CRO Forum
Internal models benchmarking study
Summary results

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This presentation is based on research (Internal Models Benchmarking Study 2008) carried out on behalf of the Chief Risk Officer Forum by Oliver Wyman

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Executive summary – internal models benchmarking study (2008)

- This 2008 CRO Forum Internal Models Benchmarking study characterises the current and anticipated future state of internal economic capital frameworks, models and governance, including planned design enhancements, implementation progress and overall use of models
- The 2008 study is a follow-up to a previous survey conducted in 2006 (a joint survey with the International Financial Risk Institute)[1]
- This study is based on the results of a survey conducted in October-November 2008, with 18 CRO Forum members and associate members participating
- The study presents the survey findings in the context of Solvency II requirements, however it is recognised that not all participants will be regulated under Solvency II
- This document summarises overall results and insights

1. 2006: Joint IFRI/CRO Forum survey on economic capital practice and applications

Executive summary – key survey results

- CRO Forum member firms are generally well prepared for the introduction of Solvency II and are on-target to comply with the directive when implemented – although most plan further investment in the run-up to implementation (improving framework governance is a particular focus) (Section 1)
- The global economic crisis has raised challenges to some modelling parameters. It is not likely to change fundamentally the methodological frameworks underpinning economic capital models, however companies continue to assess models in light of the crisis (Section 2)
  - Many participants are reviewing risk dependencies (correlation) assumptions and half of them expect to increase frequency of scenario testing (currently 43% use quarterly scenario testing)
  - 53% of companies are also considering improvements to EC-modelling of fungibility of capital (currently 49% are not modelling fungibility) and 35% will review treatment of asset liquidity (currently 78% don't model asset liquidity, which is in line with the CRO Forum's position on liquidity risk as a risk to be managed rather than capitalised)
  - Some companies are reviewing governance and reporting frequencies, however these were already on the economic capital agenda before the current downturn
  - Companies intend to continue to base their economic capital frameworks on market-consistent approaches (despite the current challenges to the application of market-consistent methodologies). The CRO Forum believes that these valuation approaches remain relevant, however the study (Section 3.2) indicates that there are certain methodological issues where views on the implementation detail vary across companies.

Executive summary – key survey results

- Economic capital modelling has moved well beyond initial implementation phase, yet firms are continually looking to upgrade elements of their modelling infrastructure (Solvency II Pillar 1 – see Section 3 of this study)
- However – contrary to expectations in 2006 – we have observed few advances in operational risk modelling for the purpose of calculating economic capital, and have not observed any emerging consensus approach for business (lapse, volume, expense etc) risk (Solvency II Pillar 1 - see Section 3 of this study)
  - The CRO Forum believes that holding capital for Operational Risk is just one part of a broader risk management approach, and therefore the nature and extent economic capital modelling should be seen in light of the overall management framework
- Ensuring an appropriate level of Business Unit and Executive engagement with economic capital results are seen as the key challenges to embedding and using economic capital capabilities in businesses (Solvency II Pillar 2 - see Section 4 of this study)
- Firms are aligned in supporting more and better disclosure of economic capital but there are a range of opinions on how to represent the diversification benefit, the allowance for which is a key driver of the EC result (Solvency II Pillar 3 - see Section 5 of this study)

Contents

Section 1
Developments since 2006 survey and run-up to Solvency II

Key observations addressed in this section

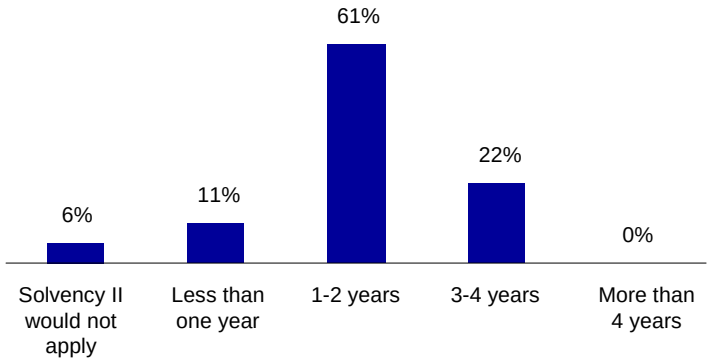
- Advances made since 2006 are generally in line with expectations, but there is still further work to do, particularly for embedding economic capital concepts in decision-making
- Operational and business risks are the exception – expected improvements to operational risk modelling for the purpose of calculating economic capital have not occurred and there is – as yet – no consensus on approaches to business risk
- In general CRO Forum members are well prepared for Solvency II, although most plan significant further investment in frameworks, infrastructure and capabilities
- Solvency II is particularly driving improvements to governance; many companies are focusing on updating documentation and improving process controls

Advances made since 2006 are generally in line with expectations, but there is still work to do, particularly for embedding economic capital concepts in decision-making

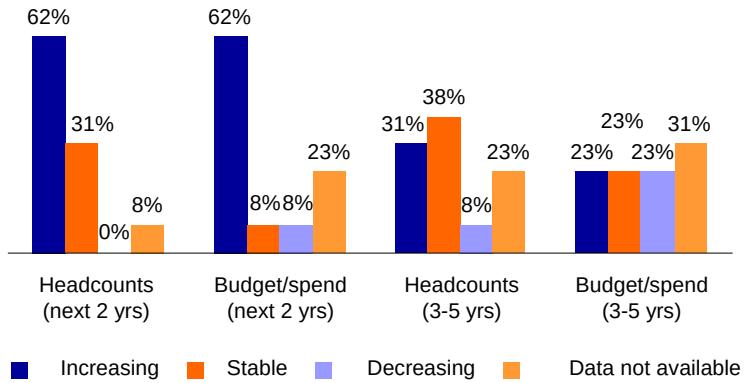
	Key observations in 2006	Observations in 2008	
Framework convergence	Growing convergence of many aspects of core EC framework design (risk type, time horizon, confidence intervals)	Frameworks have converged on post-tax 1-year VaR (adopted for most frameworks) but calibration varies	Detail in Section 3
Data quality and timeliness	Data quality and timeliness thought to be major factor hindering use of EC in day-to-day decision-making	Companies are investing in process controls. Time taken to calculate EC has not reduced (due to sophistication and coverage), despite ambition to increase frequency of reporting	Detail in Section 3
Operational and business risks	Measurement of operational and business risks lagged behind other risks	Few advances in operational risk modelling (even if the overall management framework has improved). No consensus on best approach for business risk	Detail in Section 3
Use test	Growing usage of EC in management applications and business decisions, particularly at Group level	EC now used in many business processes – but there are still challenges to fully embedding EC concepts in decision-making	Detail in Section 4
Disclosure	Insurers planned to use EC in stakeholder discussions, but needed to communicate approaches to diversification benefit	EC often disclosed publicly. Companies would like greater standardisation of disclosure, but diversification benefit poses a challenge as no consensus on best approach to representing it	Detail in Section 5

