parties may be interpreted as subjective by some. While great care was taken to identify whether the experts believed a party was primarily or secondarily responsible, this classification probably cannot be stated as an indisputable fact.

The number of cases in this study was limited to 75 in an effort to use complete data profiles that had a highly consistent set of information. A larger data sample would provide more reliable statistical outputs.

The number of injured workers and/or fatalities was not always available. Because of the limited information on casualties, this study does not categorize the human loss associated with these case accidents.

"Worker contact" did not include bystanders. Additionally, the engineering reports used in the source data did not always address whether there were any workers contacted during collapses. The likelihood of an underreporting of human contact in this study seems high.

6.2 AREAS OF FURTHER RESEARCH

In the future, this study can be expanded in size to include more case files that span a greater number of years. An increase in sample size will improve the reliability of the statistical outputs. A greater range of years would create the opportunity to track patterns in crane accidents over a span of decades. Patterns in crane accident frequencies could be cross-checked with the implementation of new industry safety standards and publications.

Further research and analysis would allow the author to identify more correlations between categories. One such correlation would be tracking the frequency that accidents occur while there is no load on the crane hook.

A study of the economic impact of each crane accident would provide a quantitative benchmark of the overall severity of each accident. This information could potentially be used to identify the most severe factors in crane accidents. An economic impact study could also provide information on the associated risks of different types of cranes and lifting operations.

Second opinions on the causes of the accidents, and a peer review of the source data would add further credibility to the results of this study. Further investigation into individual cases could allow the author to arrive at his own opinions about the cases. A "degree of confidence" could then be added to each case included in the study.

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Appendix A

Case Study Details

Source Consulted For Appendix A:

Jim Wiethorn, P.E., Haag Engineering Co. and Matthew Gardiner, P.E., Haag Engineering

#	1
Date of Incident:	10/30/2010
Location:	
City	La Porte
State	Texas
Country	USA
Crane:	
Manufacturer	Liebherr
Model	LTM 1160/2
Capacity	200 ton
Type	Hydraulic Truck
Attachments:	Man Basket
Alterations/Modifications:	
(Y/N)	N

	#	1	2010	
	Description	The crane had finished a test-lift for a suspended man basket that attaches to the crane's main hoist hook. Sometime after the test-lift was completed and the man basket was resting on the ground, the counterweight assembly at the rear of the upper works fell from the crane. The counterweight locking device was not functioning properly due to poor maintenance at the time of the operation. The counterweights were not secured, resulting in them falling from the crane.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator tried to secure the counterweight assembly without a properly working counterweight locking/unlocking indicator system.		**X**
	Service Provider			
	Owner/User	The crane owner did not properly maintain the counterweight locking/unlocking indicator system.	**X**	
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance	The cam and position sensor assembly, which provides feedback to the operator through a dash that lights up red when the cylinders are in transition between the locked and unlocked position, was not properly maintained by owner.		
	Mis-Use			

#	2
Date of Incident:	9/26/2010
Location:	
City	Myrtle Grove
State	Louisiana
Country	USA
Crane:	
Manufacturer	IHI
Model	Conveyor Ship Loader
Capacity	
Type	Custom
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**2**	2010	
	Description	A large conveyor ship loader collapsed during operation. Failure resulted from buckling collapse of the two bottom, horizontal wide flange beams attached to the forward end of the truss at the swing assembly. Severe long-term corrosion was present throughout the structure which had substantially reduced its functional integrity prior to the time of failure.	**Primary**	**Secondary**
	Site Supervisor	The proper maintenance measures were not taken		**X**
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User	Owner failed to properly maintain the equipment and knew that the crane system had deteriorated.	**X**	
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
PHYSICAL	**Manufacturer**			
	Maintenance	Significant corrosion was present throughout the crane structure.		
	Mis-Use	Crane should not have been operated in its condition.		

#	3
Date of Incident:	7/3/2010
Location:	
City	Tehachapi
State	California
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	777T
Capacity	200 tons
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	3	2010	
	Description	"The crane operator began hoisting a tower to a height to clear a component centered in the foundation. The wind velocity increased significantly pushing the load outward away from the crane when the tower neared the rear left outrigger. The installation crew tried to steady the load with the taglines, and the operator tried to lower the tower by operating load line downward. The crane started to tip-over towards its left side, and reportedly, the work crew heard several loud popping noises coming from the crane. As the boom and tower were descending towards the ground, the crane tipped-over onto its left side. The boom and tower fell to the ground in line with each on the left side of the crane."	**Primary**	**Secondary**
	Site Supervisor	"Site Supervisor/Lift Director did not fulfill his responsibilities by ensuring that conditions adversely affecting crane operations were addressed appropriately. The lift plan should have not gone above 90 percent of the load chart to account for the wind, wind pattern, and wind direction for this crane lift."		X
	Lift Director			X
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other	Wind was a major contributing factor that caused the crane to overturn.	X	
DETAILS				
PHYSICAL	**Manufacturer**			
PHYSICAL	**Maintenance**	The carrier frame had many existing repairs and cracks present, resulting in the frame having a reduced capacity to resist the overturning moment. This reduced capacity to resist the overturning moment contributed to the incident by increasing the stresses on the outrigger/carrier frame weldment to the point of failure.		
PHYSICAL	**Mis-Use**			
WIND	**Wind**	Wind was a major contributing factor that caused the crane to overturn.		

#	4
Date of Incident:	3/27/2010
Location:	
City	New York City
State	New York
Country	USA
Crane:	
Manufacturer	Liebherr
Model	LTM 1500
Capacity	600 ton
Type	All Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	4	2010	
	Description	Prior to shutting down the crane, the crane operator retracted the boom to 155-foot length, raised the boom to its highest angle of 83 degrees, positioned the crane over a building, and locked the swing drive. Later, the boom lowered to approximately 54 degrees causing the jib to impact the building. A mechanical failure of the crane during normal operation caused the accident.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer	The root cause for the boom lowering downward was due to a mechanical problem within the boom luffing cylinders.	X	
	Other			

DETAILS

PHYSICAL	**Manufacturer**	"The piston skewed toward one side of the cylinder (outboard side) when extended to full length, compressing the seals on the outboard side of the cylinder resulting in deformation of the piston seal over time, as well as cyclic loading and inevitably premature failure of the piston seals. It is our further opinion that the small differential pressure at full luffing cylinder extension allowed the pressures to oppose each other at the barrel side seal (primary piston seal) and contributed to the luffing cylinder drift."
	Maintenance	
	Mis-Use	

#	5
Date of Incident:	3/13/2010
Location:	
City	Atlantic City
State	New Jersey
Country	USA
Crane:	
Manufacturer	Potain
Model	MD 485B
Capacity	40 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**5**	2010	
	Description	Occurred during a microburst storm. The tower crane jib was ripped off of the tower during a wind gust. The falling jib also damaged the tower on its way down. The site was unoccupied at the time.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other	Wind was a primary cause of the accident	**X**	
		DETAILS		
WIND	**Wind**	Wind ripped the jib off the tower crane.		

#	6
Date of Incident:	11/2/2009
Location:	
City	Piscataway
State	New Jersey
Country	USA
Crane:	
Manufacturer	Grove
Model	RT650E
Capacity	50 ton
Type	Rough Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**6**	2009	
	Description	While removing a sheet piling, the boom of the crane bent. The operator overloaded the crane and did not follow standard practice of using the shortest possible boom extension length.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator overloaded the crane and did not follow standard practice of using the shortest possible boom extension length.	X	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
PHYSICAL	**Maintenance**			
PHYSICAL	**Mis-Use**	The operator overloaded the crane and did not follow standard practice of using the shortest possible boom extension length.		

#	7
Date of Incident:	9/21/2009
Location:	
City	Cohocton
State	New York
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	16000
Capacity	440 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**7**	2009	
	Description	After completing maintenance work on a wind turbine, the crane was lowering the boom to begin disassembly. While lowering the boom, the crane tipped over the front end of the crawler tracks.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Allowed the crane to be operated outside manufacturer charts, resulting in overloading	**X**	
	Rigger			
	Operator	Same person as lift director. Operated the crane outside the manufacturer load chart and range diagram. Did not listen to the oiler while he was instructing him to lower the load block to the ground.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The crane was overloaded and tipped.		

#	8
Date of Incident:	7/9/2009
Location:	
City	Carlsbad
State	New Mexico
Country	USA
Crane:	
Manufacturer	Link Belt
Model	HC-248H
Capacity	200 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**8**	2009	
	Description	A crane was hoisting this wheel loader from a tank at the time of the crane tip over. The crane operator raised the wheel loader from within the tank to a height clearing the side of the tank, and then the operator swung the boom from the front of the carrier to the right, going over the right front outrigger. The crane began to tip over as the boom swung past the right front outrigger.	**Primary**	**Secondary**
	Site Supervisor	Had responsibility to maintain the equipment.		**X**
	Lift Director			
	Rigger			
	Operator			
	Service Provider	Did not properly maintain the oil in the crane.	**X**	
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
PHYSICAL	**Manufacturer**			
	Maintenance	The oil in the outriggers was contaminated and not changed frequently. This caused an outrigger to not perform properly.		
	Mis-Use	The right front outrigger jack rod failed because the operator continued rotating the crane to the right, increasing the load transferred to the right rear outrigger jack. Pressure loss in the outrigger hydraulics caused the right rear outrigger to retract. This exposed the right front jack rod to multiple directional forces exceeding its structural capacities, causing the outrigger to break.		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The actual load of 32,600 pounds was 1,800 pounds more than the allowable load. The load of 32,600 pounds did not exceed the actual static tipping load of 39,765 pounds.		

