North American CRO Council

Scenario Analysis Principles and Practices in the Insurance Industry

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Table of Contents

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Section 1: Executive Summary

The effects of a tough economic environment in recent years have led insurance companies to focus on enhancing risk and capital management capabilities to support business objectives and long- term sustainability by providing management with key insights into their company's risk profile. As insurers establish and refine their risk and capital management capabilities, scenario analysis continues to play a role as part of companies' risk management and decision-making processes.

The North American CRO Council is a professional association of Chief Risk Officers (CROs) of leading insurers that seeks to promote sound risk management principles. Through the perspective gained from surveying current practices and longer term plans of current member companies of the North American CRO Council, this paper strives to promote sound practices related to stress testing, scenario testing, and reverse stress testing, collectively referred to as "scenario analysis." This type of analysis plays an important role as part of an enterprise risk management (ERM) framework and provides key support for enabling CROs and others to perform their duties and strengthen the organization's risk and capital management capabilities. The principles presented in this paper have the distinction of being grounded in the perspectives and practices of CROs and their organizations, and are intended to be a useful guide in developing a scenario analysis framework within a business-as-usual process. They also may be useful to internal or external parties tasked with reviewing a company's risk management capabilities.

Since scenario analysis frameworks should be developed consistently with the risk management framework they support, the CRO Council believes in a broad definition and application of scenario analysis. For example, this paper does not attempt to define an appropriate set of scenarios to test or the valuation basis that should be used to measure the impact of key scenarios. Provided the analysis supports the management framework and its objectives, then it is a valid approach and suitable for the application of the principles described in the subsequent pages.

The principles described in this paper are classified into three sections as follows:

Governance and Process

1. Scenario analysis requirements/approach should reflect the scale and complexity of the insurer

2. Scenario analysis should be understood and actively supported by senior management with Board oversight

3. Scenario analysis should supplement other risk management tools

4. Scenario analysis should be a flexible, fluid process rather than a mechanical exercise

5. The infrastructure and process should allow for timely analysis

6. Scenario analysis should be subject to a documented governance approach, supported by policies and procedures, and subject to independent review

7. Scenario analysis should be communicated effectively to encourage discussion and debate

Objective Function

8. Scenario analysis should be linked with and tailored to clear objective functions

9. Scenario analysis should be actionable, with links to key risk and strategy decisions

10. Scenario analysis should consider qualitative and quantitative impacts

11. Scenario analysis should be used to challenge existing assumptions and calibrations

Design & Analysis

12. The design should consider multiple time horizons

13. The design should consider impacts on all appropriate accounting or valuation bases

14. The design should consider the frequency and severity of core risks, recognizing both historical and prospective relationships

15. The design should include all appropriate aggregation levels

16. The design should account for management action

17. The design should account for single events as well as concurrent scenarios

In summary, the primary focus of this paper is the development and use of scenario analysis. The core principles span a range of topics, including governance and process, objectives and applications, and design and analysis.

While the principles address a range of topics, one of the most critical themes highlighted is the importance of context in developing a scenario analysis framework. That is to say, factors such as the type of business and risks the insurer writes and how these are managed and communicated in practice should be kept in mind when designing, developing and applying the framework. Similarly, it is important that the ultimate intended use(s) be accounted for. In practice, this means that by applying the principles laid out in this paper, it should be expected that different companies will end up with different approaches, given their specific characteristics, views and objectives. By implication, the principles do not support a “one-size-fits-all” approach.

Although the discussion supporting each principle may be read independently in any order, the reader is encouraged to consider how all principles in combination jointly support a sound scenario analysis framework.

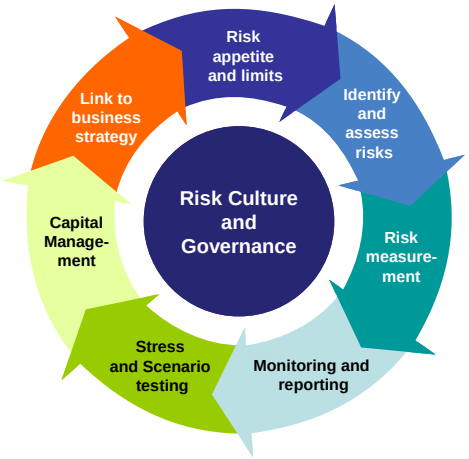
Section 2: Introduction

Stress testing and scenario analysis provide important insight to support insurers' risk and capital management processes. Although these tools are not new to the industry, they continue to evolve in conjunction with developing enterprise risk management (ERM) principles, and their application may vary widely from company to company. Consequently, they remain subject to interest and scrutiny from external parties such as regulators and rating agencies.