In general CRO Forum members are well prepared for Solvency II – although most plan significant further investment in frameworks, infrastructure and capabilities

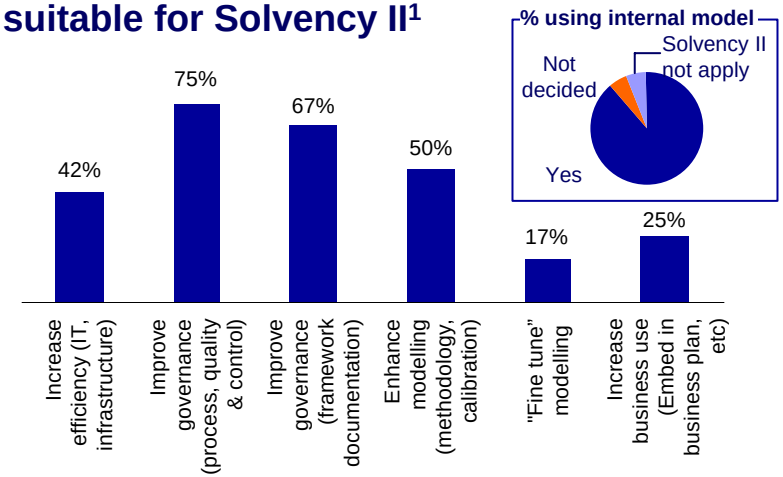
Time required to make current EC models compliant with anticipated Solvency II standard



Planned investment in headcount and infrastructure[2]



Steps required to make current EC models suitable for Solvency II[1]

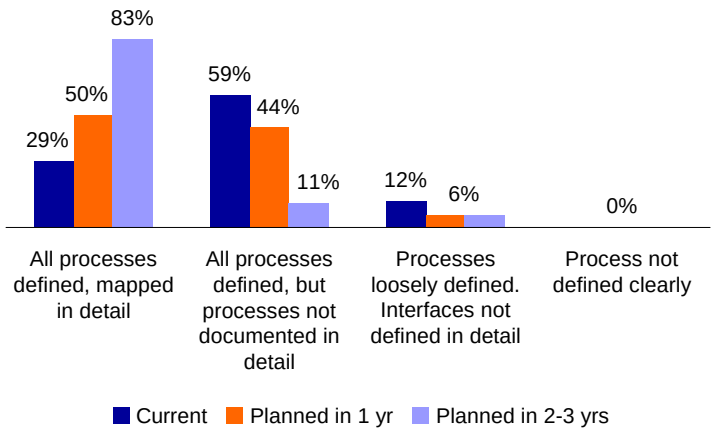


- Companies intend to use internal models for Solvency II
- Companies are generally well-prepared for the introduction of Solvency II and are on-target to comply when the directive is implemented
- Majority expect to make significant investment in headcount and infrastructure (peaking in next 2 years)
- Governance is a key focus of steps to make frameworks Solvency II compliant (see next slide)
- Companies are also working to improve efficiency and modelling capabilities (see Section 3 for discussion) or improving business use (see Section 4)

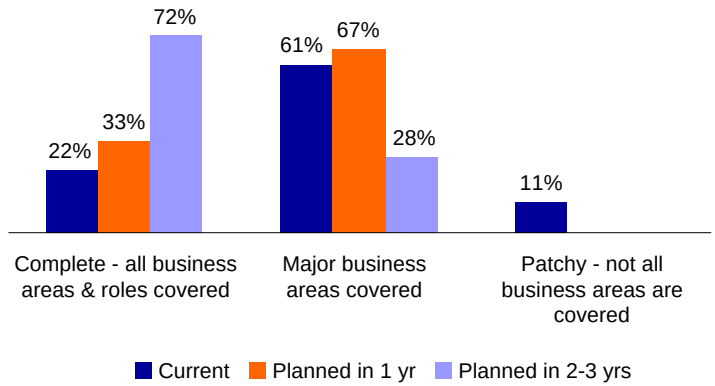
1. Percentages relate to 12 companies who answered the question, i.e. those who will be regulated under Solvency II
2. 2-year increases (where given) were +10-20% (headcount) and +20-50% (budget) (limited comparable data for 3-5 years). 13 companies answered this question and percentages relate to those companies. "Data not available" refers to answers from those 13 companies

Solvency II is driving improvements to governance, with companies focussing on documentation and improving process controls

Overall status of governance for EC processes

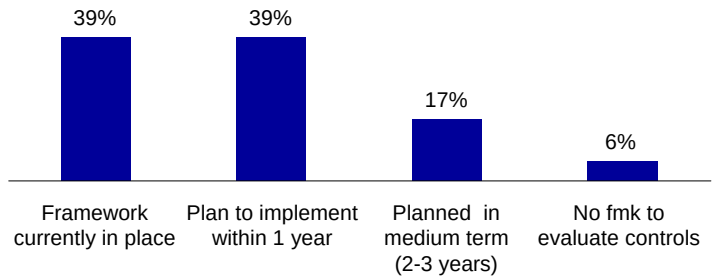


Quality of EC documentation



- Majority of companies are reviewing EC governance – with a particular focus on documentation and process controls
- While most companies are looking to develop further their modelling governance as part of their enterprise risk management developments, for many the focus of development effort is also driven by Solvency II requirements and timing
  - *"We are implementing Improved governance and audit trails to satisfy regulatory approval and reporting requirements (at Group and Solo levels)"*