#	9
Date of Incident:	6/11/2009
Location:	
City	Palm Harbor
State	Florida
Country	USA
Crane:	
Manufacturer	Terex
Model	T340
Capacity	40 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**9**	2009	
	Description	While attempting to lift the mass of a fork lift, the hydraulic crane exceeded its capacity and was pulled over. The operator was trying to pivot the mast down, and as the mast pivoted, the boom radius increased.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The crane operator was acting as lift director.		**X**
	Rigger			
	Operator	Operator did not setup properly. Operator did not account for the increase in radius as the mast was lowered in his load calculations. Operator did not place the crane to the rear of the fork lift, which would have allowed the lowering of the mast to stay within the crane's load chart capacities. The operator also did not attach the load lines at an appropriate location.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator	The operator made several errors.		
	Overload/Tipping	The load exceeded the crane capacity as it was moved to a larger radius.		

#	10
Date of Incident:	4/16/2009
Location:	
City	Reserve
State	Louisiana
Country	USA
Crane:	
Manufacturer	Caterpillar
Model	TL943
Capacity	4.5 tons
Type	Telehandler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**10**	2009	
	Description	During the process of using the telehandler, the boom was damaged. The evidence of boom damage supports an overload on the middle boom section of the telehandler. A load likely shifted onto the forks of the telehandler or the boom bounced while carrying the load.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator loaded the telehandler beyond its limits and probably introduced dynamic loads during operation.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance			
	Mis-Use	The operator loaded the telehandler beyond its limits which caused the boom to break.		

#	11
Date of Incident:	2/9/2009
Location:	
City	Marshall
State	Texas
Country	USA
Crane:	
Manufacturer	Krupp
Model	KMK 4080
Capacity	80 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**11**	2009	
	Description	The crane was in the process of moving a coiled tubing injector from the drill site. The crane tipped over the rear during a lift. This occurred as a direct result of the dynamic load applied by the load.	**Primary**	**Secondary**
	Site Supervisor	Site supervisor failed to place the crane in a safe location consistent with previous lifts	**X**	
	Lift Director	The lift director had superior knowledge concerning the dynamic loading that the coiling injector would place on the crane but did not discuss the effects with the operator or bring it up during the lift meeting.	**X**	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The crane tipped over as a result of a dynamic load.		

#	12
Date of Incident:	11/10/2008
Location:	
City	Chicago Heights
State	Illinois
Country	USA
Crane:	
Manufacturer	Northern Engineering Works
Model	Overhead Gantry
Capacity	5 ton
Type	Overhead Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	12	2008	
	Description	While operating an overhead gantry crane in a factory, the operator two-blocked the crane while he was walking under the crane. He was repositioning the crane for a pick. The operator was killed when the load fell on him. The upper limit switch did not function properly. The operator reportedly noticed the load block travelled through the upper limit about a week before the accident, but did not inform his supervisor or mechanic.	**Primary**	**Secondary**
	Site Supervisor	The crane operator was the supervisor.	**X**	
	Lift Director			
	Rigger			
	Operator	Operator had grown accustomed to using the A2B as a stop. The A2B failed to function once in previous week and time of incident. Operator was walking under load.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
OPERATIONAL AIDS	**Disconnected**			
	Setup			
	Off	A2B did not function properly. Previous malfunction not reported by operator.		
WORKER CONTACT	**Load Fall**	Operator was walking under the load when it two-blocked.		
	Crane			
	Load Drift			
	Maintenance			

#	13
Date of Incident:	9/19/2008
Location:	
City	Cherry Hill
State	New Jersey
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	2250
Capacity	300 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	13	2008	
	Description	The incident occurred while workers were in the process of dismantling a lattice boom crawler crane. A boom section had been dismantled and placed onto a trailer in order to be hauled offsite. After the boom section was lowered to the trailer by the assist crane, a ladder was placed for a rigger to access the lifting lugs to disconnect the chain hooks from the boom section. The rigger climbed the ladder, disconnected the chains, and then climbed onto the top of the boom. He then walked the lacing to the opposite side of the boom in order to access the two remaining lugs/chain hooks. Once he reached the opposite side of the boom, he fell to the ground.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	The rigger chose to not use the ladder and instead walk across the boom. His decision led to an unsafe condition that resulting in his fall.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
CRANE CONFIGURATION	**Change Configuration**			
	Erection			
	Dismantling	A worker was injured while dismantling a crane.		

#	14
Date of Incident:	9/8/2008
Location:	
City	Vail
State	Colorado
Country	USA
Crane:	
Manufacturer	Tadano
Model	ATF 220G-5
Capacity	250 ton
Type	All Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**14**	2008	
	Description	The involved incident occurred while workers were adjusting the alignment of a precast concrete wall panel. The upper wire rope sling eye was rotated such that it was resting on top of the rolling block's swivel hook latch. The operator tried to lift the whip line and rolling block when the block fell off the top of the wall. The block fell to the ground and injured a worker.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The incident occurred due to failure on the part of the lift director and signal person to maintain visual contact with the rigging and allowing the block to be positioned on top of the panel during the setting process.	**X**	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The incident occurred due to failure on the part of the lift director and signal person to maintain visual contact with the rigging and allowing the block to be positioned on top of the panel during the setting process.	**X**	
	Manufacturer			
	Other			
DETAILS				
WORKER CONTACT	**Load Fall**			
	Crane	The worker was contacted by the block.		
	Load Drift			
	Maintenance			

#	23
Date of Incident:	5/31/2008
Location:	
City	Las Vegas
State	Nevada
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	2250
Capacity	300 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	15	**15**	Primary	Secondary
	Description	While lifting, a hydraulic crane tipped over. The weight of the load was underestimated, resulting in overloading of the crane. The crane would not have tipped had the load been as expressed and documented by the supervising authorities. Failure on the part of the site supervisor to know the actual weight of their pumps even after multiple lifts over the years was the primary precipitating factor for crane tipping.		
	Site Supervisor	Did not know or specify the correct weight of the load, resulting in overloading of the crane	X	
	Lift Director	Same party as the site supervisor. Did not know weight of load.	X	
	Rigger			
	Operator	Continued with lift despite SLI warning.		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The load was much greater than the amount provided to the operator.		

#	16
Date of Incident:	8/23/2008
Location:	
City	Mobile
State	Alabama
Country	USA
Crane:	
Manufacturer	Link Belt
Model	HC 258
Capacity	200 ton
Type	Lattice Rubber Tire
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**16**	2008	
	Description	A crane was unloading on a dock. The crane collapsed when the load inadvertently landed on obstructions that crushed on the deck. The boom collapsed due to a sudden dynamic load applied to the boom, which caused lateral buckling as it was side-loaded beyond its capacity. The operator was working in the blind.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The lift director was responsible for removing the obstructions from below the load in preparation for its landing and positioning. Failure to remove and allowing the load to be landed on the barrels by the Lift Director was the primary cause of the impending accident.	**X**	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	Allowed the load to be set on unstable drum.		**X**
	Manufacturer			
	Other			

DETAILS

SIGNALS	**Signal Person**	The signal person allowed the load to be set on a drum.

#	17
Date of Incident:	8/6/2008
Location:	
City	Concordia
State	Kansas
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	888 Series II
Capacity	230 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**17**	2008	
	Description	Incident occurred when lifting a 129,000 pound wind turbine tower section. The load weight exceeded the tipping capacity of the crane at the operating radius, resulting in a tip-over. Soil bearing calculations were not done. Actual soil bearing was twice the soil capacity, and no crane mats were used. Since the crane was significantly overloaded, the LMI was either improperly set up, or was overridden.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Lift plan called for lift to take place at 95% of capacity, but then did not verify load radius in the field. Lift plan also did not call for use of crane mats.	X	
	Rigger			
	Operator	Operator did not keep load within allowable radius, and the crane consequently overloaded	X	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

STABILITY	**Soil**	
	Foundation	
	Operator	
	Overload/Tipping	Crane track bearing exceeded capacity of supporting soils (by 100%) and load was extended beyond allowable radius
LIFT PLANS	**Site Control**	
	Wrong Weight	
	Plan Issues	Inadequate support conditions planned for, and load radius was not verified.
	Operator	
	Weather	

#	18
Date of Incident:	7/30/2008
Location:	
City	Smithville
State	Texas
Country	USA
Crane:	
Manufacturer	Grove
Model	GMK 6200
Capacity	300 ton
Type	All Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**18**	2008	
	Description	Two cranes were assisting with the demolition of a bridge. One crane was used to remove bracing while another crane was used to stabilize one of two 140-foot long deep girders. The second girder was not stabilized during demolition. Once the final k-brace was removed, the unsupported girder rotated, causing the second girder to fall off the bent, pulling the second crane into the water. When the unsupported girder fell, it impacted a man lift, forcing it to the ground, seriously injuring one worker and killing another. The collapsed crane was not operating at the time of the incident.	**Primary**	**Secondary**
	Site Supervisor	Demolition plan did not account for stability of the bridge girder during demolition	**X**	
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	Sudden impact from falling beam.		
LIFT PLANS	**Site Control**			
	Wrong Weight			
	Plan Issues	In planning the critical lift, the demolition company did not determine a method to demo girders while maintaining girder stability.		
	Operator			
	Weather			
WORKER CONTACT	**Load Fall**	Beam knocked off pier which hit man lift and injured workers.		
	Crane			
	Load Drift			
	Maintenance			

#	19
Date of Incident:	7/24/2008
Location:	
City	Oklahoma City
State	Oklahoma
Country	USA
Crane:	
Manufacturer	Grove
Model	TMS900E
Capacity	90 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**19**	2008	
	Description	A truck crane tipped over while lifting a steeple onto the roof a church. The boom fell and killed a person who was in his car. The operator misread the crane's load chart, miscalculated the load, entering the wrong information into the LMI. These actions meant the crane was operated outside of its tipping design limit. Because the wrong information was in the LMI, it prevented the computer from warning the operator or engaging a fail-safe stop.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Made several errors in load calculation and crane set-up.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