This publication describes a number of principles relevant to the development, maintenance, and application of stress testing and scenario analysis frameworks.

The objective of the publication is that these principles will be useful guidelines to interested stakeholders who may be developing, reviewing or using stress testing and scenario analysis as risk management tools. They are intended to be applicable to insurance company models and could help guide a company's internal procedures, policies and processes. Additionally, they may be useful to external stakeholders, such as rating agencies and regulators, as they consider how an insurer's framework has been developed and is being applied.

The CRO Council's perspective is that there are many interrelated components to a strong ERM program:



Stress and scenario testing is one of the core components of such a program. Due to the interconnectedness of the ERM framework, scenario analysis directly supports capital management while also informing risk appetite. This helps to identify and measure key risks, which leads to refinement of stress selection and scenario analysis. Thus, scenario analysis can be seen as fitting within a broader ERM framework, which is the foundation for the principles described in this publication.

Stress testing and scenario testing are distinct and related analysis processes in which one or more metrics related to the risk or solvency of the insurer is examined to see how the metrics might perform under potential conditions. The conditions may be favorable or adverse and may include extreme or mild outcomes. This publication uses the following terms:

- Stress testing: assessing the impact of a targeted event (e.g., a 30% decline in the S&P 500 index).
- Scenario testing: assessing the simultaneous impact of a set of events (e.g., global recession), often related to a historical benchmark.
- Reverse stress testing: analyzing an adverse outcome such as business failure to identify the circumstances that might cause this to occur.

Implicit in the use of stress testing is an understanding of the likelihood of the stress in addition to the ability to measure its impact. As discussed throughout the principles (most directly in Principle 10), the impact may be measured in a number of qualitative or quantitative ways under different accounting frameworks, as dictated by the insurer's objective function. The term "scenario analysis" is used in broad reference to each of these.

Scenario analysis maintains a close relationship with supporting models. A well-functioning scenario analysis framework demands robust models to perform the analysis, and at the same time, the results of scenario analysis can inform further refinement to the models. Thus, models are crucial for this process, but the focus of this paper is not directly on the models. Models are addressed more directly in a separate CRO Council publication entitled *Capital Modeling Principles and Practices in the Insurance Industry*.

In practice, scenario analysis can vary considerably in structure, calibration and application, and one of the important conclusions to be drawn from a number of the principles described is that there is no "one size fits all" approach to developing a scenario analysis framework. Differences in company structure, business written, as well as in management's philosophy and practice in managing risk and capital associated with that business can lead to different approaches being more applicable for some insurers than others.

It should be noted that the principles described in this paper were developed from the collective thinking of the North American CRO Council membership. The principles were derived based on the member companies' current and planned practice across a range of areas such as design, processes, features, use, and limitations. As such, it is important to note that these principles are grounded in practice. It should also be noted, that while they reflect practice of CRO Council companies, they are intended to be broadly applicable to the insurance industry, regardless of company size, location or business written.

The principles are summarized at the beginning of the Core Scenario Analysis Principles section, followed by a more detailed discussion of each. Although the reader is encouraged to review the

discussion associated with each principle, there is not a strict sequential order, so it is possible to focus directly on areas of particular interest.

Section 3: Core Scenario Analysis Principles

A high level summary and reference chart of the core stress and scenario principles can be found below. However, the reader is highly encouraged to read the accompanying background and detail that follow under each principle. The detail includes useful background context, explanations, examples, and applications that will enable the interested reader to apply the principles effectively.

No.	Principle	Brief Description
	Governance & Process	
1	Scenario analysis requirements/approach should reflect the scale and complexity of the insurer	• Not a "one size fits all" endeavor
2	Scenario analysis should be understood and actively supported by senior management with Board oversight	• Senior management should use in strategic planning • Board should review and approve the framework
3	Scenario analysis should supplement other risk management tools	• Not a "silver bullet" • Used for uncovering vulnerabilities that may not be captured in other tools
4	Scenario analysis should be a flexible, fluid process rather than a mechanical exercise	• Should include both qualitative and quantitative inputs and outputs
5	The infrastructure and process should allow for timely analysis	• Able to perform ad-hoc as well as scheduled analysis • Inform risk management on emerging threats
6	Scenario analysis should be subject to a documented governance approach, supported by policies and procedures, and subject to independent review	• Documentation should be clear and up to date • Actual policies and procedures should align with intended use • Should be performed by professional staff with appropriate level of expertise
7	Scenario analysis should be communicated effectively to encourage discussion and debate	• Internal and external communications should occur with appropriate clarity and frequency • Iterative feedback and enhancement
	Objective Function	
8	Scenario analysis should be linked with and tailored to clear objective functions	• Link to capital • Link to earnings • Link to resiliency
9	Scenario analysis should be actionable, with links to key risk and strategy decisions	• Link to risk appetite and limits • Link to liquidity levels • Link to growth targets
10	Scenario analysis should consider qualitative and quantitative impacts	• Qualitative includes reputation and resiliency • Quantitative includes capital, earnings, liquidity
11	Scenario analysis should be used to challenge existing assumptions and calibrations	• Results should inform other areas of the business • Business judgment should be used to understand results
	Design & Analysis	
12	The design should consider multiple time horizons	• Should address both short-term tactical and long-term strategic risks • Consider instantaneous as well as multi-year impacts

