



SOCIETY OF ACTUARIES

## SOA Research Paper

# Economic Capital for Life Insurance Companies

February 2008

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# Background



With EC taking on increasing importance, the SOA Committee on Financial Research commissioned a paper aimed at U.S. life insurers

## The Research Objectives Covered the Mechanics and Implementation of EC Frameworks

- Discussing the common EC methods including advantages and disadvantages of each method
- Identifying factors that should be considered in the development of an EC program
- Discussing applications of EC results in pricing, management incentives, capital allocation, performance measurement and capital management
- Exploring the relationship between insurance company EC methodologies and other existing or developing solvency and risk capital frameworks
- Other objectives included identifying various issues surrounding a successful implementation, target audiences and communication, various technical issues, as well as resourcing, timing and cost considerations

The report was developed by the Tillinghast insurance consulting practice of Towers Perrin (“Tillinghast”)

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- The study was developed by Tillinghast consultants with global and U.S. specific experience with EC
  - Ian Farr — London
  - Hubert Mueller — Hartford
  - Mark Scanlon — New York
  - Simon Stronkhorst — New York
- Significant industry input was provided by the Professional Oversight Group
  - Stephen Marco — Genworth
  - Gang Ma — ING Investment
  - Larry Moews — Allstate
  - Link Richardson — AIG American General
  - Kenneth Vande Vrede — Genworth
  - Steven Siegel — SOA
  - Jeanne Nallon — SOA

# EC Frameworks in Practice

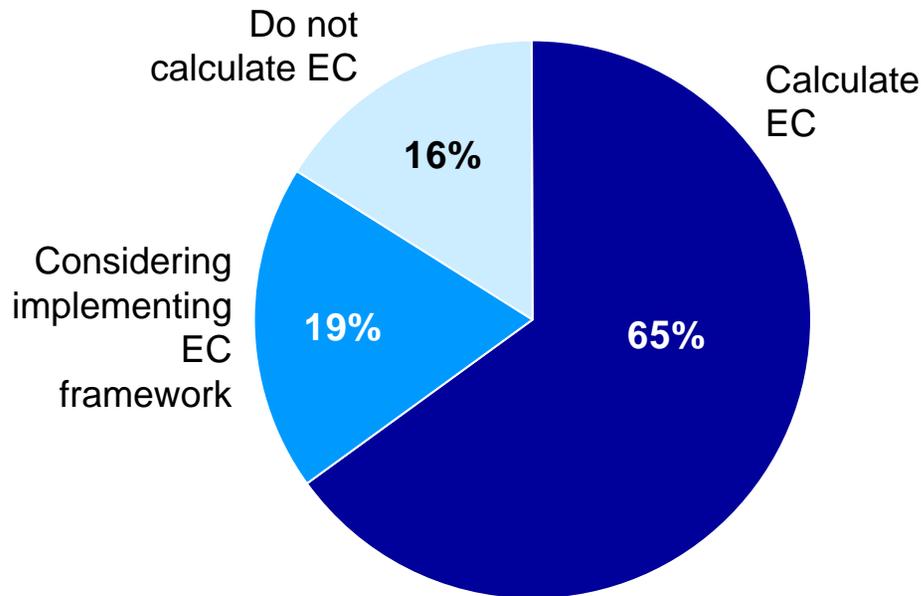


## The various ways in which capital influences shareholder value combine to drive the capital the insurer ultimately holds