STABILITY	**Soil**	
	Foundation	
	Operator	
	Overload/Tipping	The wrong weight information was used, causing the crane to be overloaded.
WORKER CONTACT	**Load Fall**	
	Crane	A bystander was struck by the falling crane.
	Load Drift	
	Maintenance	
WRONG WEIGHT	**Provided**	
	Operator	The operator used the wrong weight.
	Demolition	

#	20
Date of Incident:	7/18/2008
Location:	
City	Houston
State	Texas
Country	USA
Crane:	
Manufacturer	DSCR
Model	VersaCrane TC-36000
Capacity	2,500 ton
Type	Custom Mega Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**20**	2008	
	Description	This crane is considered a mega crane. The crane was not lifting a load at the time of the incident. The crane setup was being modified for auxiliary counterweights at a refinery. The manufacturer's minimum radius (with no load on the hook) was not adhered to, and the boom tipped over backward. The crane operator used the mast to reduce the radius and attach the auxiliary counterweights. Because the weight of the equipment between the boom and mast was sufficient to cause backward instability with no load on the hook, a minimum radius was required. The radius was below the manufacturer's minimum allowable radius, and the weight of the ropes and blocks pulled the boom backwards.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Operator did not follow manufacturer's minimum radius requirement for unloaded crane	X	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
CRANE OPERATIO	**Stuck Load**			
	Improper Setup			
	Manual Violation	Operator did not follow manufacturer's minimum radius requirement for unloaded crane.		
LIFT PLANS	**Site Control**			
	Wrong Weight			
	Plan Issues			
	Operator	Operator did not follow manufacturer's minimum radius requirement for unloaded crane.		
	Weather			
CRANE CONFIGUR-	**Change Configuration**			
	Erection	Manufacturer's minimum allowable radius was violated while attempting to attach auxiliary counterweights.		
	Dismantling			
WORKER CONTACT	**Load Fall**			
	Crane	Several workers were struck by the falling crane.		
	Load Drift			
	Maintenance			

#	21
Date of Incident:	6/11/2008
Location:	
City	Dallas
State	Texas
Country	USA
Crane:	
Manufacturer	Sun Tower Cranes
Model	STT553
Capacity	25 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	21	2008	
	Description	A Chinese tower crane, manufactured by Sun, was being used to hoist concrete buckets during construction of a new commercial building. The manufacturer says that, if raising the block in high gear, you can go through the upper limit but you have to use the emergency stop to stop the block. The operator was not paying attention while hoisting the load block. The operator was hoisting an empty load block in high gear. The load block came through the upper limits and two-blocked. The load line severed, and the block fell, killing a concrete truck driver below.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Operator hoisted load block through the upper limit switch	X	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer	Manufacturer's upper limit switch allows for load block to travel through limit when in high gear		X
	Other			
DETAILS				
PHYSICAL	**Manufacturer**	The manufacturer installed a system that gives a false sense of security. Upper limit switches should be designed to not permit travel above the limit. This manufacturing defect allowed a two-block condition.		
	Maintenance			
	Structural			
	Mis-Use	Crane operator ran block through upper limit switch		
WORKER CONTACT	**Load Fall**	Load fell, striking and fatally wounding the worker.		
	Crane			
	Load Drift			
	Maintenance			

#	22
Date of Incident:	6/4/2008
Location:	
City	Baytown
State	Texas
Country	USA
Crane:	
Manufacturer	Terex
Model	T-500-1
Capacity	65 ton
Type	Mobile Hydraulic
Attachments:	Rooster
Alterations/Modifications:	
(Y/N)	N

	#	**22**	2008	
	Description	The crane was lifting a 50-ton load from a truck bed. The operator overrode the LMI and forgot to attach a 7,500 pound counterweight. During the lift, the crane tipped over on its side.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator was apparently in a hurry and his actions directly led to the overturning of the crane.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance			
	Mis-Use	The LMI was overridden.		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The crane was overloaded and tipped.		
CRANE CONFIGURATION	**Change Configuration**	The operator forgot to attach the necessary counterweight.		
	Erection			
	Dismantling			

#	23
Date of Incident:	5/31/2008
Location:	
City	Las Vegas
State	Nevada
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	2250
Capacity	300 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**23**	2008	
	Description	The lattice boom crawler crane was one of three cranes being used to “shake out” steel in the lay-down area at the direction of the ground ironworking crew. An oiler was performing his duties and working around the crane while it was in operation when he became trapped between the counterweights and track as the upperworks rotated.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The lift director must make sure all personnel are clear of the swing path of the counterweights prior to allowing the crane to operate	X	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The signal person should immediately tell the operator to stop if somebody is in the path of the crane or load.	X	
	Manufacturer			
	Other	The oiler worker should have realized he was in harm's way and either not have been there or have told the operator to stop before he moved to where he was located.		X
DETAILS				
SIGNALS	**Signal Person**	The signal person should immediately tell the operator to stop if somebody is in the path of the crane or load.		
WORKER CONTACT	**Load Fall**			
	Crane	The worker was trapped by the crane.		
	Load Drift			
	Maintenance			

#	24
Date of Incident:	5/31/2008
Location:	
City	Wright
State	Wyoming
Country	USA
Crane:	
Manufacturer	Lampson
Model	Transi-Lift LTL-1100
Capacity	1100 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	24	2008	
	Description	This crane is considered a mega crane. The crane was lifting a 496,000 pound conveyor at a coal mine. Substantial amounts of rain occurred in the weeks prior to the lift. The tip/load block was reeved asymmetrically. Tuggers (small winches) were used to control load movements. During the lift, the jib became side-loaded, buckled, and collapsed, resulting in multiple serious injuries. The precise cause (or combination of causes) of the incident was unable to be determined without further analysis. However, all of the remaining possible causes were attributable to the same entity - the lift director and operator of the crane.	Primary	Secondary
	Site Supervisor			
	Lift Director	Site conditions (rain and wind) likely contributed to the cause of the collapse.	X	
	Rigger			
	Operator			
	Service Provider			
	Owner/User	Improper reeving and use of tuggers also likely contributed to the cause of the collapse.	X	
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	Soil	Some minor soil movement occurred, but was not significant enough to have caused the collapse by itself.		
STABILITY	Foundation			
STABILITY	Operator			
STABILITY	Overload/Tipping			
CRANE OPERATIONS	Stuck Load			
CRANE OPERATIONS	Improper Setup	The tip/load block was asymmetrically reeved, which was not accounted for in the original design of the equipment. The reeving generated torsional loads in the jib not originally accounted for.		
CRANE OPERATIONS	Manual Violation			
LIFT PLANS	Site Control	The cause is likely a combination of factors under the control of the operator and lift director.		
RIGGING	Failure			
RIGGING	Softeners			
RIGGING	Unbalanced	Improper tensions on one of the two tuggers would have caused side-loading.		
WIND	Wind	Wind possibly caused some load drift.		

#	25
Date of Incident:	5/30/2008
Location:	
City	New York City
State	New York
Country	USA
Crane:	
Manufacturer	Kodiak Crane
Model	KL-300L-DH
Capacity	16 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	25	2008	
	Description	A tower crane was being used to construct a high-rise building. In the weeks prior to the incident, the crane user jumped the crane, which required safety limit switches to be bypassed. The upper limit switch bypass was never reset. During use, the crane operator two-blocked the crane. When the load line broke, the boom went over backwards, resulting in a complete collapse of the upper section of the crane. Initially suspected "deficient welds" have been proven to have been sufficient.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator two-blocked the crane, resulting in a collapse of the equipment.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
PHYSICAL	**Manufacturer**			
	Maintenance			
	Mis-Use	Operator two-blocked crane, causing a backward stability failure of the crane.		
LIFT PLANS	**Site Control**			
	Wrong Weight			
	Plan Issues			
	Operator	Operator two-blocked crane, causing a backward stability failure of the crane.		
	Weather			
CRANE CONFIGURATION	**Change Configuration**	Safety limit switches were bypassed while jumping the crane, and were not reset for normal operations. Anti-two-block was disengaged.		
	Erection			
	Dismantling			

#	26
Date of Incident:	5/23/2008
Location:	
City	Platte County
State	Missouri
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	18000
Capacity	850 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**26**	2008	
	Description	This crane is considered a mega crane. While checking wind velocity on a windy day, the crane operator raised the boom and jib, but did not have the traveling counterweights installed. Crane tipped over while lowering the boom/jib.	**Primary**	**Secondary**
	Site Supervisor	The controlling site contractor did not account for wind velocities for proper crane operations.		**X**
	Lift Director			
	Rigger			
	Operator	Operator raised the boom and jib to check wind speed, while lowering the boom/jib, the crane tipped over. Did not have the counterweights attached.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	Crane tipped while lowering the boom/jib		
WIND	**Wind**	Wind speeds were too high, and the operator used the anemometer on the jib to check wind speeds.		
WORKER CONTACT	**Load Fall**			
	Crane	The boom fell on a worker.		
	Load Drift			
	Maintenance			

#	27
Date of Incident:	5/21/2008
Location:	
City	Atlanta
State	Georgia
Country	USA
Crane:	
Manufacturer	Liebherr
Model	550 HC
Capacity	40 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**27**	2008	
	Description	While raising the jacking frame in preparation to jump the tower crane, the jacking frame operator failed to properly seat the bearing, which slipped, causing the jacking frame to fall. A worker on board the climber survived with injuries.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Jacking frame operator (not crane operator) did not completely seat the frame before jumping.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer	The manufacturer later adjusted their jacking frame bearing design to account for the potential of this type situation and minimize the potential for slippage if the frame is not properly operated.		**X**
	Other			
DETAILS				
CRANE CONFIGURATION	**Change Configuration**	Moving jacking frame into position when jacking frame fell		
	Erection			
	Dismantling			

#	28
Date of Incident:	5/14/2008
Location:	
City	Jersey City
State	New Jersey
Country	USA
Crane:	
Manufacturer	Potain
Model	Unknown
Capacity	Unknown
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**28**	2008	
	Description	A tower crane jib was being disassembled using an assist crane. Riggers did not rig to the jib's center of gravity, and the jib section swung into one of the riggers when it was lifted and freed from the rest of the jib.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	Jib wasn't properly rigged for removal	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

RIGGING	**Failure**	
	Softeners	
	Unbalanced	Load CG wasn't centered in rigging. The load shifted and impacted worker.
CRANE CONFIGURATION	**Change Configuration**	
	Erection	
	Dismantling	Load CG wasn't centered in rigging. The load shifted and impacted worker.