13	The design should consider impacts on all appropriate accounting or valuation lenses	• Link with objective function to identify relevant regimes
14	The design should consider the frequency and severity of core risks, recognizing both historical and prospective relationships	• Both historical events and prospective indicators • Reverse stress testing to identify sources of objective failure • Identify possible departures from historical norms • Include imaginative and flexible approaches to scenario analysis
15	The design should include all appropriate aggregation levels	• Aggregation to product lines, business units, legal entities • Balance sheet impacts as well as income statement impacts
16	The design should account for management action	• Assess and challenge effectiveness of risk mitigation actions • Use metrics and models consistent with those used in other parts of the organization
17	The design should account for single events as well as concurrent scenarios	• Consider all material risks relative to the objective function • Include a sufficiently broad range of events to understand the full risk profile

Governance and Process

1. Scenario analysis requirements/approach should reflect the scale and complexity of the insurer

A scenario analysis framework should be developed with an understanding of the purpose it will serve within the organization. By clearly defining the purpose, scope, and dependencies, risk managers set the context to ensure that the framework is appropriately aligned with business objectives, and that users of the framework will apply it consistently with these objectives.

Due to differences in company structure, business written, and management philosophy, individual companies can expect to develop distinct approaches to scenario analysis. Additionally, practical constraints associated with time and resource availability may further differentiate individual companies. Although the principles described in this publication should guide the development of these frameworks and provide a common link across organizations, scenario analysis is not a “one size fits all” endeavor, and company-specific influences should drive much of the design.

The complexity of the insurer should be a key factor in defining, applying, and interpreting scenario analysis. More complex company structures require analysis to be performed at multiple levels within the organization, capturing detailed product level characteristics as well as higher level results at the regional, business unit, or legal entity level. Allowances for interaction across different levels must also be taken into account. Incorporating these concepts into scenario analysis design is the subject of Principle 15 (“The design should include all appropriate aggregation levels”).

Similarly, complexity in the insurance products written may require more careful consideration of stress scenario definitions to ensure that distinct risk characteristics are captured appropriately. This requires coordination between ERM departments and product teams. Product teams can provide key

insight into unique product characteristics that influence sources of risk. Additionally, product teams can help ensure that stress scenarios are defined in a way that is capable of being applied within existing actuarial projection systems.

Increased complexity generally creates the need for increased controls. Governance procedures should be established and communicated throughout the organization, and there must be a defined method for ensuring that these procedures are followed. Governance should be reflective of the size of the insurer, for example, large insurers may depend on multiple teams to apply the scenario analysis framework, with clear lines of communication to ensure that procedures are followed consistently, while small insurers or insurers with a homogeneous set of products might rely on an individual process owner who supervises other key individuals.

2. Scenario analysis should be understood and actively supported by senior management with Board oversight

Active support from senior management is critical for the development and ongoing use of scenario analysis. Senior management buy-in facilitates the acquisition of resources including people, time and systems to carry out the analysis. Additionally, leaders at the top of the organization set the tone for managing risk and applying controls at different levels within the company. Senior management can be especially influential for the ongoing maintenance of a scenario analysis framework after its initial establishment by ensuring that, rather than turning into a routine compliance exercise, it continues to receive appropriate prioritization and oversight.

In order to promote scenario analysis, senior management must have a clear understanding of how to extract value from the framework. Leaders should be able to take action based on results, which requires a clear establishment of how possible outcomes relate to intended objectives (discussed further in Principle 8). Links should be established with strategic planning, which is the topic of Principle 9, and these should be subject to periodic review. Additionally, senior management is uniquely positioned with a broad view of other initiatives within the organization, and from this perspective may be able to contribute to early identification of potential synergies that can be leveraged or obstacles that should be avoided.

The scenario analysis framework should be communicated to the Board, emphasizing how the framework supports business objectives. The Board's role is to review the overall approach, including management action taken as a result of analysis performed. Although the Board is unlikely to play a direct role in scenario selection, they should understand the use of scenarios and should challenge senior management to justify why the scenarios are relevant to the business. Additionally, the Board can further contribute to setting the appropriate tone throughout the organization to promote consistent application of scenario analysis and other ERM processes.