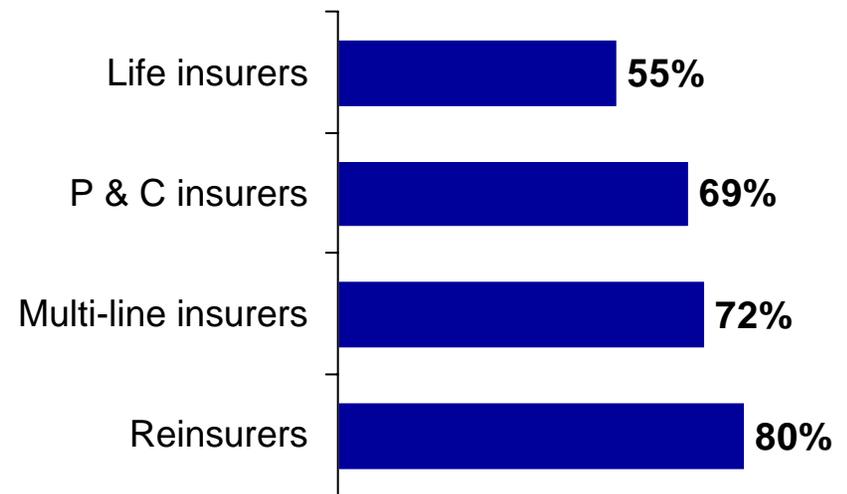
- Capital held by an insurer represents the excess of value of assets over the value of liabilities
  - Different definitions arise from different accounting conventions such as
    - inclusion of specific assets and liabilities (e.g., exclusion of intangible assets)
    - application of different methodologies (e.g., book vs market value, inclusion of prudent margins in liabilities)
- Important that capital required to support the business (required capital) and capital available to meet this requirement (available capital) are defined and measured consistently
  - Economic capital typically refers to the required capital where assets and liabilities are determined using economic principles
- Shareholders will seek to minimize the level of capital held, subject to being able to attract and retain an ongoing stream of policyholders
  - Holding additional capital attracts more risk averse policyholders and reduces costs of financial distress, thus increasing franchise value
  - However, more capital attracts frictional costs, relating to tax, investment costs and agency effects
- EC has become the key metric for assessing and quantifying risk within an Enterprise Risk Management (ERM) framework
  - Seen as a key part of strategic risk management when rating agencies assess an insurer's ERM capabilities

The importance of an EC analysis within an active risk management framework has increased substantially over the past several years, although life insurers have been slower to institute EC frameworks