#	29
Date of Incident:	4/29/2008
Location:	
City	Ingleside
State	Texas
Country	USA
Crane:	
Manufacturer	Demag
Model	CC2800 (4x)
Capacity	600 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	29	2008	
	Description	Four 600-ton cranes were used to hoist a 1200-ton offshore platform float. It was planned to hoist and track with the load in order to set the float into a graving dock. During initial hoisting, a structural failure occurred in one of the booms, killing the operator. The critical lift plan called for a pick & travel with 4 cranes starting at 95% of capacity, and all of the cranes would have had to travel outward (increase radius) to complete the lift. Boom failure occurred while hoisting, most likely due to varied hoisting speeds. The critical lift plan was doomed from the start. The precision it required is nearly impossible and an increase in radius is not acceptable when beginning at 95%.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Critical lift plan was doomed for failure before lift even started.	X	
	Rigger			
	Operator	Operators should have refused to perform lift as planned		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

CRITICAL LIFT	**Site Control**	Crane travel was blocked-had to adjust
	Wrong Weight	
	Plan Issues	Plan called for pick & travel with 4 cranes starting at 95% of capacity.
	Operator	
	Weather	
WORKER CONTACT	**Load Fall**	
	Crane	Failed boom fell on operator
	Load Drift	
	Maintenance	

#	30
Date of Incident:	4/23/2008
Location:	
City	Woods Cross
State	Utah
Country	USA
Crane:	
Manufacturer	Gehl
Model	DL12-40
Capacity	6 ton
Type	Hydraulic Truck
Attachments:	Fork Lift
Alterations/Modifications:	
(Y/N)	N

	#	**30**	2008	
	Description	At a refinery, the operator was removing a wire rope with the telescoping truck when he went in reverse without a spotter. His boom was raised and it contacted a power line that he did not see.	**Primary**	**Secondary**
	Site Supervisor	Operator was supervisor.	**X**	
	Lift Director			
	Rigger			
	Operator	Did not check for overhead obstacles and proceeded without a spotter.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
POWER LINE CONTACT	**Operator**	The operator was removing a wire rope with the telescoping truck when he went in reverse without a spotter. His boom was raised and it contacted a power line that he did not see.		
	Rigger			

#	31
Date of Incident:	4/16/2008
Location:	
City	Adelanto
State	CA
Country	USA
Crane:	
Manufacturer	Terex
Model	T340-1 XL
Capacity	40 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	31	2008	
	Description	Workers were working on highway construction in the vicinity of energized power lines. No spotters were used. The GC failed to have lines de-energized or blanketed. The crane contacted the power line, and a fire started around the crane's tires. After initially getting away unharmed, the rigger and operator were trying to put out fires when the breakers tripped. At that point in time, the operator and rigger were touching the crane and operator was electrocuted, and two workers were burned by electricity, one while rescuing the other.	Primary	Secondary
	Site Supervisor	General contractor failed to place signage to warn of overhead power lines and failed to either have turned the power off or blanket the lines.	X	
	Lift Director			
	Rigger	Rigger was electrified when he tried to put out a fire by kicking dirt onto the fire. He placed his hand in contact with the crane.		X
	Operator	Crane operator was working too close to power lines without verifying if lines were turned off. He then tried to put out tire fire while grabbing onto the crane. He was electrocuted.		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
POWER LINE CONTACT	**Operator**	Boom section contacted power line.		
	Rigger	Workers intentionally touched electrified crane.		

#	32
Date of Incident:	3/25/2008
Location:	
City	Miami
State	Florida
Country	USA
Crane:	
Manufacturer	Liebherr
Model	540 HC-L
Capacity	50 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**32**	2008	
	Description	During the jumping procedures of one of the tower "insert" sections, the 19-foot tower section fell approximately 39 stories to the ground impacting a one-story house below. Site supervision was supposed to clear the area beneath the crane, but two individuals were in the house where the section fell on them. The operator was lowering the upper sections while in the process of jumping the crane when the section hanging from the jacking frame got hung up on a chord pin. As the upper was lowered, the section became dislodged and fell.	**Primary**	**Secondary**
	Site Supervisor	Supervisors failed to clear area beneath crane during jacking procedures	**X**	
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User	Lowering section and crane upper when section got hung up on pin, section became dislodged and fell.		**X**
	Signal Person			
	Manufacturer	Insufficient instructions regarding lowering upper works while still holding section	**X**	
	Other			
		DETAILS		
WIND	**Wind**	Wind caused the jumping operation to be aborted, leading to the accident.		
CRANE CONFIGURATION	**Change Configuration**	The accident occurred during a tower extension process.		
	Erection			
	Dismantling			
WORKER CONTACT	**Load Fall**	The tower section fell and impacted two workers.		
	Crane			
	Load Drift			

#	33
Date of Incident:	3/23/2008
Location:	
City	Veracruz
Country	Mexico
Crane:	
Manufacturer	IHI
Model	Unknown
Capacity	25 ton
Type	Pedestal
Attachments:	Electro-hydraulic Grab Bucket
Alterations/Modifications:	
(Y/N)	N

	#	**33**	2008	
	Description	There were four mounted pedestal cranes on a ship. While operating one of the cranes, a sudden loss of hydraulic pressure caused the boom to drop to the deck. Inspection revealed a hydraulic failure in the lift cylinder. Inspections and maintenance had been completely inadequate.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User	Lack of adequate maintenance led to incident	X	
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance	Extremely infrequent maintenance (every 3 years) led to hydraulic failure		
	Mis-Use			

#	34
Date of Incident:	3/15/2008
Location:	
City	New York City
State	New York
Country	USA
Crane:	
Manufacturer	Favelle Favco
Model	M440E
Capacity	30 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**34**	2008	
	Description	A tower crane was climbing while holding its support collar in place when the rigging failed. The master rigger was using nylon slings attached to the I-beam lacing (as opposed to the tube lacing members). They were using chain falls to lift the collar when the rigging was cut. The collar then fell down the tower, shearing off the previously installed collars below. This led to the total collapse of the crane causing significant damage to property and multiple fatalities.	Primary	Secondary
	Site Supervisor	Supervisor allowed improper rigging techniques	X	
	Lift Director	Lift director allowed improper rigging techniques	X	
	Rigger	Collar was improperly rigged, and the rigging was cut	X	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
RIGGING	**Failure**	Rigging was secured around wrong lacing on tower sections		
	Softeners			
	Unbalanced			
CRANE CONFIGURATION	**Change Configuration**	Preparations to install collar.		
	Erection			
	Dismantling			

#	35
Date of Incident:	2/9/2008
Location:	
City	San Bernardino
State	California
Country	USA
Crane:	
Manufacturer	Unknown
Model	Unknown
Capacity	Unknown
Type	Gantry
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**35**	2008	
	Description	Workers were using a shop-built lifting frame with an overhead/trolleying electric hoist to move a large pump. There were site constraints, and the workers collectively decided to pull the load off-center. When they pulled the load off-center, the lifting frame tipped over, the pump fell, and impacted one of the workers.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Told workers to, an helped, to pull load off center	**X**	
	Rigger	Pulled load off center	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer	Lifting frame did not have a large enough base		**X**
	Other			
DETAILS				
RIGGING	**Failure**			
RIGGING	**Softeners**			
RIGGING	**Unbalanced**	Workers pulled load off center		
ENGINEERING	**Engineering**	Lifting frame did not have a large enough base		
WORKER CONTACT	**Load Fall**			
WORKER CONTACT	**Crane**	Worker hit by crane		
WORKER CONTACT	**Load Drift**			
WORKER CONTACT	**Maintenance**			

#	36
Date of Incident:	1/6/2008
Location:	
City	Gulf of Mexico
State	Louisiana
Country	USA
Crane:	
Manufacturer	Superintendent
Model	EMC 25
Capacity	
Type	Pedestal
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**36**	2008	
	Description	The operator was raising a load when there was a sudden increase in the load indicator. As he was notifying the crew that the load was stuck, the boom hoist wire rope failed near the outer bridle that was connected to the pendant lines. The lattice boom dropped suddenly onto the top of the swivel and stopped.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider	The seized sheave and failed boom hoist wire rope was covered with an excessive amount of grease which significantly affected the ability to conduct a quarterly inspection. As a result the inspections did not identify the seized sheave.	**X**	
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
PHYSICAL	**Manufacturer**			
PHYSICAL	**Maintenance**	Failure occurred when the boom hoist wire rope jumped the sheave and was cut as it extended over the edge of the sheave. The sheave had not been well maintained and the issue had not been identified		
PHYSICAL	**Mis-Use**			

#	37
Date of Incident:	12/26/2007
Location:	
City	Monrovia
State	California
Country	USA
Crane:	
Manufacturer	P&H
Model	9170 TC
Capacity	150 ton
Type	Lattice Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**37**	2007	
	Description	A lattice boom truck crane was used to erect tilt wall panels. Following completion, the crane was moved next to the street for disassembly. The boom was taken off and the tip put back. Late in the day, prior to leaving it was discovered that the counterweights had to be placed on another trailer. The operator tried to make the lift without the outriggers extended. The crane tipped and the crane fell onto the slab of the building.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Operator failed to extend the outriggers fully while making a lift.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	Operator failed to extend the outriggers fully while making a lift.		
CRANE CONFIGURATION	**Change Configuration**	Operator failed to extend the outriggers fully while making a lift. At the end of dismantling, the operator ran the crane without extending the outriggers.		