3. Scenario analysis should supplement other risk management tools

Although scenario analysis provides key insight into risk exposure and opportunities, it is not a "silver bullet" to accomplish all possible objectives on its own. In several cases, scenario analysis adds value through its interaction with other ERM systems:

- Stress test results may be core inputs to an internal risk capital model. In particular, a relatively straightforward approach to calculating capital requirements takes a set of stress test results and aggregates through multiplication with a correlation matrix. Alternatively, a more complex framework may use a range of stress test results to calibrate a full loss distribution for the business.

- Stress test results may be used to validate internal risk capital models. Conclusions drawn from a capital model may be compared to existing stress test results to ensure that material risk drivers have been captured adequately.

- Stress test results may be used to validate or parameterize economic scenario generators.

- Scenario analysis can be used to understand vulnerabilities that may not be captured by other tools. Management can gain additional comfort and obtain a more complete picture of the overall risk profile by defining key scenarios of interest in addition to a broad range of stochastic scenarios or standalone stress tests.

- Reverse stress testing can be referenced to assist with the communication of capital requirements and sources of risk to a wide audience of stakeholders.

As the interaction of complementary ERM tools often forms part of an iterative feedback and improvement cycle, lines of communication must be established between systems and teams. To the extent that conclusions drawn from scenario analysis results differ from conclusions drawn from other tools, validation should be performed to explain any differences and inform appropriate actions taken in response to these results. To the extent that scenario analysis results reinforce conclusions drawn from other tools, those conclusions could be viewed with a higher level of credibility (still subject to business judgment discussed in Principle 11). By maintaining a holistic view of other ERM tools and their distinct purposes, risk managers can ensure that scenario analysis frameworks are developed in an optimal way to support business objectives.

4. Scenario analysis should be a flexible, fluid process rather than a mechanical exercise

As the role of scenario analysis within an organization continues to be refined, development of the framework should remain an iterative process, incorporating detailed feedback and high level

guidance from key stakeholders. Obtaining buy-in from key stakeholders within the organization is important to promote adoption of scenario analysis within existing and developing business processes. To ensure that stakeholders are supportive of scenario analysis efforts, feedback should be obtained at regular intervals and incorporated into the development and application of stress scenarios. As internal buy-in continues to evolve, often in conjunction with training and increased understanding of potential uses and benefits, the unique perspectives from different functions within the organization can provide valuable insight for continued development, and in turn, scenario analysis can inform further refinement of business processes.

External factors, especially those attributable to the economic environment, play an important role as well. For example, changing economic conditions demand a review of stress scenarios to ensure that they remain aligned with management's objectives. As new threats emerge, additional testing should be incorporated to assess the potential impact of these threats. Additionally, evolving industry best practices in the measurement and projection of assets and liabilities demand regular review of underlying valuation systems, which may indirectly impact the measurement of scenario impacts.

Changing demands from senior management may also warrant a review of the scenario analysis process. For example, a refinement in strategic objectives or a revision to the risk appetite statement could place increased attention on certain risks while reducing the significance of others. In this example, stresses would be recalibrated to ensure that they produced relevant information to remain aligned with the company's approach to risk management.

The information obtained from scenario analysis will often highlight areas where further investigation is desired, at which point resources can be allocated accordingly to further build out scenario analysis capabilities. A culture that promotes an ongoing process of feedback and subsequent refinement enriches the overall process and better enables the model to meet the requirements of each key stakeholder.

5. The infrastructure and process should allow for timely analysis

For scenario analysis to be useful, it needs to be able to provide information to users in timeframes that ensure the information is relevant, fresh, and segmented appropriately. The need for timely analysis is therefore an important requirement for any system and process design.

This can present challenges for many insurers where complex models may have very significant timelines. However, the level of precision in these detailed models may not always be needed to meet the objectives of the scenario analysis. In these situations, it may be appropriate to sacrifice some aspects of model precision for the benefit of improving timeliness. This is not to say that the calibration of stress scenarios is in vain or that results cannot be trusted. Indeed, for many of the intended uses of stress scenario analysis, there does not need to be the same high degree of precision as there may be for other models (e.g., policy level statutory reserving models). To maximize the potential for embedding scenario analysis into business management, a balance must be struck between the

pursuit of mathematical precision and the practical ability to calculate materially correct results when needed.