**Prevalence of EC Calculation Globally**



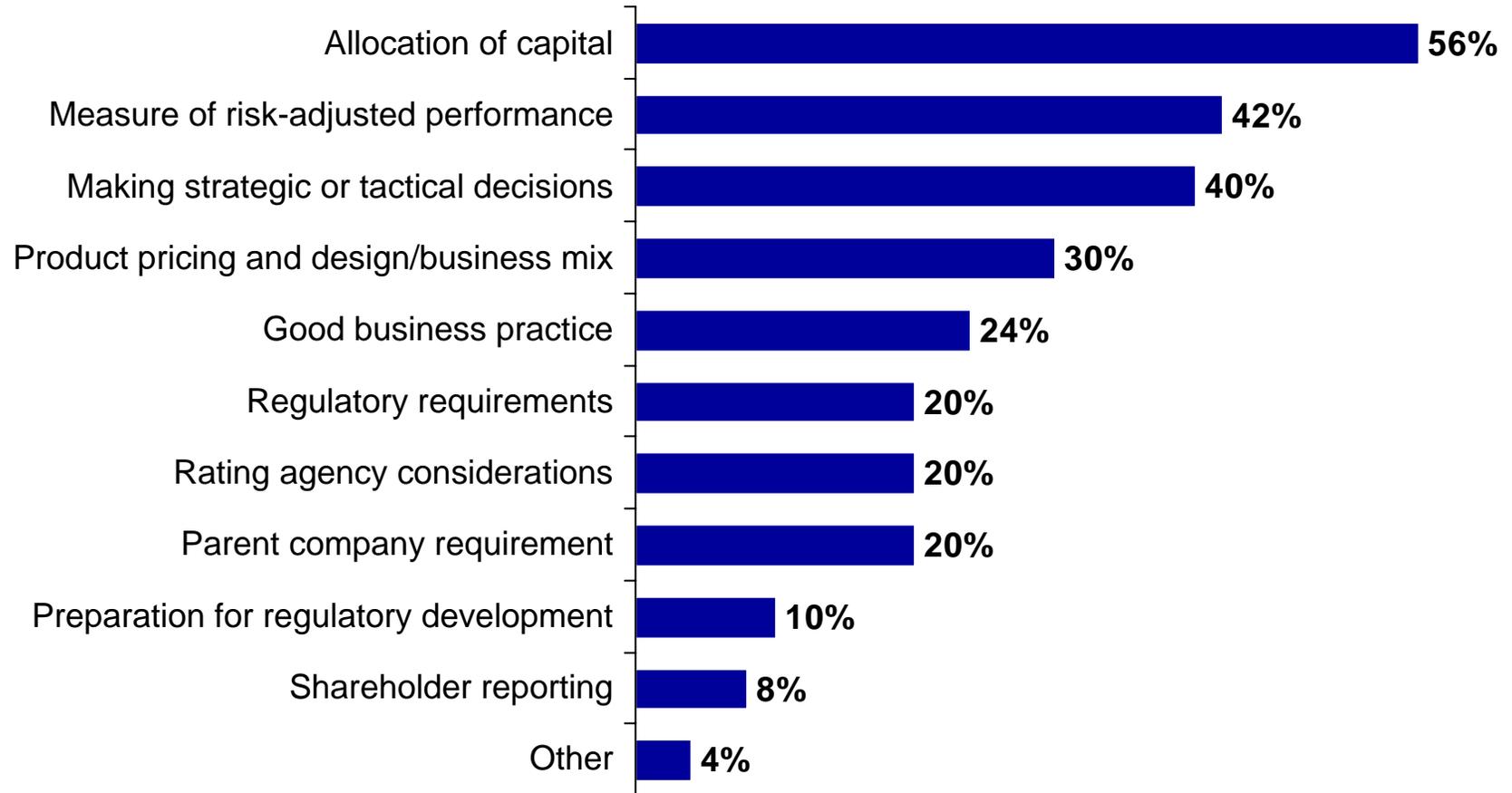
**Prevalence of EC Calculation by Type of Insurers**



Source: Tillinghast 2006 ERM Survey.

There are numerous reasons why insurers calculate EC

### Primary Drivers for Calculating EC



Source: Tillinghast 2006 ERM Survey.

## Observed differences in practice by region reflect differences in external drivers behind EC calculations in North America vs Europe

- Implementation methodology
  - Stress testing and stochastic approaches both common
- Measure of risk
  - Conditional Tail Expectation (“CTE”) and Value at Risk (“VaR”) are equally popular globally
  - CTE more common in North America
- Assessment period
  - Increased use of a one-year horizon, particularly in Europe
  - Portfolio runoff more common in North America
- Aggregation of risks
  - Use of correlation matrix prevalent

Survey results confirm use of two main approaches in practice:  
a liability runoff approach and a one-year mark-to-market approach

