

Casualty Catastrophe Risk Modeling

Casualty catastrophes have become increasingly frequent and severe over the past decade, exposing (re)insurers to much more risk than they may realize. One root cause can trigger a chain reaction that can bleed balance sheets and even imperil solvency. Until recently, casualty carriers had little choice but to accept this risk. The maturation of Enterprise Risk Management (ERM) practice and the development of new casualty-specific catastrophe models, though, signal a change. The more complex the casualty risks and regulations carriers face, the more they are recognizing that improving their ERM practices could yield competitive advantage. Now, it is possible to make the accumulation of casualty risks both knowable and manageable. As casualty catastrophes become more common, carriers will be able to take informed action to protect their capital.

Casualty Catastrophes, Frequent and Severe

Property catastrophes are utterly familiar. The same exposures generally can be found in the same regions. Little changes from one year to the next. As a result, property (re)insurers have access to a considerable amount of historical data, which is evident in the sophistication and utility of the models at their disposal. Unfortunately, casualty (re)insurers do not have access to information of this depth. The historical record is thin and constantly changing. The variables almost seem infinite, making it almost impossible to identify, model, and evaluate a large set of scenarios.

The “casualty catastrophe” is perhaps the most daunting threat that casualty (re)insurers face today. One root cause has the potential to trigger a chain reaction of liability through a web of tightly intertwined business relationships. The proliferation of liability is replicated in casualty (re)insurance portfolios, leading to the possibility of unexpectedly high claims, a drain on capital, and, in the extreme, risk to a firm’s solvency. Multiple lines of business and insureds are swept up in a casualty catastrophe, and the carriers involved may have to pay claims that seem unrelated to the event’s initial trigger.

Casualty catastrophe occurrences have become increasingly common over the past decade. The current financial catastrophe is the easiest to cite, due to its sheer size and the fact that it is still unfolding. But, there have been many others. The collapse of the “dotcom economy” led to scandals around initial public offering (IPO) laddering and equity analyst conflicts of interest. Accounting firms were not alone in suffering financial loss related to such debacles as Enron, WorldCom, Tyco, and Adelphia. While insured losses did not reach those of property catastrophes, economic damages were profound. Enron’s loss of USD66 billion in market capitalization alone—not including the economic damage caused to other companies—was more than double that of Hurricane Ike (approximately USD30 billion). The financial catastrophe in progress now is estimated to have caused economic damage of above USD1 trillion, with more likely to follow.

Casualty catastrophes, unfortunately, do not follow patterns—unlike property catastrophes. The geographies, natural conditions, and other indicators of hurricanes,

earthquakes and other property disasters offer some sense of predictability. A hurricane on the Florida coast is not unusual. Casualty catastrophes, however, rarely arise from the same conditions – or in the same companies or industries – as their predecessors. In fact, many casualty catastrophes are “black swans,” at least to the insurers that cover them. They appear out of nowhere and wreak havoc quickly.

Just about every large public or private company and its service providers (e.g., investment banks, law firms, accountants, and consultants), strategic partners, and supply chain participants is a potential flashpoint. The data set is vast, and when casualty catastrophe indicators appear, it is typically too late to take preventive action. Therefore, casualty writers need to be proactive in regards to the unknown, as difficult as that may seem.

Uncertainty is always a factor in insurance risk and capital management decision-making. Targeted, supported assumptions applied to available data using thoroughly researched and carefully designed models are intended to counteract the unknown, at least to the extent possible. Thus, to protect their capital from the casualty catastrophe risk, carriers have needed a tool that can probe a portfolio to apply potential disaster scenarios, identify likely exposures and map how liability would spread from the root cause to other industries, geographic jurisdictions, and lines of business. Not only has the technology been difficult to develop, it has tended to conflict with the prevailing practice of siloed risk management.

Tracking Integrated, Intricate Risks

Casualty (re)insurers do not cover standalone risks. A steep drop in stock price, product defect with recall, or other event could lead to class action lawsuits and ultimately large claims. This emergent reality, however, is difficult to address. A carrier would need to identify the many possible starting points of a liability chain reaction and follow their rapidly spreading implications throughout a portfolio. Without powerful modeling technology, this process is time-consuming, impossible to complete, and likely to miss key threats and underlying exposures.