Fundamental to achieving the optimal balance is a common understanding of how the scenario analysis framework will be used. Key aspects to consider include:

- Scope and complexity of the analysis. Scenario analysis supports certain areas of the business, and it must appropriately capture material risks to which the business is exposed. However, it is neither possible nor desirable to capture every possible event that could potentially impact the company, so practical development guidelines should be established when defining scenarios.
- Interaction with other decision-making tools. To the extent that the analysis is the primary tool used to support business decisions, resources should be allocated to develop the framework for these purposes. On the other hand, to the extent that the analysis is a supporting tool for other business processes, the ability to produce high level metrics or general directional impacts may be sufficient.
- Output requirements. The level of detail, frequency of results, and audience associated with scenario analysis results should be identified, and output reports should be developed to meet these requirements. Overinvestment in producing excessively detailed reports does not necessarily add value or clarity and may even restrict the ability of stakeholders to take action.

By structuring the scenario analysis framework around its uses, stakeholders can focus their attention on the relevant pieces of information and can adapt more readily to changing conditions. For example, during periods of heightened uncertainty (which by their nature are difficult to predict), increased demands may be placed on the scenario analysis team to understand emerging threats and potential outcomes. Ensuring that the scenario analysis framework is capable of responding to these situations enables risk managers to efficiently leverage available information and maintain an updated view of the company's risk profile.

6. Scenario analysis should be subject to a documented governance approach, supported by policies and procedures, and subject to independent review

As with all modeling frameworks, documentation plays an important role in support of governance procedures. The following items should be included in documentation:

- The objectives of the scenario analysis
- A specific individual or team who owns the process, along with their respective roles and responsibilities
- Details of the stresses and scenarios being analyzed

- Justification for why the stresses and scenarios were chosen
- A description of models used in the analysis
- The extent to which expert judgment has been relied upon
- A process for updating the scenarios
- How and when results should be reported

Documentation should remain up to date, which requires periodic reviews to ensure that new information or procedures are captured appropriately. One way to accomplish this is to establish that any changes to the framework require immediate documentation updates in conjunction with the approval process. Another approach, which may be performed in addition, is to assign a documentation owner with a defined schedule of periodic reviews. While assigning individual responsibility and establishing accountability are often effective ways to ensure that documentation is maintained, it must be understood that ultimately the entire team shares responsibility for documenting their approach.

In conjunction with the establishment and review of documentation, regular reviews should also be undertaken to ensure that actual procedures being followed support intended use. Neither the creation of documentation nor the analysis of stress scenarios is an end goal by itself; rather, these are both important supporting tools in pursuit of a broader ERM objective. Clearly defining the objectives and retaining a focus on those objectives are what allow value to be extracted from scenario analysis.

Professional staff with the appropriate level of expertise should be involved in all stages of the process. Although certain components of the analysis may be automated, independent reviews are required to confirm that the analysis has been performed as intended and the results are interpreted consistently with established principles.

7. Scenario analysis should be communicated effectively to encourage discussion and debate

Effective communication enhances risk management by providing information that may be used to make decisions, enhance processes, or identify emerging issues. As with most models, it is usually preferable that scenario analysis results are not used in isolation. Supplementing scenario analysis with additional information obtained from other established processes creates a richer set of information to inform strategic decisions. To the extent that opposing conclusions could be drawn from different decision-making tools within the organization, results must be reviewed to explain any conflicts before taking action. Additionally, in many situations, relative changes or directional impacts are often viewed as more useful than the absolute level of results. When referencing modeled results, including those from internal risk capital models, management should make use of many tools available at their disposal for internal benchmarking. For example, results that differ significantly from those implied by historical trends may indeed be valid, but further review would be warranted in the

absence of a satisfactory explanation. Independent points of view should also be considered, as unique perspectives from distinct areas of the company might influence holistic action taken at the enterprise level. By maintaining an awareness of the intended purposes for which scenario analysis has been developed, senior managers can incorporate strategic considerations and the results of other models to ensure that they have a complete perspective for making business decisions.

It is crucial for risk owners to have a good understanding of how calculations are performed, including reliance on external sources, and this information must be communicated to decision makers along with results. Accompanied by this context, scenario analysis results can provide useful input to inform decisions in conjunction sound business judgment.

In addition to communicating results from the analysis, internal coordination during the early stages of analysis is also valuable. There should be coordination among risk experts and business units when establishing key scenarios for consideration. Although there may be good reasons for different areas of the business to focus on different scenarios, there should be a common level of understanding with respect to the methods used for identifying these scenarios. Similarly, establishing a common structure and tone for reporting results helps both internal and external audiences to understand the results of the analysis, ultimately positioning leaders to identify areas where additional focus may be needed or where action should be taken.