## Two Main Approaches to EC



## There are a number of different ways in which to define EC

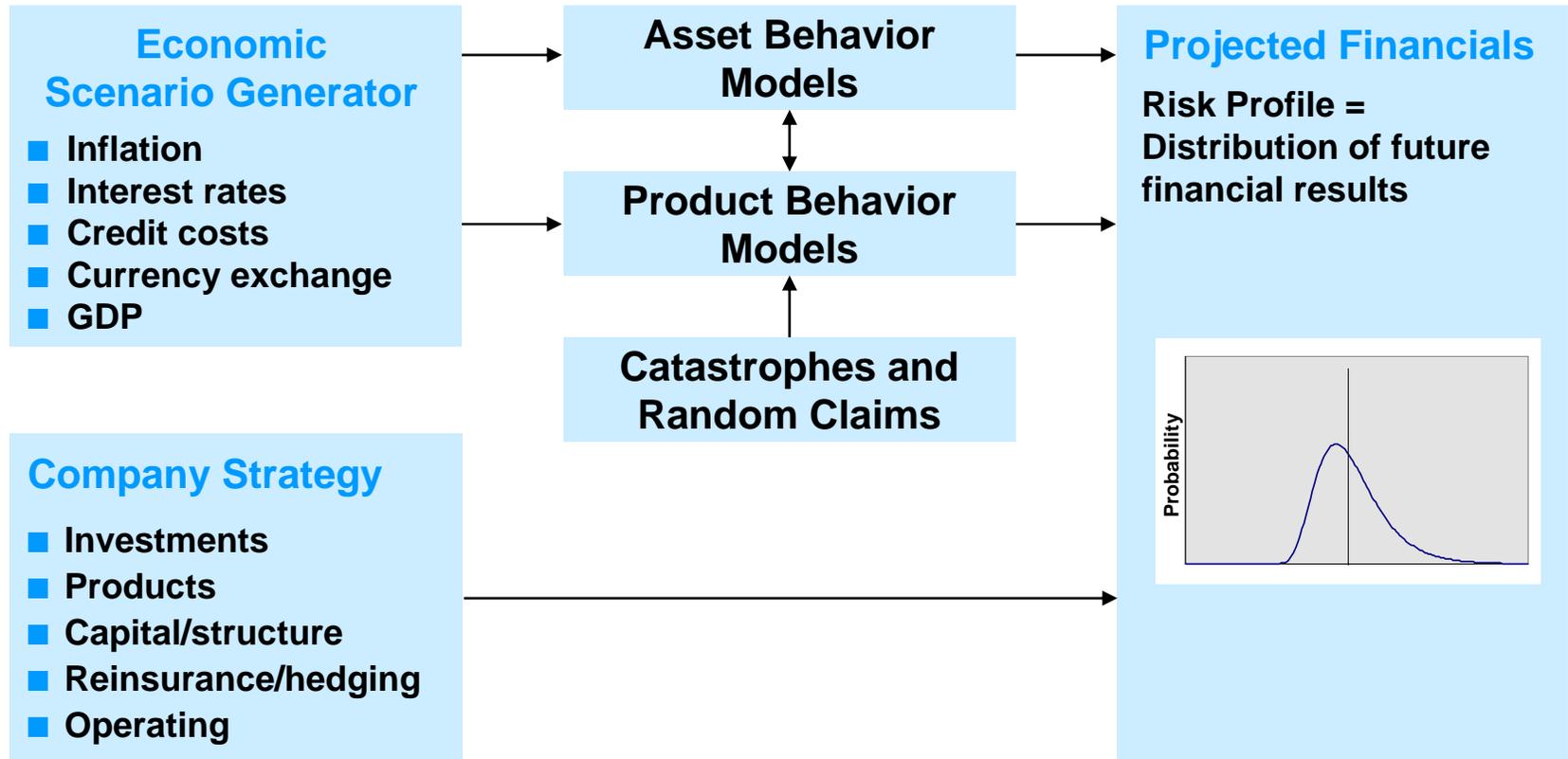
- In deciding on a definition of EC to use, insurers need to make a number of key decisions
  - What time horizon to use
  - Which measure(s) of risk to use
  - Which risks to include
  - What level of confidence to target
- There are also a number of implementation decisions to be made (e.g., stochastic vs. stress testing quantification method) — consequently, there are a large number of possible ways in which EC can be defined
- In practice, two methods have emerged as the most common:
  - **A liability runoff approach**
    - The level of total initial assets, less some measure of reserves for liabilities, required to pay all future policyholder benefits at the chosen confidence level
  - **A one-year mark-to-market approach**
    - The level of assets, in addition to the market value of liabilities, needed to cover a fall in the market value of net assets over a one-year time horizon at the chosen confidence level