Framework to evaluate effectiveness of the internal controls for EC reporting



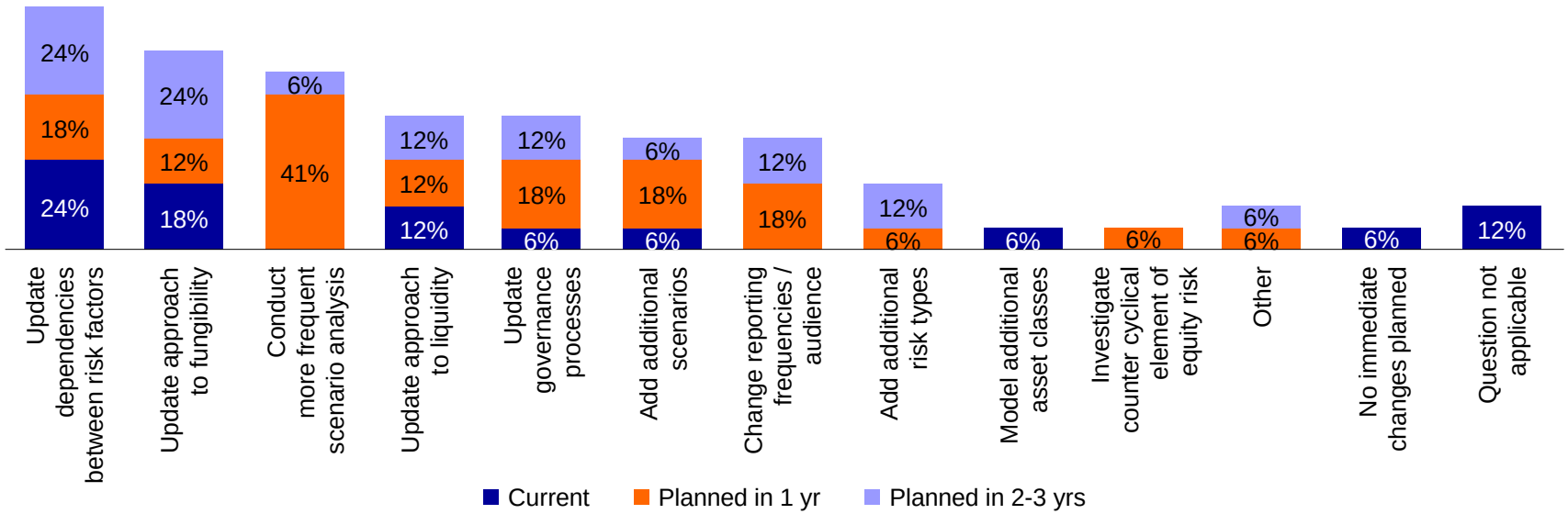
Section 2
Impact of global economic crisis on economic capital modelling

Key observations addressed in this section

- The global economic crisis has raised challenges to some modelling parameters. It is not likely to change fundamentally the methodological frameworks underpinning economic capital models, however companies continue to assess models in light of the crisis
  - 65% of companies will review dependency (correlation) assumptions and 47% expect to increase frequency of scenario testing (currently 43% use quarterly scenario testing)
  - 53% of companies are also considering improvements to EC-modelling of fungibility of capital (currently 49% are not modelling fungibility) and 35% will review treatment of asset liquidity (currently 78% don't include asset liquidity risk in their economic capital calculations, which is in line with the CRO Forum's position on liquidity risk as a risk to be managed rather than capitalised)
  - Some companies are reviewing governance (35%) and reporting frequencies (29%), however these were already on the economic capital agenda before the current downturn
  - Companies intend to continue to base their economic capital frameworks on market-consistent approaches (despite the current challenges to the application of market-consistent methodologies). However the study indicates that there are certain methodological issues where views on the implementation detail vary across companies.

Global economic crisis has raised challenges to some modelling parameters but is not likely to fundamentally change the approach to EC

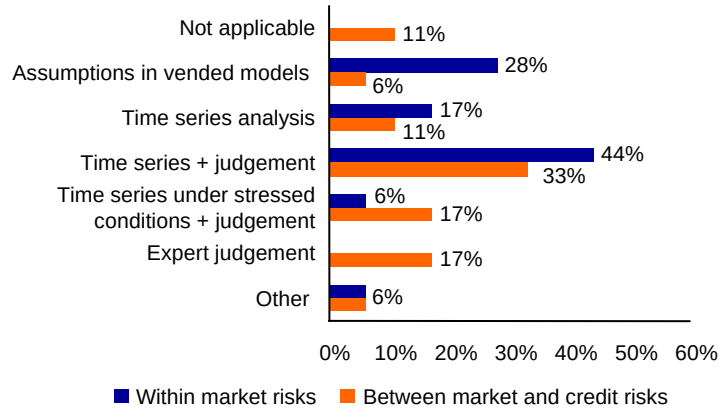
Changes to economic capital model being considered in light of recent market developments



- Global economic crisis has raised challenges to modelling parameters however – although there is room for improvement – overall insurance companies have managed to navigate comparably well through the crisis and internal market-consistent models appeared to pass successfully this first litmus test
- 82% of companies reported that they were reviewing aspects of their economic capital frameworks in light of recent market conditions – although for many (at the time of survey completion in November) this had not yet translated to specific plans for change
- Key areas of review are dependencies (65%) and scenario analysis (47%), treatment of fungibility of capital (53%) and treatment of asset liquidity (35%) (highlighted in following slides)
- Other areas of review, e.g. governance (35%), reporting (29%) and risk-type review (18%), are already being considered as part of existing initiatives (such as preparations for Solvency II)

Companies are expecting to review their dependency (correlation) assumptions and to use scenario testing more extensively

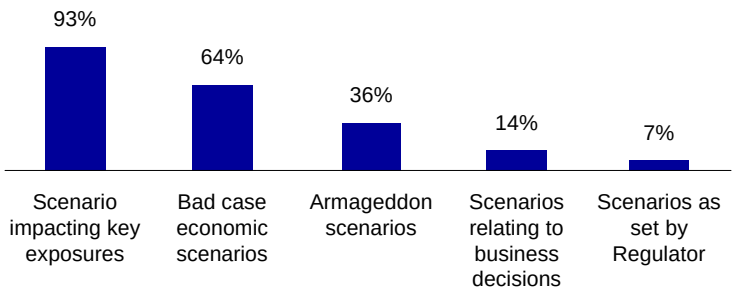
Approaches to estimating dependencies for market and credit risks