#	38
Date of Incident:	12/11/2007
Location:	
City	Harker Heights
State	Texas
Country	USA
Crane:	
Manufacturer	Link Belt
Model	HC 248H
Capacity	200 ton
Type	Truck Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**38**	2007	
	Description	A lattice truck crane was erecting precast wall panels. While making a safety video on how to erect precast wall panels, a worker knocked out the wrong brace, and the panel fell over onto an adjacent crane	**Primary**	**Secondary**
	Site Supervisor	Told workers to remove the wrong brace	**X**	
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
WORKER CONTACT	**Load Fall**	Crane was impacted when a worker removed the wrong brace on a concrete wall panel		
	Crane			
	Load Drift			
	Maintenance			

#	39
Date of Incident:	10/12/2007
Location:	
City	Grenada
State	Mississippi
Country	USA
Crane:	
Manufacturer	Kranco Inc
Model	Log Boom
Capacity	40 ton
Type	Log Boom Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**39**	2007	
	Description	The operator was lifting a load of logs when the crane collapsed. Evidence indicated that failure initiated at the lower flange connection installed in the backstay. The crane was brittle from excessive sulfur content and aging. Some significant overload event likely occurred shortly before the ultimate collapse.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	There was likely some operational overload before the collapse.	**X**	
	Service Provider			
	Owner/User	The crane was aging and may have reached its limit of operation.	**X**	
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance	The crane was aging.		
	Mis-Use	There was likely some operational overload before the collapse.		

#	40
Date of Incident:	9/25/2007
Location:	
City	Lufkin
State	Texas
Country	USA
Crane:	
Manufacturer	Yale
Model	Yale
Capacity	3 ton
Type	Floor operated overhead
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**40**	2007	
	Description	While operating an overhead crane, the operator maneuvered the crane such that the hooks attached to the crane accidently caught on a 4,000 pound flask, knocking it to the ground and contacting the operator.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator did not adhere to requirements by the manufacturer's operator manual for proper use of the involved crane. The operating method was a direct contributing factor in knocking the flask to the ground.	**X**	
	Service Provider			
	Owner/User	Labels on the controls were illegible. This was not deemed a contributing factor in the involved incident because the operator was highly familiar with the controls.		
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
WORKER CONTACT	**Load Fall**	An object was knocked by the crane and contacted the worker		
	Crane			
	Load Drift			
	Maintenance			

#	41
Date of Incident:	9/5/2007
Location:	
City	San Jose
State	California
Country	USA
Crane:	
Manufacturer	Unknown
Model	Unknown
Capacity	75 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	41	2007	
	Description	A hydraulic truck crane was being used to move a generator. Workers attached rigging the generator at the bottom of the generator. The CG was well above the rigging lift points. The load was lifted, but then flipped and fell. The rigging was attached at the manufacturer's designated lifting points, but the riggers should have followed industry standards of avoiding rigging below the CG, especially not with the attachment points so close together.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	Riggers lifted the load knowing the pick points were below the CG and it would flip.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other	The generator manufacturer had the lifting points marked too close together, especially when combined with the large dimensions and their location below the CG	**X**	
DETAILS				
LOAD	**Placement**			
LOAD	**Stability**	The generator manufacturer had the lifting points marked too close together, especially when combined with the large dimensions and their location below the CG		
RIGGING	**Failure**			
RIGGING	**No Softeners**			
RIGGING	**No Tag Lines**			
RIGGING	**Not Balanced**	The generator manufacturer had the lifting points marked too close together, especially when combined with the large dimensions and their location below the CG. The riggers proceeded anyway.		

#	42
Date of Incident:	8/22/2007
Location:	
City	Little Rock
State	Arkansas
Country	USA
Crane:	
Manufacturer	Terex Comedil
Model	CTT 561-20
Capacity	20 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**42**	2007	
	Description	A tower crane was operating in the blind delivering loads of bricks being used in the construction of a medical building. The brick masons foreman was giving directions via radio. While load was being lowered, the foreman walked away and continued signaling the operator. The bricks were lowered until one of the laborers was impacted by a pallet of bricks.	Primary	Secondary
	Site Supervisor			
	Lift Director	The lift director/signal person walked away from a moving load while giving signals.	X	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The lift director/signal person walked away from a moving load while giving signals.	X	
	Manufacturer			
	Other			
		DETAILS		
SIGNALS	**Signal Person**	The signal person walked away and did not give the stop command when the load approached a worker.		
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift	The load contacted a worker while it was being lowered.		
	Maintenance			

#	43
Date of Incident:	8/10/2007
Location:	
City	
State	Illinois
Country	USA
Crane:	
Manufacturer	Terex
Model	T340-1
Capacity	40 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**43**	2007	
	Description	A mobile hydraulic crane was being dismantled for travel. Two ironworkers were assisting with the outriggers. As the operator was retracting the outrigger, the worker grabbed the outrigger with his arms and his arm was crushed. The operator started retracting the outrigger and the rigger was next to the crane but did not have his hand/arm in the assembly until after the retraction started.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	The rigger placed his arm in the path of a retracting outrigger.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
CRANE CONFIGURATION	**Erection/Dismantling**	The rigger placed his arm in the path of a retracting outrigger during dismantle.		
WORKER CONTACT	**Load Fall**			
	Crane	The rigger placed his arm in the path of a retracting outrigger.		
	Load Drift			
	Maintenance			

#	44
Date of Incident:	7/16/2007
Location:	
City	
State	Louisiana
Country	USA
Crane:	
Manufacturer	Peiner
Model	Peiner
Capacity	20 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	44	2007	
	Description	The tower crane was lifting of bundles of reinforcing steel from the ground to the formed deck of a dome approximately 160-180 feet above grade. The lifting operation was a blind pick for the landing of the reinforcement. During the landing, a rigger was contacted with the load he was trying to control.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger	Did not use a tag line and had sole responsibility for controlling the load.	X	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	Had a responsibility to give commands to the operator who was working in the blind.		X
	Manufacturer			
	Other			
DETAILS				
SIGNALS	**Signal Person**	Blind operation. Responsible for where the load goes.		
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift	Worker was contacted by the load. No tag line used.		
	Maintenance			

#	45
Date of Incident:	7/13/2007
Location:	
City	Woodinville
State	Washington
Country	USA
Crane:	
Manufacturer	Terex
Model	T340-1
Capacity	40 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**45**	2007	
	Description	A mobile hydraulic crane was at a residence to assist a tree company in removing a tree in the back yard. The tree company has a tree marking/cutting procedure based on the capacity of the crane. The operator provided a maximum load capacity of 60% of allowable due to the inherent dynamic motion when the trunk is cut. The worker had marked the portion of the trunk and rigged the trunk. He cut the tree and the load bounced, causing the boom to buckle. The wrong load was provided. The operator has to totally rely on the expertise of the arborist relative to estimated weight of the trunk they are cutting. The arborists incorrectly estimated the weight, even though they are trained specifically for that purpose.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The arborist was directing the lift and was in control of the load weight, rigging and crane signals.	**X**	
	Rigger	The tree removal company failed to cut the tree to the proper allowable load that could be picked by the crane.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The arborist cut a trunk that overloaded the crane and failed the boom.		
WRONG WEIGHT	**Provided**	The tree removal company failed to cut the tree so the proper allowable load could be picked by the crane.		
	Operator			
	Demolition			

#	46
Date of Incident:	7/9/2007
Location:	
City	Fort Carson
State	Colorado
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	888 Series II
Capacity	230 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	

	#	**46**	2007	
	Description	The construction crew was placing six, pre-cast concrete double tees measuring 75 feet wide by 568 feet long. Collapse of a precast double tee roof panel was caused when a rigging loop snagged following manual placement operations and disconnecting the load. The introduction of loading from a single point load from the snag caused forces that destroyed the double tee, leading to its collapse. This was a blind pick.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The size of the load required a much more difficult lift procedure. A different construction process may have reduced the difficulty and chance of failure.		**X**
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The signal person was handling the slings that caused the snag. The signal person was responsible for being certain that the hooks did not become snagged as he gave the signal to cable up. He gave the "all clear" command that was the assurance that crane operator relied on to continue cabling up.	**X**	
	Manufacturer			
	Other			
		DETAILS		
LOAD	**Placement**			
LOAD	**Stability**	The load snagged, causing it to be destroyed and collapse.		
SIGNALS	**Signal Person**	The signal person was responsible for being certain that the hooks did not become snagged as he gave the signal to cable up. He gave the "all clear" command.		