Objective Function

8. Scenario analysis should be linked with and tailored to clear objective functions

Scenario analysis can address multiple purposes while focusing on a range of potential stresses and scenarios, and upfront recognition of this potential diversity encourages the placement of appropriate design elements and controls. Scenario analysis can have important potential applications in a number of areas, including:

- Strategic planning
- Solvency monitoring
- Risk mitigation, including reinsurance and hedging decisions
- Product development and pricing
- Risk appetite
- Investment strategy and asset allocation

For each area of use, key scenarios must be identified along with a model for analyzing the impact of those scenarios. An important point is that the intended use of the analysis should drive the scenario selection and design decisions. For example, if the focus of the analysis is on product development and pricing, scenarios should cover all relevant risks for the product and should be run through detailed product models. As an alternative example, if the focus of the analysis is on investment strategy, the emphasis would generally be on market scenarios and may involve less granular liability models. Influencing factors such as the ability to communicate results should also be considered when establishing scenarios. The enterprise-wide context for the analysis may also play an important role. For example, if the analysis performed by a domestic insurer is a subset of a larger, global analysis, then additional care may be required to ensure consistency between scenarios for aggregation purposes.

As discussed in Principle 3, scenario analysis is often called upon to supplement existing tools. Establishing how the analysis will interact with other models and metrics to inform decision-making should be considered when developing the scenario analysis framework. Clarifying the intended use provides important context for internal and external stakeholders. By ensuring that objectives are identified and agreed upon upfront, a common reference point is established for communicating and interpreting results.

9. Scenario analysis should be actionable, with links to key risk and strategy decisions

Principle 8 discusses the links that should exist between the design and the objectives of a scenario analysis framework. To maximize the potential for achieving those objectives, there should be a process for timely reporting of relevant information to the right people along with a process for taking action based on the reported information. The establishment of actions in response to modeled results elevates the framework from a simple source of information into a decision-making tool that can be used to add value throughout the insurance organization.

A successful action strategy contains certain key components, for example:

- Triggers – Triggers identify situations under which action should be taken. For example, a company might define a range of equity scenarios and a maximum tolerance for equity exposure within that range. If any of the stress scenarios were to exceed the stated tolerance, risk mitigating actions would be triggered.

- Actions – The actions themselves must be defined so that once a trigger is activated, the action can be executed. At least one action should be associated with each distinct trigger. Actions should generally be defined as higher level strategic responses rather than detailed transactions, as this promotes flexibility to respond to changing business conditions and economic environments. For example, once a threshold is exceeded for maximum equity risk exposure, the strategic action might consist of an escalation of the issue to a defined individual or committee, who could then identify an appropriate response.

- Ownership – Ownership must be declared to ensure that actions are taken appropriately. In addition to performing the scenario analysis, an individual or team should be responsible for reviewing the results and identifying triggers. An individual or team should also be responsible for translating the strategic action into a specific task and executing that task. Although this process includes distinct areas of ownership, it is possible that the same team will own each.

Principles related to risk appetite and strategy statements are discussed more thoroughly in a separate publication.

10. Scenario analysis should consider qualitative and quantitative impacts

Scenario analysis should consider both qualitative and quantitative impacts to produce a more complete picture of risk. A quantitative analysis could include the impact of scenarios on capital, earnings, liquidity, or other financial statement metrics, with the purpose of the analysis dictating which metric is most appropriate—for example, if the focus were on solvency, capital measurements would be critical, while if the focus were on quarterly financials, earnings would typically be more relevant. The level of granularity contained in the risk appetite statement should also influence the choice of metrics to ensure that the analysis can be directly linked to risk appetite for supporting strategic risk management decisions.

A qualitative analysis provides additional insight for risks that are traditionally difficult to capture in mathematical models. Qualitative metrics include reputation, resiliency, and innovativeness. As with a quantitative analysis, the purpose of the analysis should dictate the choice of qualitative metrics—for example, a company that brands itself as a leader in providing creative solutions might be particularly concerned with how potential changes in the labor market could impact its ability to innovate.

When designing qualitative and quantitative metrics, there is a subtle distinction between how the metrics influence the measurement of scenario impacts and how the metrics influence the scenarios themselves. Scenarios may consist of qualitative events (e.g., system errors lead to financial misstatements) or quantitative events (e.g., global equity markets decline by 20%). After the scenarios are defined, a similar distinction must be made between measuring the impact qualitatively (e.g., how the scenario impacts a company' reputation) or quantitatively (e.g., how the scenario impacts earnings). A close relationship exists between the design of the scenario and the measurement of scenario impacts, as both should be directly influenced by the purpose of the analysis.

11. Scenario analysis should be used to challenge existing assumptions and calibrations

Scenario analysis is an important source of information to supplement other processes or models. Models should not be used in isolation, and supplementing models with additional information obtained from other established processes creates a richer set of information to inform strategic decisions. By testing specific scenarios or isolating stresses on individual assumptions, scenario

analysis provides detailed results that may be used to reinforce existing calibrations or challenge assumptions from other models. To the extent that differing conclusions could be drawn from different decision-making tools within the organization, results must be reviewed to explain any conflicts before taking action.