Because of the impracticality of integrated liability risk management under these conditions, most casualty (re)insurers segment their efforts to protect their capital, for example, by geography or line of business. This approach leaves gaps, some of them quite wide. An anticipated directors and officers (D&O) claim for a particular insured may arise from an event that also triggers D&O—and possibly errors and omissions (E&O)—claims for other insureds. The losses begin to mount, often in excess of carrier expectations.

Because of the complexity and uncertainty involved in integrated casualty catastrophe risk management, carriers generally have not advanced their risk management practices in this regard. They instead have continued to manage liability risks independently and assume the integrated risks, sometimes unknowingly. The capital needed to support cover for a specific D&O peril, for example, may not account for ancillary D&O effects from an event elsewhere in the portfolio ... not to mention the E&O implications. In the event

of a casualty catastrophe, it is not enough to model these scenarios separately and aggregate the results. The whole may be greater than the sum of the parts.

Catastrophe risks must be identified, accumulated, and modeled as entreties in order for their implications to be understood and hedged.

1. Locate areas of vulnerability to catastrophe risk in a portfolio
2. Identify casualty catastrophe mechanisms and determine how they operate within a portfolio
3. Model the major disaster scenarios that could trigger substantial casualty losses
4. Formulate a risk management plan that addresses the full reach of each scenario identified

Ultimately, identifying and managing casualty catastrophe risk requires a systematic approach. The various connections within a portfolio must be scoured in order to understand the implications of a particular event. A product recall could lead to product liability, D&O, and E&O claims. A plane crash due to equipment malfunction could cause claims for product liability, D&O, and life to be filed. Likewise, an industrial accident causing workers compensation or employers liability losses could lead to general liability, environmental, and D&O claims. The implications of a particular situation can reach far beyond the root cause, even if it stretches the imagination.

Enterprise-Wide Evaluation

The purpose of ERM is straightforward and unequivocal. It is intended to help (re)insurers determine how much capital is needed to support the risks they assume (subject to risk tolerance). Instead of segmenting portfolios and handling each peril on a standalone basis, ERM calls for a holistic approach to capital management. These frameworks are used to identify and monitor threats, develop action plans, and measure results. The result, of course, should be the optimal deployment of capital, ultimately leading to an increase in firm value.

Unlike the traditional tools of the trade, ERM entails the assumption of risk based on its marginal impact to the company as a whole. While one risk, on its own, may seem tolerable, it could lead to disproportionate accumulation of linked risks. A portfolio may appear to be diversified, but one event would expose a costly underlying reality. This is exactly the problem that casualty writers experience in regard to casualty catastrophes. Insureds from several industries or countries could be affected by the same event, diluting the benefits of risk and geographic diversification. Separate risks do not reflect the integrated reality, masking a greater risk that typically goes unhedged.

Using ERM frameworks, casualty (re)insurers can ascertain the impacts of a new risk on their entire businesses. Within the casualty catastrophe context, this includes the risks resulting from the proliferation of risk along a supply chain or through other business relationships, such as joint ventures and partnerships. The implications of covering a new insured may be more profound than they appear at first.

The careful evaluation of each new risk added to a portfolio moves the firm toward a metrics-based approach to risk and capital management, facilitating governance and enhancing the deployment of capital. The only problem for casualty writers, however, has been the availability of data and models to determine the true effects of a new risk to the carrier's entire portfolio. Even if a casualty carrier wanted to make the most of an ERM framework, it would be limited by data and technology. Fortunately, this situation is changing.

Innovation is catching up with the casualty catastrophe threat to (re)insurer capital. Access to rich data sets and the development of new technology now enables casualty writers to see how liability can radiate from one insured through an entire portfolio. The unknown, in effect, is becoming knowable.

Casualty Cat Exposes Exposure

Developed by Guy Carpenter & Company, LLC ("Guy Carpenter") and Arium, Ltd., Casualty Cat facilitates the study of single- and multi-peril casualty catastrophe risks in an insurer's broader risk management plan. Through a rigorous analysis of inter-industry trading and supply chain data, carriers can assess key vulnerabilities, providing a foundation for risk transfer planning and execution.