#	47
Date of Incident:	7/2/2007
Location:	
City	Philadelphia
State	Pennsylvania
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	2250
Capacity	250 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**47**	2007	
	Description	The incident occurred during the offloading process of a precast concrete column which was to be erected for a parking garage. During the lift, the load became stuck on a fire hydrant and the ironworker injured himself dislodging the load.	Primary	Secondary
	Site Supervisor			
	Lift Director	Held responsibility for the lift process that apparently went wrong.	X	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other	Ironworker did not need to be involved in dislodging the load.	X	
DETAILS				
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift	The ironworker was injured dislodging the load when it contacted an object it was not meant to encounter.		
	Maintenance			

#	48
Date of Incident:	6/19/2007
Location:	
City	San Antonio
State	Texas
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	2250
Capacity	300 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**48**	2007	
	Description	A new crane was delivered to a power plant. The service technician had set all the limits including the upper limit which stops the boom at 87 degrees. Several weeks later during a routine lift, the operator boomed up to 95 degrees and a portion of the boom buckled. Soon after, the boom buckled again and fell. It was found that the operator had overridden the limit switch. The operator confessed that he was routinely making higher picks than normal and had overridden the device.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator overrode the Lattice Boom Hoist Disconnect (Boom Kick Out) and LMI and boomed beyond the limits.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
OPERATIONAL AIDS	**Disconnected**	The Lattice Boom Hoist Disconnect (Boom Kick Out) and LMI had been overridden.		
	Setup			
	Off			
LIFT PLANS	**Site Control**			
	Wrong Weight			
	No Plan			
	Operator	The crane operator disabled the limit switch and boom up too high causing the boom to buckle.		
	Weather			

#	49
Date of Incident:	6/2/2007
Location:	
City	Roanoke
State	Texas
Country	USA
Crane:	
Manufacturer	Caterpillar
Model	572
Capacity	455 ton
Type	Side Boom Pipelayer
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	49	2007	
	Description	Two side boom pipelayers were attempting to lift a railcar with a transformer inside it back onto the tracks. After several attempts, the transformer rocked, striking and cutting the wire rope load line of the side boom resulting in the transformer rolling off the rail car.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Same person as crane operator. Lift was poorly planned and should not have been attempted.	**X**	
	Rigger	Same person as crane operator. The load was not secured, as the transformer was not properly rigged to ensure that it did not become unbalanced.	**X**	
	Operator	Should not have operated with an unstable load. Should also have waited until additional cranes arrived to ensure they had enough lifting capacity. Ignored other parties' warnings that he did not have sufficient equipment to perform the lift.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
LOAD	**Placement**			
	Stability	The load was unstable.		
LIFT PLANS	**Site Control**			
	Wrong Weight			
	Plan Issues	The lift required a greater amount of rigging equipment and lifting capacity.		
	Operator			
	Weather			
RIGGING	**Failure**			
	Softeners	The rigging became unbalanced.		
	Unbalanced			

#	50
Date of Incident:	6/2/2007
Location:	
City	Fort Lauderdale
State	Florida
Country	USA
Crane:	
Manufacturer	Lorain
Model	MC1650 Moto-Crane
Capacity	165 ton
Type	Lattice Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**50**	2007	
	Description	A lattice truck crane tipped over during high winds of a storm in Fort Lauderdale while 300 feet of boom were extended upward. No plans were made for a boom laydown area despite knowing that a tropical storm was brewing off the coast. The tropical storm hit the west coast of Florida rather than the east coast, but it was reasonable to expect high winds and the boom should have been lowered.	Primary	Secondary
	Site Supervisor	Erected crane without adequate boom laydown area, which meant that the operator had no immediately available place to boom down.	X	
	Lift Director			
	Rigger			
	Operator	Did not lay down boom with a tropical storm coming ashore		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
STABILITY	**Soil**			
	Foundation			
	Operator	The operator left the long boom up in the air when a tropical storm was approaching.		
	Overload/Tipping			
WIND	**Wind**	The operator left the long boom up in the air when a tropical storm was approaching.		

#	51
Date of Incident:	2/13/2007
Location:	
City	Charleston
State	South Carolina
Country	USA
Crane:	
Manufacturer	Terex
Model	HC110
Capacity	110 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	51	2007	
	Description	Hospital construction. The crane was re-positioning in order to set A/C units on the roof. As the operator made several turns in a tight location next to varying heights in the building. In order to fit, the operator raised the boom to near its maximum. During a turn with the boom at high elevation, the crane tipped. Wind analysis indicated that the 22 mph wind gusts reported was not sufficient to overturn the crane. The boom was at or near its maximum boom angle (80-degrees plus). Lattice structures become unstable when near vertical a fast turn or if the crawlers jerk the boom will become off-centered and pull the crane over.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Operator traveled with the boom at too high an angle and made sudden turns with the tracks.	X	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

STABILITY	**Soil**	
STABILITY	**Foundation**	
STABILITY	**Operator**	Operator traveled with the boom at too high an angle.
STABILITY	**Overload/Tipping**	
CRANE TRAVEL	**Operator**	Operator traveled with the boom at too high an angle.
CRANE TRAVEL	**Rigger**	

#	52
Date of Incident:	2/2/2007
Location:	
City	Corpus Christi
State	Texas
Country	USA
Crane:	
Manufacturer	Cleasby
Model	Conveyor Boom
Capacity	1 ton
Type	Truck-mounted Boom
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**52**	2007	
	Description	A truck-mounted boom was being used to load shingles onto the roof of a residential house. Sometime after the shingles were loaded onto the roof, the roof and some of the house walls collapsed.	**Primary**	**Secondary**
	Site Supervisor	Joists had not been installed in the house, making it an unfit structure on which to place the load.	**X**	
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
LOAD	**Placement**	The load was placed on a structure that was not capable of holding the load.		
	Stability			

#	53
Date of Incident:	1/16/2007
Location:	
City	Port Hueneme
State	California
Country	USA
Crane:	
Manufacturer	Link Belt
Model	HC278-H
Capacity	300 ton
Type	Lattice Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**53**	2007	
	Description	A lattice boom truck crane tipped over while offloading a yacht from a ship. The correct load chart and LMI information were used. However, during the lift, wind forces applied to the side of the yacht caused the yacht to drift away from the crane. As the yacht drifted, it increased the radius and caused the crane to tip, with the yacht crashing down to the ground underneath it. The wind and subsequent drift of the load also applied a dynamic load on the crane.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The lift director determined the wind conditions were safe to operate in.	**X**	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The crane tipped after wind drifted the load and increased the radius.		
WIND	**Wind**	Wind was the primary cause of the collapse.		

#	54
Date of Incident:	12/15/2006
Location:	
City	Calapooia River
State	Oregon
Country	USA
Crane:	
Manufacturer	DeMag
Model	AC 435
Capacity	150 Ton
Type	All Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	54	2006	
	Description	While constructing a bridge, the crane was at 70% capacity, making a dual pick. There was no sudden event, and the boom collapsed. This failure was identical to another previous failure with the same type of crane the prior week. The radius and weight of the load were confirmed to be well within the crane's capacity. The load/configuration was at a reported 70% of the allowable.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer	There was a boom design defect.	**X**	
	Other			
DETAILS				
PHYSICAL	**Manufacturer**	The boom failed while only at 70% allowable capacity.		
	Maintenance			

#	55
Date of Incident:	12/2/2006
Location:	
City	Cleveland
State	Ohio
Country	USA
Crane:	
Manufacturer	American Hoist & Derrick
Model	S-10
Capacity	Unknown
Type	Stiffleg Derrick
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	55	2006	
	Description	Workers were in the process of reeving a stiffleg derrick. The manufacturer's on-site rep directed the erection of the derrick. He decided that the derrick should be reeved in the air, as opposed to on the ground. They used small diameter wire rope to hoist larger diameter rope and reeve. Between the two ropes, a short piece of wire rope (between diameters) was used to connect the ropes grips. The use of the short connector wire rope resulted in an effective kink in the rope system. The grips on the short piece of rope contacted one of the sheave guards and was cut. The large diameter rope fell and hit the hoist operator on the ground.	**Primary**	**Secondary**
	Site Supervisor	The way the ropes were planned to be reeved resulted in the failure.	**X**	
	Lift Director			
	Rigger	Rigger used grips that were too small which allowed the load line to pull through and drop.		**X**
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
RIGGING	**Failure**	The loss of control by the grips dropped the load line on the operator.		
	No Softeners			
	No Tag Lines			
	Not Balanced			
CRANE CONFIGURATION	**Change Configuration**			
	Erection	The failure occurred during a reeving process.		
	Dismantling			
WORKER CONTACT	**Load Fall**	The loss of control by the grips dropped the load line on the operator.		
	Crane			
	Load Drift			
	Maintenance			

#	56
Date of Incident:	11/29/2006
Location:	
City	San Francisco
State	California
Country	USA
Crane:	
Manufacturer	Linden Comansa
Model	LC140
Capacity	8 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	56	2006	
	Description	A 50 pound load fell 10 feet from its rigging and struck a worker. The load was improperly rigged by the rigger using a basket hitch.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Was not using tag lines		**X**
	Rigger	Improperly rigged the load, leading to it falling out.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	Signal person was responsible for giving the signals to the operator and ensuring he was not directing the load over personnel on the deck.		**X**
	Manufacturer			
	Other			
		DETAILS		
LOAD	**Placement**			
LOAD	**Stability**	The load fell out of its rigging		
RIGGING	**Failure**	The rigging was not appropriate for the lift		
RIGGING	**Softeners**			
RIGGING	**Unbalanced**			

#	57
Date of Incident:	11/13/2006
Location:	
City	Kenmore
State	Washington
Country	USA
Crane:	
Manufacturer	Grove
Model	RT75S
Capacity	50 ton
Type	Rough Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**57**	2006	
	Description	An employee was struck by a falling 40-foot H-pile. The beam was being lifted to a vertical position while attached to one end by a mobile crane. There was a sudden release of an "E" locking clamp that was attached to the pile. Side loading of the locking device was the primary cause of the load release. This was caused by an off-centered placement of the clamp. Lack of maintenance of the locking clamp as noted by the residue build-up in the teeth of the clamp could have exacerbated slippage of the device as it was side loaded.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The Lift Director was responsible for ensuring the injured worker had heard his warning and had moved from the swing path of the load.		**X**
	Rigger	Off-center placement of the clamp (in conjunction with the corresponding off-center circular scrapes) was the primary cause of load release.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
PHYSICAL	**Manufacturer**			
	Maintenance	The clamp was poorly maintained		
	Mis-Use			
RIGGING	**Failure**	The rigging clamp was not placed properly, leading to loss of load.		
	Softeners			
	Unbalanced			
WORKER CONTACT	**Load Fall**	The load fell and struck the worker		
	Crane			
	Load Drift			
	Maintenance			