Models can provide useful output to inform and influence decisions but cannot replace sound business judgment. Models and their limitations must be understood in the context of how they are used, with periodic review and refreshes to ensure that design, resources, and objectives remain aligned. Scenario analysis can support this review in different ways. Applying individual stresses may produce unexpected results, highlighting the need for more detailed analysis that might have been overlooked in base conditions. Additionally, reverse stress testing provides additional insight into key scenarios which might influence the calibration of capital models, especially if tests suggest unusual sources of risk.

When performing reviews and analysis on model calibrations, clear communication helps to ensure that results are interpreted correctly. Ensuring that all relevant teams are included in testing models and reviewing results is important for formulating an action plan in response to any main conclusions drawn from the analysis.

Design & Analysis

12. The design should consider multiple time horizons

The design of a scenario analysis framework should consider impacts over multiple time horizons. For example, the application of stresses over a one year risk horizon may produce significantly different conclusions compared to the application of stresses over a five year risk horizon, and additional insights can be obtained by analyzing both, with an awareness of similarities and differences in underlying assumptions.

Scenario analysis may be called upon to support multiple business objectives, which should require consideration of multiple time horizons. For example, stresses performed to analyze liquidity risk exposure might involve a horizon of less than one year, while scenarios used in support of business planning could span several years. When used for business planning, the time horizon should be consistent with the business planning period, which often requires the analysis to be performed over multiple subsequent years.

The design of a scenario analysis framework should reflect its use, which may include support for both shorter-term tactical objectives as well as longer-term strategic objectives. In conjunction with the purpose of the analysis, the length of the time horizon may influence certain technical components of the framework. Longer time horizons introduce additional calibration complexity when attempting to account for a wider range of possible outcomes, which may introduce modeling or extrapolation risk that needs to be managed. Additionally, longer time horizons may demand the inclusion of certain

components that would be less material for shorter time horizons, such as strategic management actions or new business forecasts. Recognizing the potential complexity of longer time horizons, the requirements for a scenario analysis used in this capacity often emphasize higher level direction and understanding rather than strict numerical precision.

13. The design should consider impacts on all appropriate accounting or valuation bases

Identifying the appropriate valuation basis is critical when designing a scenario analysis framework, and the valuation basis should align with the business objectives for which the framework will be used. As the framework may support multiple objectives, multiple valuation bases should be chosen as appropriate for each objective. For example, performing stress tests in support of regulatory reporting requirements in the United States generally mandates a defined statutory basis, while calibration of an internal risk capital model requires financials to be measured consistently with how the business is managed, which can vary from company to company.

The selection of an appropriate valuation basis generally defines which models will be used to perform the analysis, and in this way, the valuation basis also influences the definition of stresses. By reviewing characteristics such as the scope of business to include and the level of granularity within the company structure, risk managers can ensure that the analysis is consistent with capabilities of existing models. For example, if mortality assumptions within the selected model rely on a generic unisex table, it would not make sense to define complex mortality stresses that vary by gender and underwriting status. Additionally, practical considerations such as run time and resource availability should be considered.

14. The design should consider the frequency and severity of core risks, recognizing both historical and prospective relationships

Regardless of the implementation approach or valuation basis, calibration of risks and dependencies between them is a critical design component. Historical events and observed relationships over time should be analyzed to produce empirical estimates of possible future outcomes. From this analysis, risk managers may wish to identify specific scenarios for additional focus. At the same time, risk managers must also acknowledge that emerging trends could cause future outcomes to diverge materially from past experience. The uncertainty of prospective events can be incorporated into the analysis in a number of ways:

- Increasing historical volatility with a margin for conservatism
- Maintaining a set of emerging risks that are distinct from more traditional sources of risk
- Performing trend analyses to identify changes in risk over time

When looking across multiple risks, consideration must be given to statistical relationships between them. Again, historical data may be useful to calibrate these dependencies, but these assumptions should be challenged. Risk management often involves consideration of extreme events, and relationships between risks may emerge very differently in a stressed environment, and this might not be captured in available historical data. Due to potential challenges associated with credibly estimating future dependencies, additional model testing should be performed to quantify the sensitivity of results to these assumptions.

In addition to traditional stress testing, which measures the impact of targeted risk events, reverse stress testing should be considered. Reverse stress testing attempts to uncover the specific scenario or set of scenarios that could produce a given adverse outcome. This identification of potential sources of objective failure provides additional insight for informed decision-making.