The foundation of casualty catastrophe modeling – as with any other type of catastrophe modeling – is data. A carrier must have access to relevant and reliable information to use in the modeling process. And prudent ERM practices suggest that firms move beyond the basic requirements and advance their knowledge of risks that may not have been previously captured. In the past, the data for casualty catastrophe scenarios was either unavailable or simply not requested by underwriters. The maturation of this space, however, has led to improvements relative to both accessibility and use. Beyond exposures and limits, (re)insurers can obtain rigorous policy level data on the industries exposed to various liability claims. This is required for assessing vulnerabilities to both the classic and systemic elements of casualty catastrophes. High-quality data and the systems that capture it (along with corresponding industry classifications) have improved substantially for in-force casualty portfolios. Once sourced, improved casualty data can be applied to specific scenarios to identify future potential accumulations.

In order to address the interconnected nature of casualty catastrophes, Casualty Cat measures risk and impact by proximity to cause. Based on the spread of an event's implications across industry and coverage lines, a risk accumulation profile is developed, showing a portfolio's exposures and providing a starting point for risk mitigation planning.

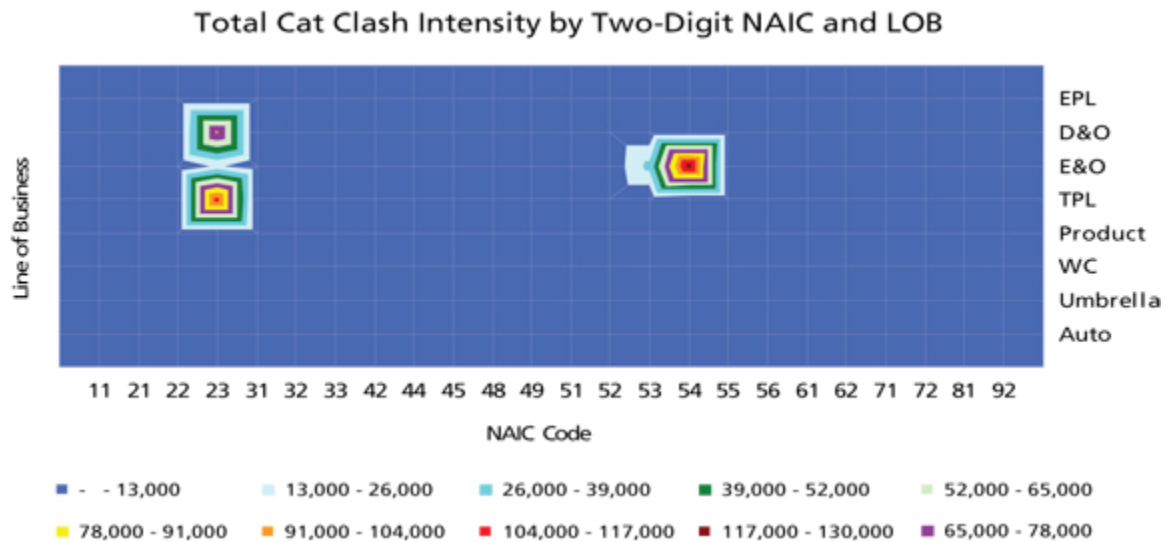
Casualty Cat uses techniques grounded in network theory and measures the inter-industry links and connectivity between policies. The strength of each relevant link, the degree of connectivity, and directional flows indicate the likelihood of catastrophic casualty loss. The modeling and analysis of each risk's industry classifications or line of business vulnerabilities to various systemic and classic propensity factors helps (re)insurers identify the classes and lines with the greatest catastrophic clash potential. By analyzing a

casualty portfolio’s clash concentration at different industry classification levels and weighing multiple sources of clash intensity, a (re)insurer can begin to develop a systematic approach to identifying which areas in a portfolio call for additional probing. The analysis may unearth and identify unpredictable “black swans,” events with no discernable precedent, as well as locate and provide insight into a portfolio’s more predictable catastrophic “white swan” casualty vulnerabilities.