Companies are reviewing dependency assumptions

- Companies typically use a combination of analyses of historic data and expert judgement, or rely on dependency structure assumed in vended models
- 65% of companies are planning to review their dependency (correlation) assumptions in light of recent market conditions, but for a significant proportion existing tail correlations are proving adequate

Types of scenario currently tested in addition to standard EC calculation[1]



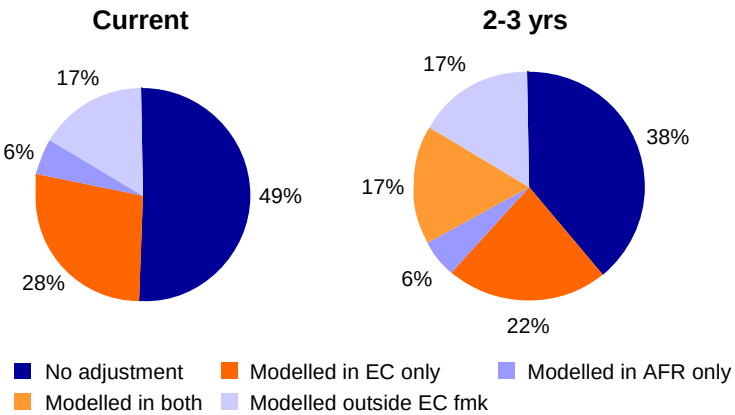
Use of scenario analysis may increase

- Companies are now expecting to use more extensive scenario testing (in addition to standard EC model)
- However for many (at the time of survey completion in November) this was yet to be fully translated into firm implementation plans
  - We expect that a number of companies will have since implemented (or commenced development of) more comprehensive scenario testing
- 29% considering adding additional scenarios (note only 1 company has firm plans to implement change)
- 47% considering more frequent scenario analysis (note only 2 companies have firm plans to implement change)

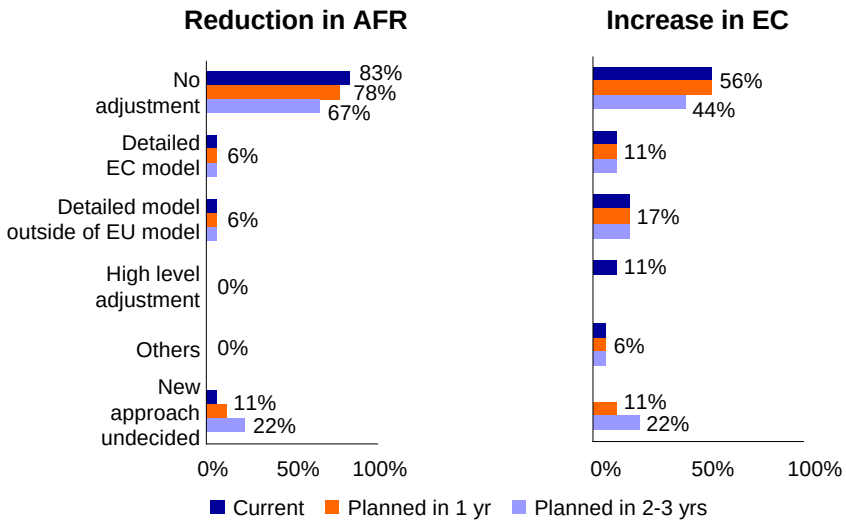
1. Answers from those participants where scenario testing is currently implemented in the EC framework (14 companies)

Majority of companies are expecting to review their approach to capital fungibility, which is not currently widely modelled within EC frameworks

Proportion of companies allowing for fungibility



EC and AFR[1] approaches to allowing for fungibility



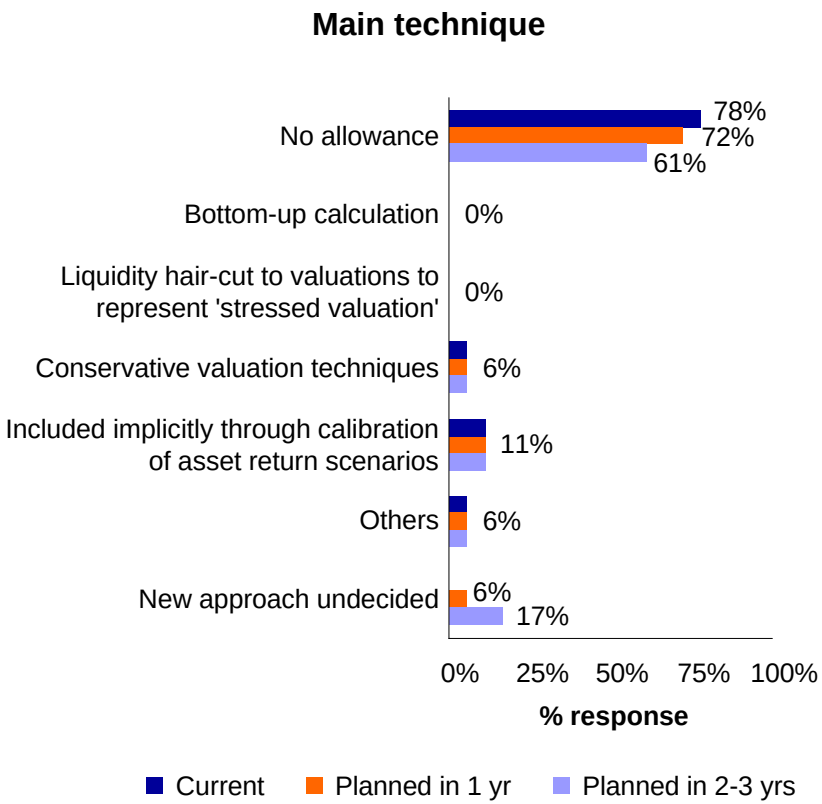
Modelling of fungibility of capital

- Current market conditions have highlighted potential for increased constraints on ability to move cash/capital between regulated entities within a group ("fungibility") in times of stress
- For majority of companies the impact of restrictions on capital fungibility is not captured within EC framework
  - However where fungibility is modelled, 71% of companies estimate it has a significant impact on group risks (>10% change in results)
- 53% of companies are planning to review their treatment of fungibility in light of recent market events but firm plans to change are more limited
- Companies proposed a range of modelling approaches for fungibility[2]
  - Bottom-up modelling of capital transfers between BUs and parent/BUs (within EC framework) (28%)
  - Modelling outside of EC framework (22%)
  - Modelling local regulatory capital requirements (within EC framework) (11%)
  - Include impact in valuations within EC framework (6%)
  - No opinion/approach not decided/not answered (39%)

1. Available Financial Resources
2. Relates to best theoretical approach. 1 company suggested 2 approaches, therefore percentages do not add up to 100%.