## Liability runoff approach

- EC is based on the amount of initial assets needed to cover liabilities at a required confidence level projected over the lifetime of the business
  - For each scenario examined, the minimum amount of assets required to satisfy all liabilities by the end of the projection is determined
  - Scenarios are rank ordered to form distribution of the required initial asset amounts
  - EC is a function (e.g., VaR or CTE) of the distribution for a given confidence level less some measure of the liabilities
- In practice, different variations of the runoff approach exist, due to differences in
  - Liability valuation basis
    - Different liability basis results in a different split between liabilities and EC, but total required assets is effectively unchanged
    - Popular choices are a statutory, economic or best estimate basis
  - Measures of interim solvency
    - No solvency check at interim points implicitly allows profits and losses in different time periods to offset each other
    - Measures of interim solvency create a more stringent EC requirement; solvency is assessed over interim periods as well as over the entire projection
  - Degree to which new business projected
- Frequently implemented using an integrated stochastic model, although other implementation approaches are possible

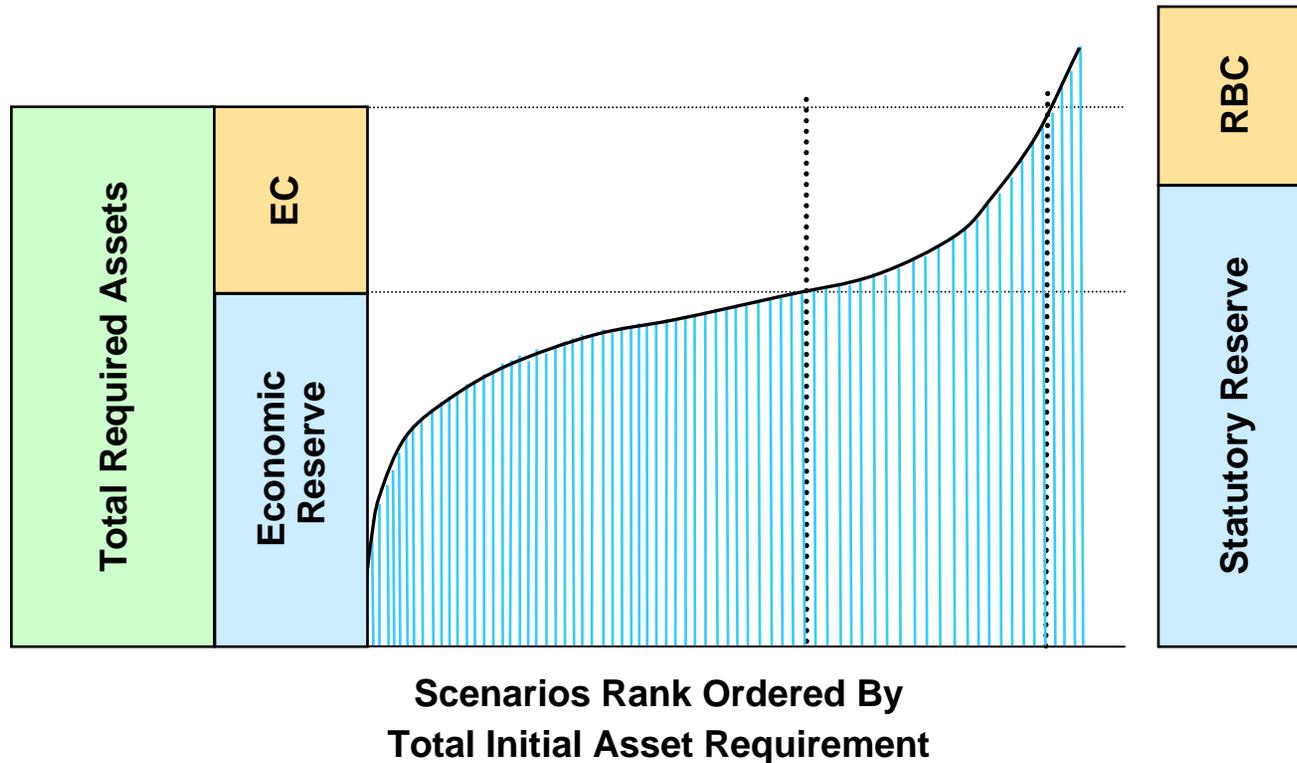
Principles-based approaches to reserves and capital being adopted in the U.S. by NAIC (e.g., C-3 Phase 2) use a liability runoff approach (with statutory liability basis and an assessment of interim solvency)