Heat Maps Make Exposure Visible

Consider, for example, an insurer covering a wide range of casualty lines, such as D&O, E&O, and Third-Party Liability (TPL). The carrier writes a sizable book of professional risks (i.e., NAIC 54) and also specializes in insuring clients in the construction industry (i.e., NAIC 23). Using the Casualty Cat-generated heat maps (below), one can track line of business (vertical axis) and industry (horizontal axis) implications of a particular scenario.

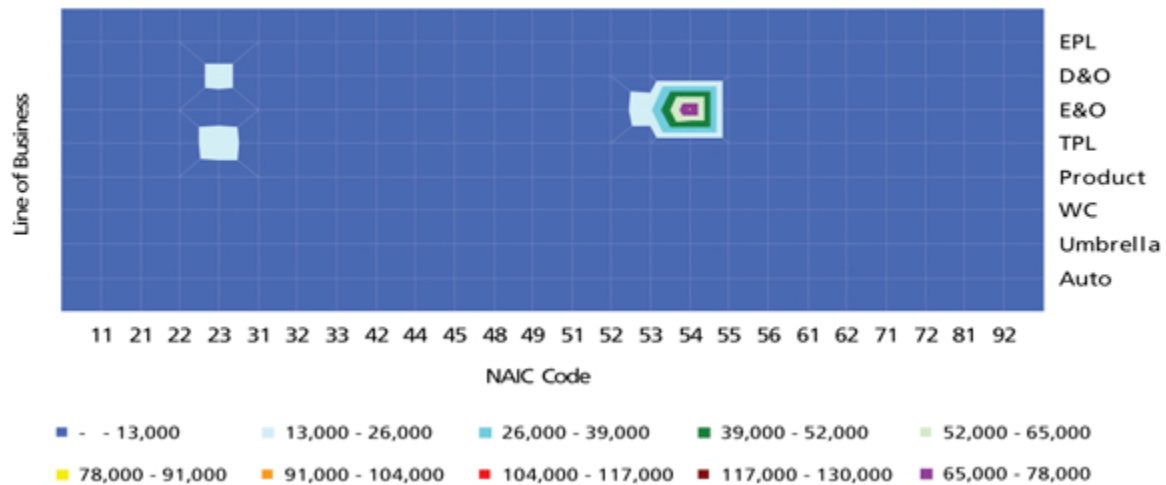
Casualty Cat’s portfolio management analysis indicates that having risk concentrations in these areas increases a (re)insurer’s total catastrophe clash exposure (as depicted in the heat map below in red, orange and yellow). Its total clash intensity, however, results from varying degrees of underlying single source company (i.e., “classic clash”) risks, as well as exposure to multi-company (“systemic clash”) events – depending on the industry. The carrier currently manages these exposures by applying lower maximum limits on professional and construction industry sectors that are particularly disconcerting.



Source: Guy Carpenter & Company, LLC

This hypothetical casualty writer's E&O for Professional, Scientific & Technical Services (i.e., NAIC 54) shows the greatest overall exposure to casualty catastrophes, as one may expect. As depicted in the heat map below, Casualty Cat reveals that these exposures show a tendency toward systemic risk rather than classic clash (as depicted by purple, grey and green) and will be driven by the sheer volume of policies written – impacted by intense regulation and vulnerability to an economic downturn.