Some companies are reviewing how economic capital models can help with asset liquidity risk management

Incorporation of liquidity risk associated with forced sales into EC frameworks ("asset liquidity risk")



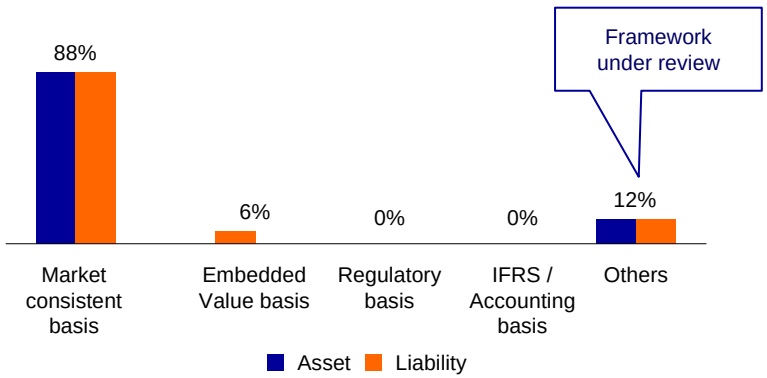
Use of EC modelling to help with liquidity risk management

- A minority of companies capture (or have plans to capture) *asset* liquidity risk (i.e. the risk of additional losses associated with forced sale of large volumes into illiquid markets) directly within their EC frameworks
- Consensus view is that holding capital is an ineffective means of managing liquidity risk; companies instead use a comprehensive liquidity risk management framework[1]
- However in light of current global economic crisis 35% of companies are reviewing whether EC models can help with their approach to managing liquidity risk (as shown on page 13)
  - This may not directly lead to holding additional capital for liquidity risk, rather it is an additional tool to aid the development of appropriate management processes

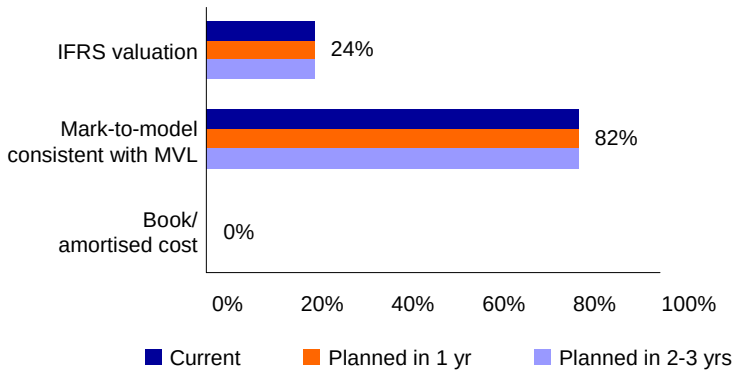
1. Liquidity risk management (Best risk management practices) – CRO Forum, October 2008: "Requiring capital to provide for liquidity risk is an ineffective means of managing this risk. Liquidity risk is a risk to be managed at all times – before, during, and after any stress event – and no amount of capital can replace comprehensive liquidity risk management"

Companies continue to support the use of market consistent techniques for economic capital

Approach to valuing assets and liabilities within EC framework[1]



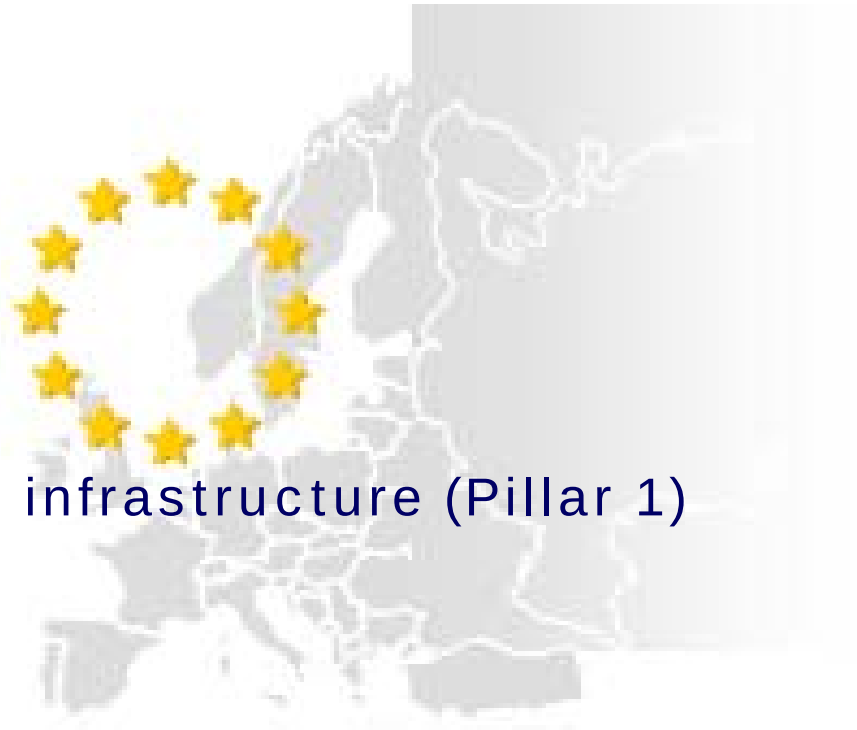
Approach to valuing non-traded assets within EC framework[2]



Use of market-consistent methodologies

- Impact of market turmoil has led a number of market commentators to question the use of market-consistent valuation techniques
- Majority of companies reported that they use market-consistent valuation methodologies (for both assets and liabilities)
- No companies reported at the time of the survey that they were reviewing market-consistent approach in light of recent market events
  - However we note that since the survey was carried out there may have been further developments in this area; for example the CFO Forum has announced it is re-examining the principles of MCEV in light of current market conditions
- The CRO Forum believes that, for valuation purposes, the market-consistent valuation approaches that form the basis for risk models have remained suitable and informative in times of crisis. However the study indicates that there are certain methodological issues where views on the implementation detail vary across companies (as shown in Section 3.2, p.27-30)