#	58
Date of Incident:	11/10/2006
Location:	
City	Mammoth Lakes
State	California
Country	USA
Crane:	
Manufacturer	Grove
Model	RT880E
Capacity	80 ton
Type	Rough Terrain
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**58**	2006	
	Description	A mobile crane was dispatched to a condominium project to lift steel bents on the roof of the project. The operator was working in the blind and signals were both radio and hand signals. There had been prior problems with the radios so the signal person was using both and preferred hand. The signal man gave the signal to lower slowly but never countered with a stop either vocal or hand. The load line became slack and when the riggers were prying the load, it fell off the column and hit a workers foot.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	Lift director was not consistent with signals and did not watch what was happening with the load.		X
	Rigger	The rigger was not in the proper position and was performing unsafe work practices.	X	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The Lift Director was also the signal person and did not follow proper protocol by not watching the load while he was signaling allowing the lines to go slack.	X	
	Manufacturer			
	Other			
DETAILS				
SIGNALS	**Signal Person**	No signal was given to stop lowering the load.		
WORKER CONTACT	**Load Fall**	The load fell off of a column it had come to rest on and hit a worker.		
	Crane			
	Load Drift			
	Maintenance			

#	59
Date of Incident:	9/19/2006
Location:	
City	Aurora
State	Colorado
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	4100W
Capacity	230 ton
Type	Lattice Crawler
Attachments:	30 foot jib
Alterations/Modifications:	
(Y/N)	N

	#	**59**	2006	
	Description	A crawler crane was unloading supplies at a construction site. The crane was outfitted with a 30 foot jib, lowering the lift capacity to 20,000 pounds. The crane was overloaded at about 178% of its maximum capacity. Upon final positioning, the load was approximately three feet off the ground when there was a sudden drop of the load of about 1 foot and then the jib buckled, dropping the load and overhaul ball to the ground. The dynamic rebound of the luffing boom and vertical tower caused the tower to snap and the assembly crashed to the ground.	**Primary**	**Secondary**
	Site Supervisor	The lift director/site supervisor had ultimate responsibility for load weight accuracy and told the operator the incorrect weight.	X	
	Lift Director	The lift director/site supervisor had ultimate responsibility for load weight accuracy and told the operator the incorrect weight.	X	
	Rigger			
	Operator	Did not use LMI.		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

OPERATIONAL AIDS	**Disconnected**	
	Setup	
	Off	LMI was not used.
LIFT PLANS	**Site Control**	
	Wrong Weight	The lift director specified the wrong weight, leading to the overload of the crane
	No Plan	
	Operator	
	Weather	
WORKER CONTACT	**Load Fall**	
	Crane	A piece of the broken crane contacted the crane operator, causing minor injury
	Load Drift	
	Maintenance	

#	60
Date of Incident:	9/16/2006
Location:	
City	Newport Beach Bay
State	California
Country	USA
Crane:	
Manufacturer	Marion
Model	101m
Capacity	75 ton
Type	Mounted Marine Dredger
Attachments:	Clamshell Bucket
Alterations/Modifications:	
(Y/N)	Y

	#	60	2006	
	Description	The crane was being used for dredging. The converted dredging crane had controls that were difficult to operate. Allegedly, the operator injured himself while attempting to use the controls.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Utilizing the glide swing correctly, will reduce the operator's force and movement of the swing lever and help prevent the operator from over-maneuvering the crane.		X
	Service Provider	The air-activated swing control system did not offer adequate metering precision for rotating the crane for the dredging operation. Other parts of the crane controls were appropriate.		X
	Owner/User	The air-activated swing control system did not offer adequate metering precision for rotating the crane. Other parts of the crane controls were appropriate.		X
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**	The air-activated swing control system did not offer adequate metering precision for rotating the crane for this operation.		
	Maintenance			
	Mis-Use			

#	61
Date of Incident:	6/19/2006
Location:	
City	Silsbee
State	Texas
Country	USA
Crane:	
Manufacturer	Shaw-Box
Model	Series 800 Hoist
Capacity	5 ton
Type	Overhead Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**61**	2006	
	Description	An overhead crane hoist was being used to lift a cart. During the lift, the cart was pulled to the side against manufacturer warnings/industry standards and the line came out of the drum grooves resulting in it being cut. When the load line was cut, the cart fell and struck a worker.	**Primary**	**Secondary**
	Site Supervisor	Did not sufficiently train their employees in lift operating. They should have been strictly forbidden to attempt a side pull.	**X**	
	Lift Director			
	Rigger			
	Operator	Operated the crane when the load was to the side, resulting in a side pull.	**X**	
	Service Provider			
	Owner/User	Did not sufficiently train their employees in lift operating. They should have been strictly forbidden to attempt a side pull.	**X**	
	Signal Person			
	Manufacturer			
	Other			

DETAILS		
PHYSICAL	**Manufacturer**	
	Maintenance	
	Mis-Use	The wire rope was cut due to the crane being operated in an inappropriate manner.
LIFT PLANS	**Site Control**	
	Wrong Weight	
	Plan Issues	
	Operator	The operator performed a lift when the load was not centered under the free-hanging load line.
	Weather	
WORKER CONTACT	**Load Fall**	The load fell and struck a worker.
	Crane	
	Load Drift	
	Maintenance	

#	62
Date of Incident:	5/7/2006
Location:	
City	Los Angeles
State	California
Country	USA
Crane:	
Manufacturer	Liebherr
Model	630 EC-H
Capacity	20 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**62**	2006	
	Description	A technician was erecting a crane and was ready to reeve the load line. The system had an automatic reeving system and the technician did not bring the correct tools up on the tower. He decided to continue the operation without the required tools. The load line hoist drum began to spin out of control and caught a man's leg in the rope, cutting it off. At some point as he was placing the wire rope on the deck of the boom, sufficient slack developed that it started to pull the rope coiled on that deck. The other worker was standing on the moveable work basket and may have tried to step on the rope to keep it from running out. The rope caught his leg and pulled him into the boom.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The technician failed to follow proper procedures and was directing the operations.	**X**	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
CRANE CONFIGURATION	**Erection/Dismantling**	The technician failed to follow proper procedures		
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift			
	Maintenance	During erection a worker was caught in the hoist rope automatic reeving system.		

#	63
Date of Incident:	3/30/2006
Location:	
City	Salem
State	Virginia
Country	USA
Crane:	
Manufacturer	Grove
Model	TMS
Capacity	30 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**63**	2006	
	Description	At a tool factory, a crane company was hired to lift a 17,500 pound lathe. During the lifting operations the slings failed and the load fell. The lathe was re-rigged and the slings failed again. The lathe was re-rigged a third time with wire ropes at the request of the crane operator and the lift was successful.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director	The lift director was responsible for the riggers.	**X**	
	Rigger	The riggers failed to provide softeners for the nylon slings. Additionally, improper rigging of the slings in a choker configuration overloaded the slings.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
RIGGING	**Failure**	The rigging was done improperly twice.		
	Softeners	The riggers failed to provide softeners.		
	Unbalanced			

#	64
Date of Incident:	1/17/2006
Location:	
City	Waco
State	Texas
Country	USA
Crane:	
Manufacturer	Budgit Hoists
Model	Electric Chain Hoists
Capacity	2 ton
Type	Overhead Crane
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**64**	2006	
	Description	A worker was rigging and lifting an approximately 80-foot-long catwalk with one of two overhead cranes. The catwalk disengaged from the hook and impacted a worker sweeping the floor under the load.	**Primary**	**Secondary**
	Site Supervisor	Failed to adequately train all employees in overhead crane operation.		**X**
	Lift Director			
	Rigger	The rigger is responsible for ensuring proper engagement of the hardware in order to ensure that a load will not become disengaged from the rigging. The primary cause of the incident was that the rigger did not ensure proper engagement of the rigging hardware	**X**	
	Operator	Failed to ensure that he was not lifting the suspended load above personnel.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

LIFT PLANS	**Site Control**	
	Wrong Weight	
	Plan Issues	
	Operator	Did not follow practice of not lifting over people.
	Weather	
RIGGING	**Failure**	Rigger did not engage the rigging hardware.
	Softeners	
	Unbalanced	
WORKER CONTACT	**Load Fall**	The load fell and hit a worker.
	Crane	
	Load Drift	
	Maintenance	

#	65
Date of Incident:	12/22/2005
Location:	
City	Pineland
State	Texas
Country	USA
Crane:	
Manufacturer	LeTourneau
Model	JC-40
Capacity	20 ton
Type	Pedestal
Attachments:	Grapple
Alterations/Modifications:	
(Y/N)	Y

	#	**65**	2005	
	Description	The pedestal crane was used to off-load logs from trucks and stack them in a circular configuration around the tower column and then place them for preparation for the mill. The crane was originally operated sparingly, but recently had been relocated for heavier use. A service company was hired to dismantle, refurbish/modify, upgrade, and erect the crane at the new site. Four years later the crane collapsed. Post collapse inspection revealed imperfections, cracks, corrosion and damage to the crane which was a direct contributor to the ultimate collapse as a result of fatigue.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider	When they refurbished the crane, the service provider was responsible for ensuring the crane was capable of meeting governing national standards once placed back in operation. They failed to assess the issues with the crane. They also were responsible for maintenance up until the time of collapse.	**X**	
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance	The crane had several maintenance issues that led to its collapse from fatigue.		

#	66
Date of Incident:	10/24/2005
Location:	
City	Hallandale Beach
State	Florida
Country	USA
Crane:	
Manufacturer	Liebherr
Model	200-HC
Capacity	10 ton
Type	Tower
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	66	2005	
	Description	A tower crane was being used to construct a high-rise building. An impending hurricane required that the crane be properly prepared and vaned prior to the leaving the crane. Reportedly, the operator left one swing brake secured. The tower crane was braced at two locations back to the concrete structure. During the storm, the upper brace connection pulled out of the concrete allowing the upper portion to fail in torsion and collapse to the ground.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	The operator left one of the swing brakes on.		X
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other	The engineer did not provide the proper design for the attachment of the crane into the post tensioned slab. There was no shear reinforcement.	X	
		DETAILS		
CRANE OPERATIONS	**Stuck Load**			
CRANE OPERATIONS	**Improper Setup**			
CRANE OPERATIONS	**Manual Violation**	The operator left one of the swing brakes on.		
ENGINEERING	**Engineering**	The engineer did not provide the proper design for the attachment of the crane into the post tensioned slab. There was no shear reinforcement.		
WIND	**Wind**	High winds during a hurricane overstressed the attachment points.		