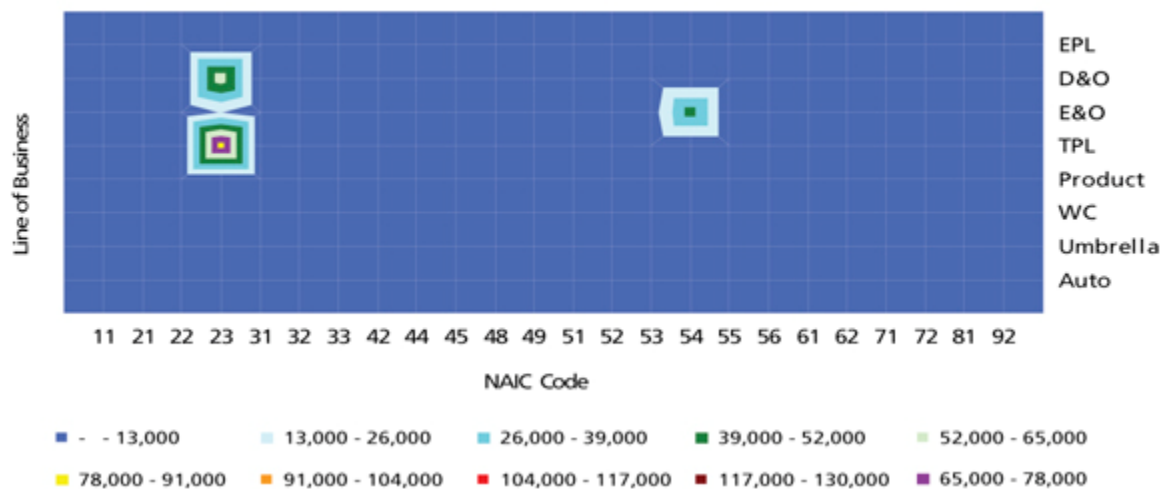
Systemic Cat Clash Intensity by Two-Digit NAIC and LOB



Source: Guy Carpenter & Company, LLC

According to Casualty Cat, the next two highest exposures are TPL for the construction industry (i.e., NAIC 23), followed by D&O for the construction industry (as depicted in the heat map below by purple, grey and green). However, Casualty Cat suggests that these exposures exhibit more signs of classic clash intensity rather than systemic, perhaps arising from a longer and more complex supply chain, greater public exposure as well as the number of subcontractors involved.

Classic Cat Clash Intensity by Two-Digit NAIC and LOB



Source: Guy Carpenter & Company LLC

Having identified the areas of highest accumulated casualty risk, the carrier can focus on what disaster scenarios trigger a catastrophic casualty loss in a particular industry segment. Casualty Cat can prompt a carrier to generate relevant scenarios that play to a portfolio's vulnerabilities, testing capital adequacy and risk management strategies more effectively. A carrier can also consider whether current pricing adequately reflects the relative level of risk for that industry compared to others in the portfolio ... and load for it accordingly.

Carriers then can apply metrics (such as the insureds' exposed policy limits and premiums) to estimate losses, assess relative vulnerabilities, and assign risk loads – other portfolio management activities. No longer concealed, casualty catastrophe risks can become knowable and therefore manageable. Casualty Cat enables risk-bearers to take action and enhance their implementations of ERM.

Case Study: The Professional Liability Casualty Catastrophe Scenario

Consider hypothetical commercial property construction and development company “X,” which has several high-profile commercial office projects around the world. In this scenario, the company was found to have massively underestimated both development costs (due in part to negligent risk management advice received from the insurer’s environmental audit team) and projected occupancy rental returns at two important commercial office sites in a major city (e.g., London, New York, Dubai, or Shanghai).

Company X failed to make provisions for inaccurate cost estimates and expected returns on its balance sheet, creating a financial “black hole” that the company’s auditors missed. Company X made misleading representations to property investment funds. It raised capital from banks using an overly optimistic analysis of expected financial returns based on the advice of real estate intermediaries. This has led to a D&O class action against company X by its U.S. shareholders, and the company has had to file for bankruptcy.

While the situation has already become precarious, this is only the first link in the causal chain of exposure, and the contagion spreads quickly. Businesses that provide services to company X – such as quantity surveying, prospectus marketing, legal advisory, accounting, and software design – could become entangled in litigation. Their insurers could have to pay claims later as a result, because their insureds are proven by litigators to have had a role to play in the chain of responsibility, however remote, for company X’s collapse.

The attorneys and accountants advising the commercial property construction and development company on its transactions could become defendants, as well, not to mention the consulting firms that helped set the strategy underlying the failed projects and the investment bankers involved in underwriting them. Even the software development firm is at risk, as it may have misrepresented the nature of the payments made via the accounting software. The insurers providing cover for the project could have E&O exposure in relation to the negligent insurance and environmental risk management advice provided.