With a liability runoff approach, a real world stochastic projection basis is frequently used



Aggregation is achieved by adding risk profiles scenario by scenario

EC is derived from the resulting distribution of initial required assets



The most important measure is the total needed assets, rather than the specific split between “liabilities” and “capital”

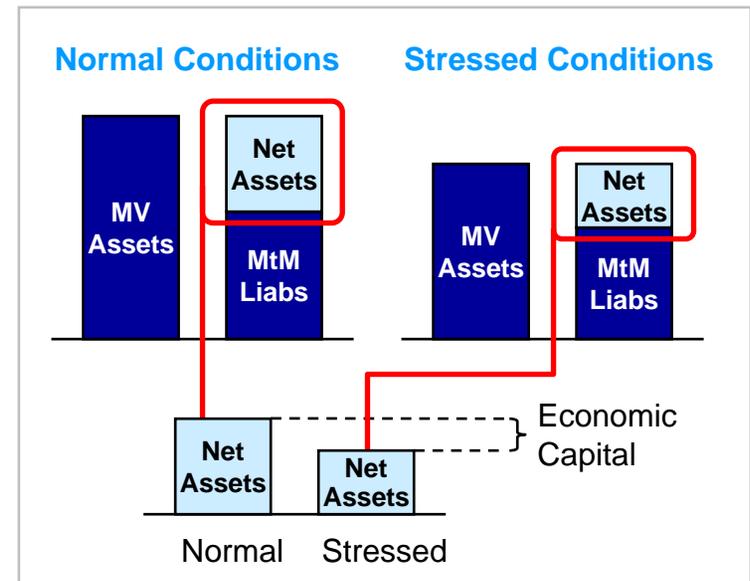
## One-year mark-to-market approach

- EC is based on the amount of assets needed to remain solvent over a one-year time horizon at a required confidence level, measured on a mark-to-market basis
  - Opening assets and liabilities projected for one year
  - Mark-to-market value of net assets calculated and discounted to valuation date
  - Tail distribution of the PV of mark-to-market net assets is developed by repeating under different conditions
  - EC measure(s) (e.g., VaR, CTE) calculated from tail distribution
- In practice, stochastic and stress testing implementation approaches are used
  - With stress testing, a limited number of stress scenarios are run, which have been calibrated to give results in the relevant tail of the capital distribution
  - Stochastic approaches are becoming more common, but are usually more complex, particularly for business with financial options and guarantees, where “stochastic on stochastic” modeling may be required

Approach began in the banking industry and is soon to be the basis for insurer solvency regulation across Europe (currently in U.K. and Switzerland, expanding under Solvency II)

## One-year mark-to-market approach is frequently implemented using stress testing

- Assets are measured at market value; liabilities are measured on a best estimate basis, i.e., all prudence is removed
- Separate stresses are applied to cover a variety of market, credit and insurance risks
- The stress tests applied are each calibrated to a probability level over a one-year time horizon, consistent with the target financial strength rating
- Results are aggregated using a correlation matrix approach



Each approach has a number of pros and cons

## Risk Management & Risk-Based Performance Considerations

Liability Runoff	One-Year Mark-to-Market
+ Measures risk over period risk is held, so better for long-term decision making	+ Facilitates link between risk quantification and risk management
+ Subjectivity in assumptions (e.g., with respect to management actions) may be important for strategic decision making; including management actions is difficult to implement comprehensively	+ Relies on deterministic adverse scenario analysis to examine longer term risks and management actions. This allows a realistic assessment of taking action or holding additional capital
+ Longer-term decision making not distorted by volatility of economic assumptions over short term	+ Short-term volatility to economic assumptions may be very relevant when assessing risk management options currently available
+ More accurately captures risks that emerge over time	– Fails to provide information about emergence of risk over time
- Can result in a timing mismatch with short term performance being compared with risk and capital based on a longer term	+ Risk quantification and risk management linked to performance management over the typical annual performance reporting cycle
	– May be less relevant to risk quantification and risk management for liabilities that are highly illiquid