1. One company reported using market-consistent and EV approaches for internal models, hence percentages do not add up to 100%
2. Some companies reported using both IFRS and market-consistent valuation methodologies



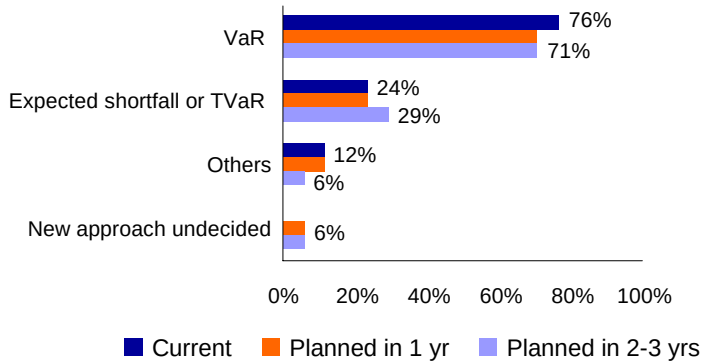
Section 3.1
Upgrades to modelling infrastructure (Pillar 1)
Framework and capabilities

Key observations addressed in this section

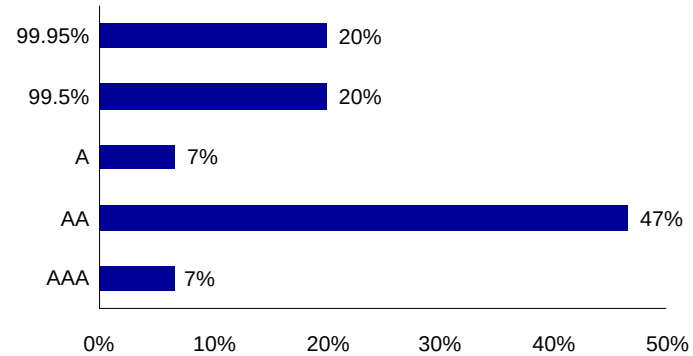
- Economic capital modelling has moved well beyond initial implementation phase yet firms are continually looking to upgrade elements of their modelling infrastructure
- Frameworks have converged on 1-year VaR (although there are exceptions) however calibration of frameworks varies between companies and there are still a number of different approaches to aggregation
- Frameworks generally include tax impacts (or there are plans to move to a post-tax basis)
- Desire to increase speed of economic capital modelling was a strong message in 2006, however there has been little evidence of improvement in this area (other than for those with replicating portfolios).
  - The CRO Forum believes this is due to companies embedding greater sophistication and complexity into their capital models, which has broadly offset any efficiency gains in time taken to calculate EC

Economic capital frameworks have converged on 1-year VaR (although there are exceptions) however calibration of frameworks varies

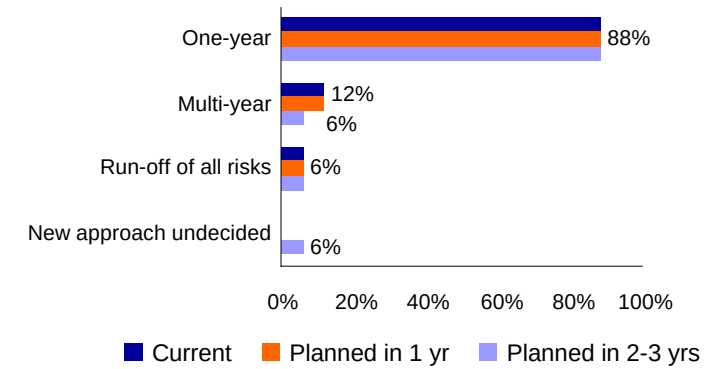
Statistic used for measuring economic capital[1]



Calibration (confidence interval/target rating) used for economic capital (VaR approach)[3]



Risk horizon (i.e. time horizon over which risk factors are stressed)[2]

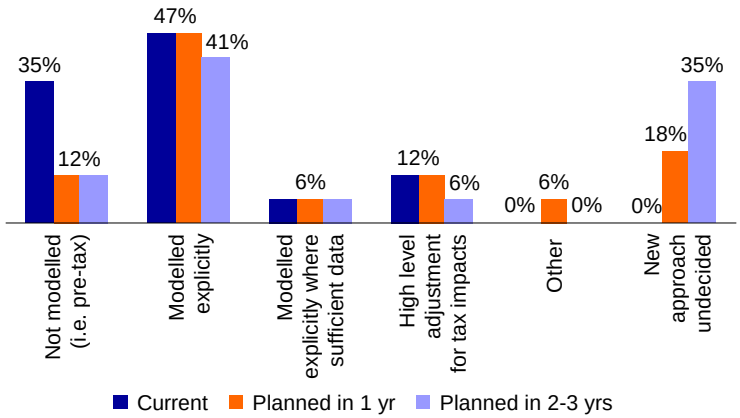


- 1-year VaR is the typical approach for economic capital (albeit with some differences in implementation approach), with a minority favouring TVaR (perhaps not surprising given its adoption for some regulatory frameworks)
- Results for calibration are more varied, with 60% of companies calibrating frameworks to a target debt rating and 40% choosing a specific confidence interval

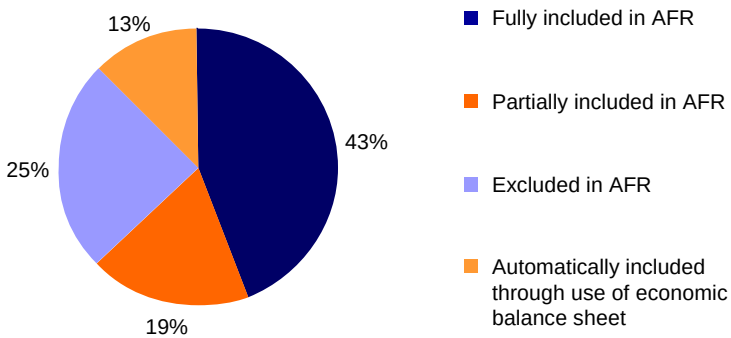
1. Two companies use both VaR and expected shortfall/TVaR, hence percentages do not add up to 100%
2. One company selected both multi-year and run-off of all risks, hence percentages do not add up to 100%
3. Two companies using TVaR are not included