Thus, one event, centered on a single company’s actions, could have profound consequences for several carriers and reinsurers. In addition to direct risk for the carrier providing E&O cover for the project, insurers writing D&O policies for the companies involved (however tangentially) could wind up paying substantial claims. Eventually, this exposure flows up to reinsurers, resulting in considerable financial damage along the way.

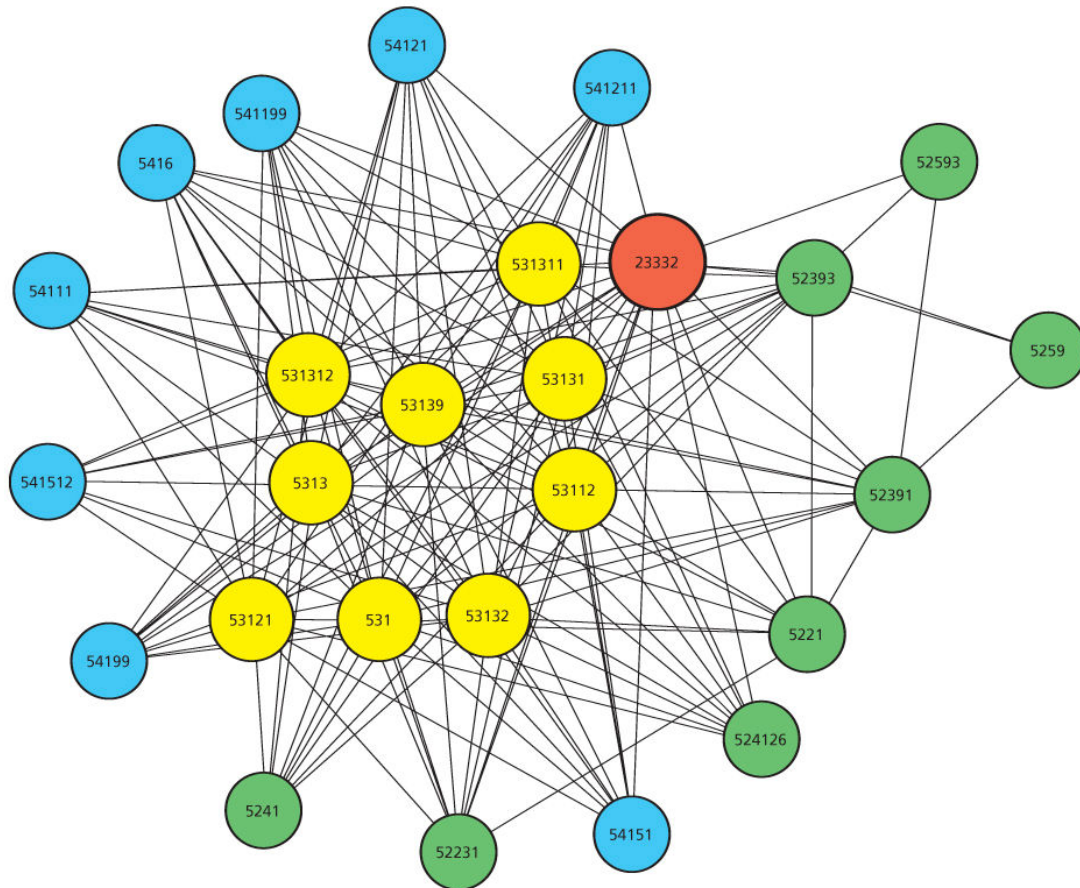
Potentially Affected Industries (by NAICS*)