## Ease of understanding and communication is an important consideration

### Ease of Understanding and Communication

Liability Runoff	One-Year Mark-to-Market
+ Conceptually relatively easy to understand	+ Conceptually relatively easy to understand
+ Generally consistent with approaches used by NAIC	+ Generally consistent with approaches used in other industries
– Becomes more difficult to explain and easily misunderstood with increased model complexity (e.g., model assumptions, risk interactions, management actions)	– Still requires a runoff projection (to calculate mark-to-market values) and so shares some of the same challenges and complexities of the liability runoff approach
– Division of assets required between reserves and EC is usually important, but may not always be easily understood	– Mark-to-market valuations are often not immediately intuitive and can take time to understand

## Both approaches pose certain implementation challenges

### Implementation Considerations

Liability Runoff	One-Year Mark-to-Market
<ul style="list-style-type: none"> <li>– Modeling generally complex with decisions to be made over long term (e.g., new business modeling, management actions, risk interactions)</li> </ul>	<ul style="list-style-type: none"> <li>– Mark-to-market liability valuations required can lead to “stochastic on stochastic” calculations; more simplistic approaches (e.g., stress testing) are less accurate and provide less insight into overall capital distribution; replicating portfolio techniques may provide solutions</li> </ul>
<ul style="list-style-type: none"> <li>– Model complexity can be challenging and lead to longer implementation timeframes and technical challenges (e.g., run times, memory issues)</li> </ul>	<ul style="list-style-type: none"> <li>– Mark-to-market liability valuations challenging for tail events and for liabilities or risks for which no liquid traded market exists</li> </ul>
<ul style="list-style-type: none"> <li>+ More sophisticated models can produce richer quality output providing more significant insights</li> </ul>	<ul style="list-style-type: none"> <li>– Absence of traded market in a particular liability (or risk) requires assumptions to be made about the emergence of information about risks as well as the emergence of the risk itself</li> </ul>
<ul style="list-style-type: none"> <li>– Inclusion of interim solvency assessments can add to the model complexity</li> </ul>	<ul style="list-style-type: none"> <li>+ Generally easier to calibrate EC to target confidence levels over one year</li> </ul>
<ul style="list-style-type: none"> <li>– Can pose challenges in aggregation across different lines of business with different durations</li> </ul>	<ul style="list-style-type: none"> <li>+ All risks measured over the same time horizon, so consistent aggregation (and demonstration of diversification benefits) easier to achieve</li> </ul>

Ultimately, in deciding on an EC approach, an insurer needs to consider a number of factors

- Objectives and intended applications of EC framework
  - Capital adequacy
  - Risk monitoring and control
  - Performance measurement and management
  - Risk-based decision making
  - Risk-based pricing
- Constraints (in implementation and ongoing)
  - Budget
  - Time
  - System
  - Human resource
- Type of business

Decisions need to strike balance between simplicity, reliability and practicality

## Other Risk Capital Frameworks



## Globally, there are many other existing or developing solvency and risk capital frameworks

- Regulatory and rating agency capital frameworks currently in use or in development include:
  - Basel II
  - Solvency II (Draft Framework Directive — July 2007)
  - U.S. NAIC RBC: Factor approach
  - U.S. NAIC RBC: Principles-based approach
  - Regulators of a number of other countries
    - U.K. ICA and general capital requirements, Swiss Solvency Test: SST, Canada OSFI: MCCSR, Australia: Required Capital
  - Rating agencies
    - S&P's New RBC Insurance Capital Model and S&P's New Internal EC models acceptability criteria, Moody's General EC principles, Fitch Prism EC Model, A.M. Best EC principles
- These frameworks can differ in a number of areas:
  - Risks covered
  - Approaches used: standard formulas, models and scenarios
  - Assessment period, risk metrics and confidence level
  - Correlation, hedging
- Overall, the above frameworks show strong similarities in a number of areas, but also some significant differences in resulting capital, modeling requirements and methodology