#	67
Date of Incident:	9/8/2005
Location:	
City	Fort Lauderdale
State	Florida
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	888 Series II
Capacity	230 ton
Type	Lattice Crawler
Attachments:	Luffer
Alterations/Modifications:	
(Y/N)	N

	#	**67**	2005	
	Description	The crawler crane was booming down in preparation for a lift when it began tipping over. As a result of the tipping, the crane's luffing attachment fell and contacted an adjacent building.	**Primary**	**Secondary**
	Site Supervisor	The timber mats were installed incorrectly.	**X**	
	Lift Director	Did not appropriately plan the lift.	**X**	
	Rigger			
	Operator	The boom angle, radius, and boom length were outside of the manufacturer chart limits.	**X**	
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			

DETAILS

STABILITY	**Soil**	The timber mats were installed incorrectly.
	Foundation	
	Operator	Operated the crane outside its chart limits.
	Overload/Tipping	The crane was overloaded, causing it to tip.

#	68
Date of Incident:	7/11/2005
Location:	
City	Fort Worth
State	Texas
Country	USA
Crane:	
Manufacturer	Grove
Model	TMS-750B
Capacity	50 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	68	2005	
	Description	The operator was holding a suspended load for an hour and a half while workers were replacing a spring. The lift director did not address the load on the line and the potential for a stuck load while instructing the riggers to cut a bolt to release the load. The load was suspended and the operator was given instructions on how much pressure to put on the line, pulling up. When the bolt was cut, the load jumped up and drifted over, pinning the riggers hand. While trying to hoist up, and then boom up to lift the load off his hand, the boom buckled. The rigger had placed his hand in a potential pinch point knowing the load was under pressure and currently partially suspended.	Primary	Secondary
	Site Supervisor			
	Lift Director	Did not block the load to prevent slippage while replacing springs	X	
	Rigger	Placed his hand in a pinch point	X	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
RIGGING	**Failure**			
RIGGING	**Softeners**			
RIGGING	**Unbalanced**	Load wasn't blocked against unintentional movement		
WORKER CONTACT	**Load Fall**			
WORKER CONTACT	**Crane**			
WORKER CONTACT	**Load Drift**	Worker placed himself and his hand under a partially suspended load		
WORKER CONTACT	**Maintenance**			

#	69
Date of Incident:	6/13/2005
Location:	
City	Tom Green County
State	Texas
Country	USA
Crane:	
Manufacturer	International
Model	2002
Capacity	8 ton
Type	Gin Pole Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**69**	2005	
	Description	Workers were using a gin truck to dismantle an oil rig. During a lift, a rigger was hanging onto an unbalanced load when it shifted and became much more unbalanced. The sudden shift of the load threw the rigger into the air.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	The rigger failed to balance the load and the imbalance was worsened when he placed his weight on top of the light end. Ensuring balance of a load is a primary responsibility of the rigger/swamper in all lifts.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
LOAD	**Placement**			
	Stability	The load was not balanced and it was made worse by actions of rigger.		
RIGGING	**Failure**			
	Softeners			
	Unbalanced	The load was not balanced when it was rigged.		

#	70
Date of Incident:	5/23/2005
Location:	
City	Port Fourchon
State	Louisiana
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	888 Series II
Capacity	230 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	70	2005	
	Description	Risers were being transferred at a port from barges to work boats. During one of the lifts the crane tipped due to the load being beyond the allowable load radius. The lift director/site supervisor instructed the operator to boom down and swing. It was a blind pick in the dark.	**Primary**	**Secondary**
	Site Supervisor	Was in charge of site and was giving signals.	X	
	Lift Director	Was in charge of the lift and was giving signals.	X	
	Rigger			
	Operator			
	Service Provider			
	Owner/User			
	Signal Person	The operator had to rely on the signals given by the signal man.	X	
	Manufacturer			
	Other			
DETAILS				
STABILITY	**Soil**			
	Foundation			
	Operator			
	Overload/Tipping	The crane boomed beyond its allowable radius and tipped.		
LIFT PLANS	**Site Control**	The site supervisor was in charge of the lift and was giving the signals.		
	Wrong Weight			
	No Plan			
	Operator			
	Weather			
SIGNALS	**Signal Person**	The operator had to rely on the signals given by the signal man.		

#	71
Date of Incident:	2/24/2005
Location:	
City	Bowie
State	Texas
Country	USA
Crane:	
Manufacturer	Link Belt
Model	LS-108H II
Capacity	50 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**71**	2005	
	Description	A lattice boom track crane was being prepared for unloading and erecting a drilling rig. During the move, the load line needed to be re-reeved. Journeyman and apprentice riggers were in the hole threading the wire rope back onto the spool. The journeyman performed the task the first time but while they were getting off the crane, the wire "bird-nested" again. The apprentice got back into the spool hole and rethreaded. As he was standing on the deck watching the line, he either stumbled or fell into the hole and got his leg trapped in the winch.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger	Rigger lost his balance and fell into the crane's hole, becoming trapped by the winch.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
CRANE CONFIGURATION	**Change Configuration**			
	Erection	Maintenance being performed during erection.		
	Dismantling			
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift			
	Maintenance	Worker re-threading the load line was caught in the spool.		

#	72
Date of Incident:	11/18/2004
Location:	
City	Cedar Crest
State	New Mexico
Country	USA
Crane:	
Manufacturer	Manitex
Model	M2592
Capacity	25 ton
Type	Hydraulic Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	72	2004	
	Description	A crane was placing a roof beam of a two-story building. The general contractor provided their own 4-inch nylon sling chokers to secure the ends of the beam to the hook of the crane. The lift director had discussed and taught the riggers the procedure required to rig a glue-lam beam. The riggers were responsible for the rigging. The rigging was inadequate, with one sling that was slack. The beam suddenly moved from the pocket because it was snagged. The beam fell and a worker had to jump out of the way.	Primary	Secondary
	Site Supervisor			
	Lift Director	Was responsible for teaching the riggers how to rig the beam properly.	**X**	
	Rigger	Did not properly rig the beam, leading to loss of load.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
		DETAILS		
RIGGING	**Failure**			
RIGGING	**Softeners**			
RIGGING	**Unbalanced**	The rigging was not done properly, leading to an unbalanced load.		

#	73
Date of Incident:	11/15/2004
Location:	
City	Winfield
State	West Virginia
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	999
Capacity	250 ton
Type	Lattice Crawler
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**73**	2004	
	Description	The crew had to move two cribbing tables into an area below a large steel duct and under the two beams. The crane lifted the load over to the edge of the building and the workers pushed the table to a certain point under the duct structure. A worker slipped while his foot was located in a pinch point. The other two workers were unable to hold the load, allowing it swing back toward the worker, pinching his foot between the suspended load and stationary object.	**Primary**	**Secondary**
	Site Supervisor	Had responsibility to keep area clear of dangers and warn workers of danger.		**X**
	Lift Director			
	Rigger	The rigger created the situation by placing his foot in a very visibly dangerous area. His ability to control his portion of the load was also affected.	**X**	
	Operator			
	Service Provider			
	Owner/User			
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
WORKER CONTACT	**Load Fall**			
	Crane			
	Load Drift	The load drifted when a rigger lost control of his portion of the load when he stepped in a dangerous location.		
	Maintenance			

#	74
Date of Incident:	10/20/2004
Location:	
City	Galveston
State	Texas
Country	USA
Crane:	
Manufacturer	Hagglunds
Model	Unknown
Capacity	45 ton
Type	Overhead
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	**74**	2004	
	Description	An overhead crane installed on a ship was being used to off load large food pallets. The experienced operator was lifting his third or fourth bundle when the crane collapsed. The bolts securing one set of the bogies (an assembly of two or more axles arranged to permit vertical wheel displacement and equalize the loading on the wheels) had failed and dropped the entire crane along with the operator who was killed. The sole cause of this accident was a lack of maintenance. The bolt threads were so corroded that the tension applied by the moving crane stripped the threads off. The crane was approximately 8 to 10 years old and did not appear to have ever been maintained.	**Primary**	**Secondary**
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator			
	Service Provider			
	Owner/User	The owner did not maintain the crane, leading to its deterioration and collapse.	**X**	
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
PHYSICAL	**Manufacturer**			
	Maintenance	There was an extreme lack of maintenance, leading to a collapse.		
WORKER CONTACT	**Load Fall**			
	Crane	Operator fell with the crane as it collapsed.		
	Load Drift			
	Maintenance			

#	75
Date of Incident:	10/6/2004
Location:	
City	South Boston
State	Massachusetts
Country	USA
Crane:	
Manufacturer	Manitowoc
Model	777T Series II
Capacity	200 ton
Type	Lattice Truck
Attachments:	
Alterations/Modifications:	
(Y/N)	N

	#	75	2004	
	Description	A contractor was shaking out steel on a commercial construction site. The jib wasn't properly reeved, and the LMI wasn't properly set up. The jib was overloaded and sustained a structural failure and collapsed.	Primary	Secondary
	Site Supervisor			
	Lift Director			
	Rigger			
	Operator	Operator did not familiarize himself with the crane before operating	X	
	Service Provider			
	Owner/User	Owner reeved the jib line wrong, and didn't properly program the LMI	X	
	Signal Person			
	Manufacturer			
	Other			
DETAILS				
CRANE CONFIGURATION	**Change Configuration**			
	Erection	Initial setup was wrong. The jib line was reeved wrong and the LMI wasn't reading the load.		
	Dismantling			