Majority of economic capital frameworks are post-tax (i.e. include the impact of tax), with further movement expected in that direction

Allowance for taxes in economic capital model



Allowance for deferred tax assets (or deferred tax liabilities) in AFR[1]

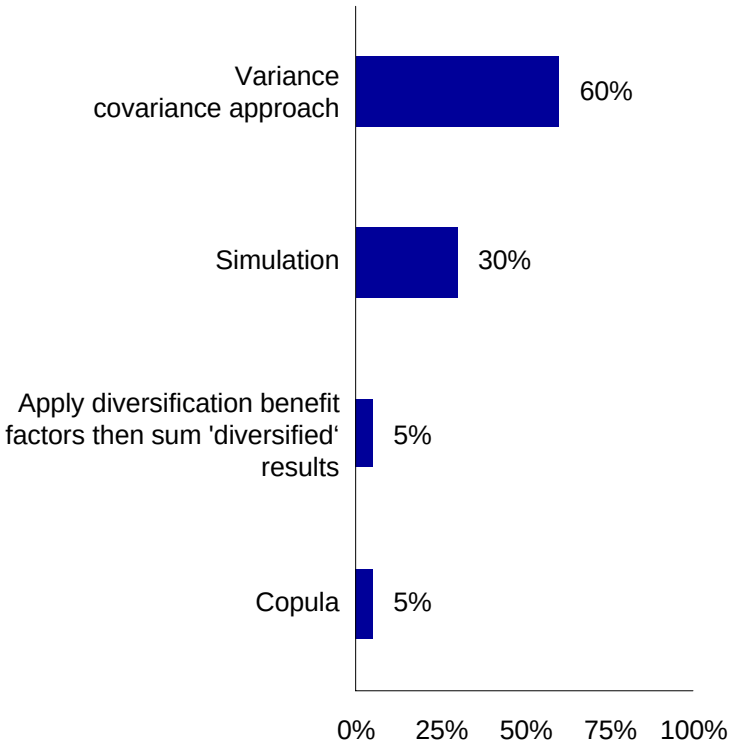


- 65% of economic capital frameworks currently allow for the impact of tax, and this is expected to rise to 88% within one year
- 79% of companies include some value for deferred tax asset or liabilities in AFR (either automatically included in economic balance sheet or explicitly included in AFR calculation)
- 82% of companies affected favour a post-tax approach for Solvency II

1. Answers based on 16 companies who answered this question

Majority of companies are currently using variance/covariance for overall aggregation approach, but there is a slight trend towards alternatives

Overall aggregation approach used in EC model[1]

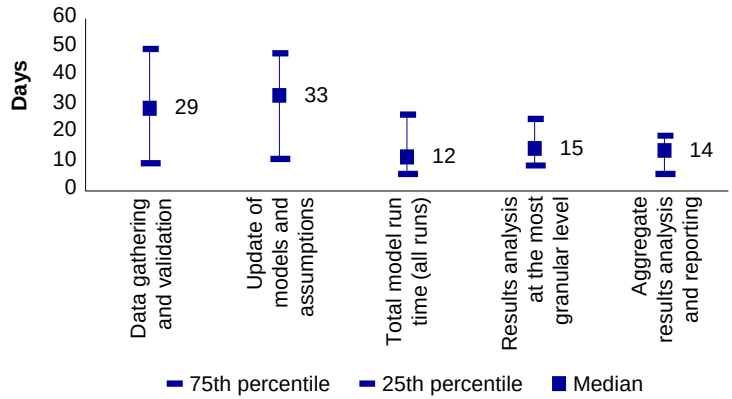


- 60% of companies use variance/covariance for overall aggregation approach
- However this includes widespread use of stochastic models for significant risk types (DFA for P&C, stochastic models for market risks)
- Three companies using variance/covariance approach are considering alternatives
  - 2 considering switch to copula approach
  - 1 considering switch to Monte Carlo simulation based on Gaussian copula approach

1. Two companies used more than one overall aggregation approach (hence percentage for individual company is 5%)

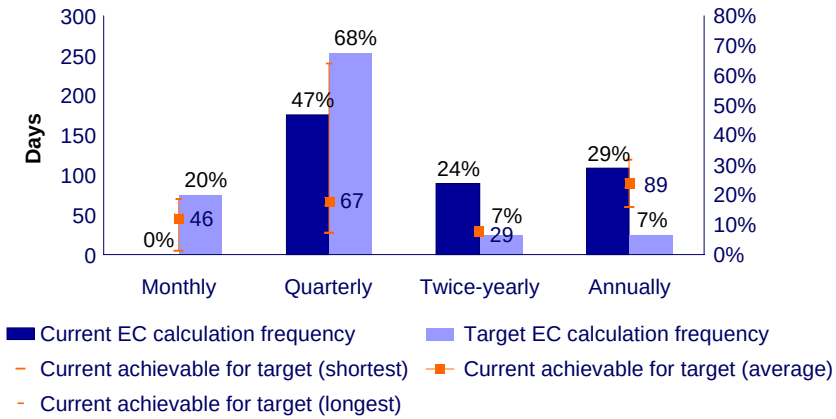
Companies are working towards increasing the frequency of reporting however – as in 2006 – time to calculate EC remains a constraint for some

Number of days currently used for each step in calculating economic capital (full EC process)



- 2006 survey found that lengthy calculation process might be hindering the ability of companies to use EC in decision-making
- Results from 2008 suggest that total time to complete full EC process is the same or longer than in 2006[1]
- The CRO Forum believes this is due to companies embedding greater sophistication and complexity into their capital models, which has broadly offset any efficiency gains

Current maximum speed for EC process vs. target frequency of EC results[1]