Solvency II will use a one-year mark-to-market method, whereas U.S. principles-based approach moves to a liability runoff method

Framework	Overall Observations
U.S. NAIC RBC: Factor approach	<ul style="list-style-type: none"> <li>■ Factor-based approach</li> <li>■ Covers all insurance and asset risks (C-1, C-2, C-3 risks) and some operational risk via the C-4 component</li> <li>■ Assessment period is the runoff of the business</li> <li>■ Confidence level of factors is implicit (approximately 90% VaR or CTE 95)</li> <li>■ Aggregation formula allows for correlation between C-1 and C-3 risks</li> <li>■ Basis is U.S. statutory balance sheet</li> </ul>
U.S. NAIC RBC: Principles-based approach	<ul style="list-style-type: none"> <li>■ C-3 Phase III for life and C-3 Phase IV for fixed annuities: Subject to criteria for setting prudent assumptions and margins</li> <li>■ Stochastic modeling for market risks, with prudent estimates for other risks</li> <li>■ Assessment period is the runoff of the business</li> <li>■ Confidence level of CTE 90</li> <li>■ Correlations between products, but not across risks or across segments</li> <li>■ Basis is U.S. statutory balance sheet</li> </ul>
Solvency II — Draft framework directive — July 2007 (solvency capital requirements)	<ul style="list-style-type: none"> <li>■ Risks covered are underwriting, market, credit, liquidity, operational, legal</li> <li>■ Uses standard approach or approved internal models</li> <li>■ Assessment period is one year</li> <li>■ Confidence level of 99.5% VaR</li> <li>■ Correlation approach is prescribed for the standard approach, other aggregation techniques for internal models subject to approval</li> <li>■ Total balance sheet approach based on market-consistent valuation</li> </ul>

# Successfully Implementing EC



## Risk modeling is critical; approaches will depend on nature of risks and availability of relevant data

- For typically included risks when calculating EC — economic and underwriting risks — the following aspects are covered in the research:
  - Nature of risks
  - Data availability
  - Typical approaches to modeling risks
- For example, mortality risk
  - Nature of risks
    - Catastrophe risk: Short-term factors such as infectious disease pandemics can cause temporarily adverse mortality experience
    - Volatility risk: The two main sources with mortality are number of deaths and size of claims; impact on capital is generally significantly smaller than that due to other risks
    - Mis-estimation/parameter risk: Past experience is not necessarily a good guide to future experience; relates to past random fluctuations, heterogeneous data, errors in collecting or analyzing data
    - Trend risk: How future experience might evolve, e.g., medical advances or alternatively, infectious diseases and lack of cures might result in greater/lower than expected reductions in mortality rates
  - Data availability
    - Literature on extreme events can be used to calibrate catastrophe risk; data is often questionable
    - On volatility risk, the statistics from the insurer's portfolio are mostly readily available
    - The insurer's mortality studies can provide a basis for calibrating for mis-estimation risk
    - Historical population mortality statistics are readily available to calibrate the trend risk; since the period of mortality of insured population is limited, companies typically use general population statistics
  - Typical approaches to modeling risks
    - Using stress testing
    - Using stochastic modeling

## Successful EC implementation depends on several other factors

- Governance and achieving buy-in
  - Centralized vs. decentralized
- Resources
  - Human resources
  - System resources
- Timeframes and budgets
- Modeling considerations
  - Stochastic processing limitations
  - Model testing: including back testing

Beyond implementation, ongoing requirements and constraints are as important

Implementation of EC will only add value if it is used effectively within the business operations of an insurer

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- Capital adequacy
- Risk monitoring and control
- Performance measurement and management
- Risk-based decision making
- Risk-based pricing
- Business and strategic planning
- Mergers and acquisitions

To obtain maximum benefit EC requires both internal utilization and external recognition