15. The design should include all appropriate aggregation levels

A scenario analysis framework should be aligned with an insurance company's risk management structure, which generally considers different dimensions at multiple levels within the organization. Measuring the impact of stresses performed at varying levels of granularity gives management key insight into risk exposures, enabling better management of blocks of business across regions, business units, or other entities in the management structure.

Insight into actual and potential diversification benefits between products, risks and regions is an important part of understanding an insurer's risk profile which requires analysis to be performed at aggregate levels. In addition to measuring existing sources of diversification benefits, focus can also be given to the potential impact of adding or removing products and entering or exiting markets. As with other design elements, the purpose of the scenario analysis framework and the company's business objectives determine the specific focus of the analysis.

When assessing aggregate results, detailed, lower-level models continue to play an important role. In practice these models, in conjunction with an aggregation function, are often responsible for producing output to inform the analysis. Furthermore, product owners and local subject matter experts should be involved when interpreting and communicating modeled results.

16. The design should account for management action

Scenario analysis should account for management actions, including both proactive risk controls and reactive loss mitigation under stressed conditions. For example, management actions may include:

- Hedging
- Reinsurance
- Operational controls

- Sale of distressed business units
- Modifying premium scales for new business
- Adjusting credited rates

When incorporating these into models, each action's effectiveness should be assessed and challenged. Governance and documentation should be in place to describe how management actions have been determined and how they could change in reaction to changing environments. Recognition should be given to the fact that the environment which triggers the action may also inhibit the action's success. For example, selling a struggling business unit is not a viable strategy if prospective buyers are unable to tolerate the associated risk or unable to raise the necessary level of capital. In practice, identifying and incorporating management actions may be an iterative process as the effects of the action are picked up and analyzed by rerunning the scenario analysis.

17. The design should account for single events as well as concurrent scenarios

A scenario analysis framework should include all risks that are material to the objective function being considered. To achieve a sufficiently inclusive set of tests, both single events (e.g., the S&P 500 index declines 40%) as well as concurrent scenarios (e.g., a global recession causes a decline in all major equity indices, a widening of credit spreads, and increased liquidity concerns). While single events facilitate a more specific focus on selected risk drivers, concurrent scenarios are a more realistic reflection of actual market behavior and give additional insight related to the interaction of key risks. The analysis should account for the possibility that the impact of concurrent scenarios on capital adequacy, earnings volatility, and other metrics may be greater or less than the sum of the impacts of each individual event in isolation.

The stresses and scenarios tested should span a sufficiently broad range of events to capture the insurer's overall risk profile. Although risk management often maintains a focus on the tail of each distribution, this does not mean that mild or favorable scenarios should be overlooked. Indeed, while the realistic scenarios that cause an insurer to miss its objectives have an extreme impact overall, the components of those scenarios will most likely include individual risk drivers moving in different directions and at different levels within their probability distributions. Accurately assessing the overall impact of such scenarios requires an understanding of the full range of possible events.

Section 4: Conclusion

As insurers establish and refine their risk and capital management capabilities, scenario analysis continues to play a role as part of companies' risk management and decision-making processes. In this paper the North American CRO Council has presented its perspectives on this type of analysis.

The principles described in this paper relate to the design, application and governance of scenario analysis frameworks. The principles are intended to promote sound practices with respect to scenario analysis and be a useful reference for their various stakeholders. This would include those tasked with designing and developing the framework, as well as management and the Board looking to use the framework to make better informed decisions. By following the principles presented in this paper, insurers will be able to incorporate scenario analysis in support of a broad array of strategic business decisions and in so doing enhance the overall utility and value of the analysis to the insurer.

The principles address a range of topics and one of the most critical themes highlighted in a number of them is the importance of context in developing a scenario analysis framework. Factors such as the type of business and risks the insurer writes and how these are managed in practice should be kept in mind when designing the analysis and communicating results. Similarly, it is important that the ultimate intended use(s) be accounted for when developing, validating, and applying the scenario analysis framework.

In addition to providing direct benefits to insurers internally, it is expected that these principles will be of value to external stakeholders such as regulators and rating agencies as they assess the strength and soundness of insurers' scenario analysis frameworks, particularly to the extent that these assessments will impact the regulator or rating agency's view of the insurers' risk and capital management practices.

Note that though the paper lays out a number of principles that can be applied to the development and use of scenario analysis frameworks, this should not be interpreted as the CRO Council attempting to prescribe a particular methodology or approach that all insurers should adopt. Indeed, by applying the principles laid out in this paper, it should be expected that different companies will end up with different approaches, given their specific characteristics, views and objectives. By implication, the principles do not support a "one-size-fits-all" approach, and it is the CRO Council's view that there are dangers in applying such a view to the design, implementation, or governance of scenario analysis frameworks.

North American CRO Council

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