Industry Code	Description
23332	Commercial and Institutional Building Construction
5221	Depository Credit Intermediation
52231	Mortgage and Non-mortgage Loan Brokers
52391	Miscellaneous Intermediation
52393	Investment Advice
5241	Insurance Carriers
524126	Direct Property and Casualty Insurance Carriers
5259	Other Investment Pools and Funds
52593	Real Estate Investment Trusts
531	Real Estate
53112	Lessors of Non-residential Buildings (except Mini-warehouses)
53121	Offices of Real Estate Agents and Brokers
5313	Activities Related to Real Estate
53131	Real Estate Property Managers
531311	Residential Property Managers
531312	Non-residential Property Managers
53132	Offices of Real Estate Appraisers
53139	Other Activities Related to Real Estate
54111	Offices of Lawyers
541199	All Other Legal Services
54121	Accounting, Tax Preparation, Bookkeeping, and Payroll Services
541211	Offices of Certified Public Accountants
54151	Computer Systems Design and Related Services
541512	Computer Systems Design Services
5416	Management, Scientific, and Technical Consulting Services
54199	All Other Professional, Scientific, and Technical Services

Source: Guy Carpenter & Company, LLC
 *North American Industry Classification System

Using the network diagram generated by Casualty Cat, a roadmap of risk highlights the implications of the property developer’s black hole. Company “X” is in the center of the map (in this case represented by NAICS code 23332), with direct exposures radiating from it by industry (e.g., NAICS code 52393 – Investment Advice). But, the exposure chain extends beyond these one-degree relationships. Some industries either derive their exposure from other industries, or through a combination of direct and indirect exposure.

Casualty Cat Network Diagram: Exposure Extent



Source: Guy Carpenter & Company, LLC

As a result of the interconnected nature of business relationships across industries, many companies that ostensibly have little to do with commercial property development could be sued, putting their insurers at risk. The direct relationship of “one cause, one effect” clearly cannot be the benchmark for risk management. This hypothetical case shows that the actions of one company could subject countless others to litigation. For (re)insurers, the consequences can be costly.

A Platform for Action

While Casualty Cat makes the domino effect from the original trigger seem intuitive, the threats derived from the cause are not readily discernable on their own. A carrier would have to devise a scenario, trace the implications through a vast network, and hope that nothing is missed. A scenario could be overlooked, or an implication may not be captured. As this relatively straightforward example shows, complexity arises quickly. Think about the level of effort needed to anticipate the effects of the subprime mortgage crisis or the initial public offering (IPO) laddering situation back in 2000. Without the capabilities of a robust model, there is plenty of room for error.

Since no event occurs in a vacuum, a single incident can gain momentum rapidly and take months – even years – to run its course. Even the seemingly unrelated could be contaminated. Casualty Cat discovers the hidden links that could lead to unexpected claims well into the future, allowing carriers to take preventive measures now.

Using Casualty Cat to determine the potential extent of the risks to a casualty carrier's portfolio, it is possible to construct and implement a thorough risk management plan. If a casualty catastrophe does strike, the protection afforded by the Casualty Cat-supported plan should prevent balance sheet damage and, in the extreme, threats to solvency. Of course, the carrier will be able to improve capital management as a result of more informed decision-making and the implementation of underwriting risk controls.

Enterprise Protection, Capital Optimization

Casualty risk is changing. Single risks have become the portals by which catastrophes can enter a portfolio. The action is swift, and the consequences severe. Warnings are few ... if there are any at all. The only protection possible is to be proactive: casualty writers must plan now for events that cannot be anticipated. While this has been close to impossible in the past, the application of a well-planned ERM framework supported by a cutting-edge casualty catastrophe model can provide the insights needed to make informed decisions about the capital a carrier puts at risk.

Currently, ERM is primarily used to help determine capital requirements, but it has even wider applications. ERM provides the procedural and analytical structure necessary to determine the implications of covering new risks, shifting portfolio tactics or pursuing new types of business. Casualty catastrophe models, such as Casualty Cat, enable the discipline required to make ERM frameworks effective. Together, they advance the modeling of casualty risks considerably, enabling a holistic view of the casualty portfolio and empowering carriers to fill the gaps in their risk management plans. The tools of the trade are evolving alongside the changing nature of the casualty threats that carriers face whether within a portfolio, among lines of business, or among business units in a multinational group.

Countless integrated casualty risks may be buried in (re)insurer portfolios. Many are unknown, but they do not have to be. Maturing processes and deeper insights are pulling casualty catastrophe risks to the foreground. No longer concealed, the threat they pose is reduced, and casualty writers can make decisions about capital that reflect the full spectrum of risks they cover.

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