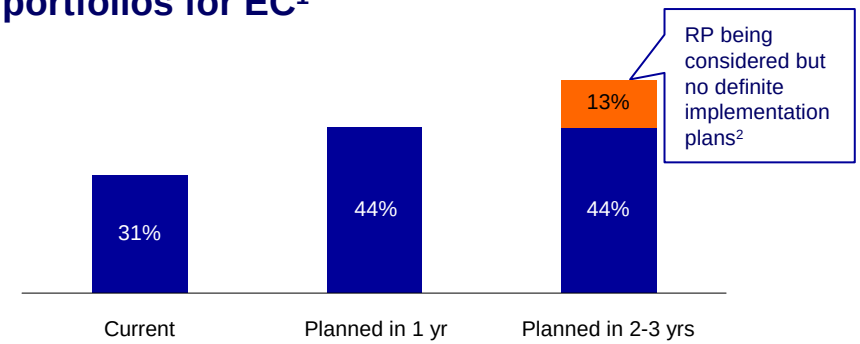


- Companies are aiming to move towards quarterly or monthly calculation of EC (see light blue bars on chart)
- Analysis of current maximum speed for EC process suggests that some companies may need to reduce further the time taken to calculate EC in order to produce timely results
- In some cases issue is already being addressed - for example one company is implementing a new approach that will allow results to be produced within a ~5 day turnaround time

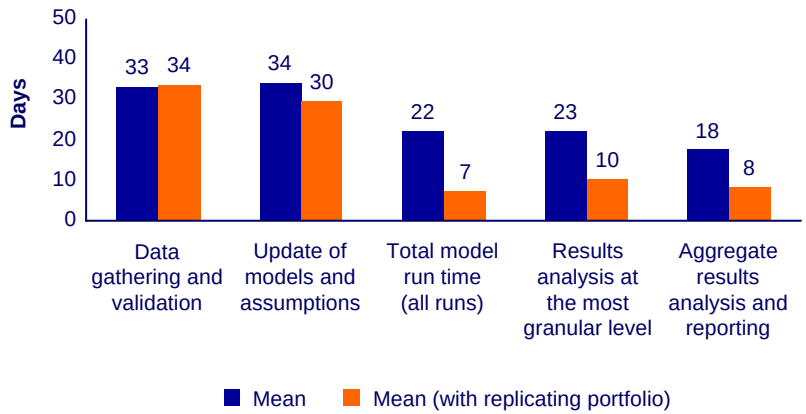
1. Data may not be directly comparable due to uncertain treatment of weekends and process overlaps in 2006. However 2008 results are on average 23 days longer than in 2006. When analysis is restricted to companies participating in both surveys, EC calculation is 37 days longer in 2008 than 2006

A number of insurers are currently implementing replicating portfolio approaches

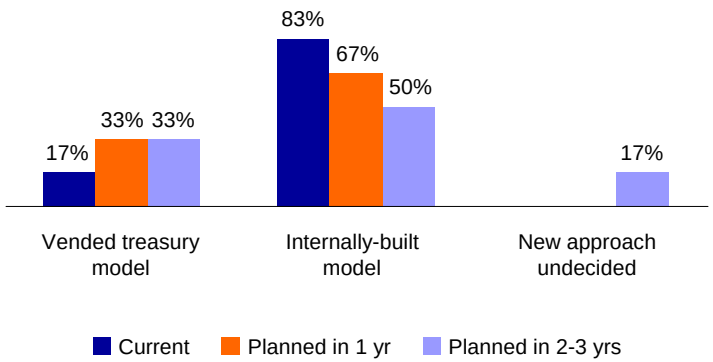
Insurers using replicating portfolios for EC[1]



Impact of replicating portfolios on modelling speed

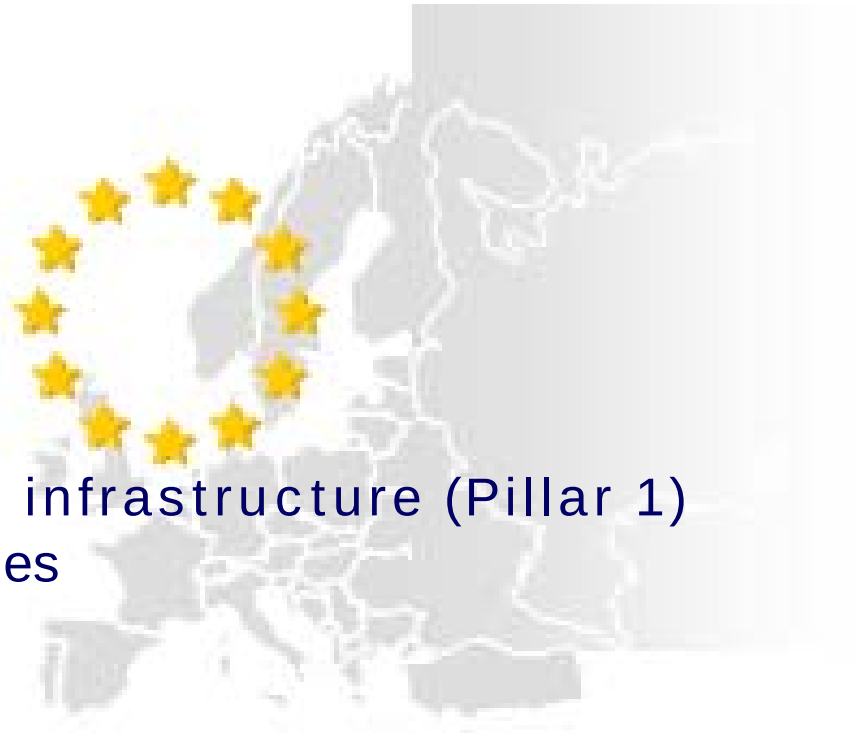


Modelling software used to construct replicating portfolio[3]



- Companies indicated several reasons for implementing replicating portfolios (modelling complex liabilities, asset liability management and increasing run capacity)
- Results suggest insurers may be able to speed up the calculation of embedded market risks in their liabilities through use of a replicating portfolio approach
- Companies which have already implemented replicating portfolios refresh the replicating portfolio at least quarterly

1. Analysis excludes pure P&C insurers (i.e. percentages calculated based on a total of 16 companies)
2. Comments from 13% of insurers suggested are either planning or considering implementing replicating portfolios however other answers indicate plans are not finalised
   Comments from 19% suggested that they are considering replicating portfolios for non-EC purposes, these were not included in this analysis
3. Analysis based on 6 companies currently using replicating portfolio approach (may include a non-EC use of replicating portfolio).



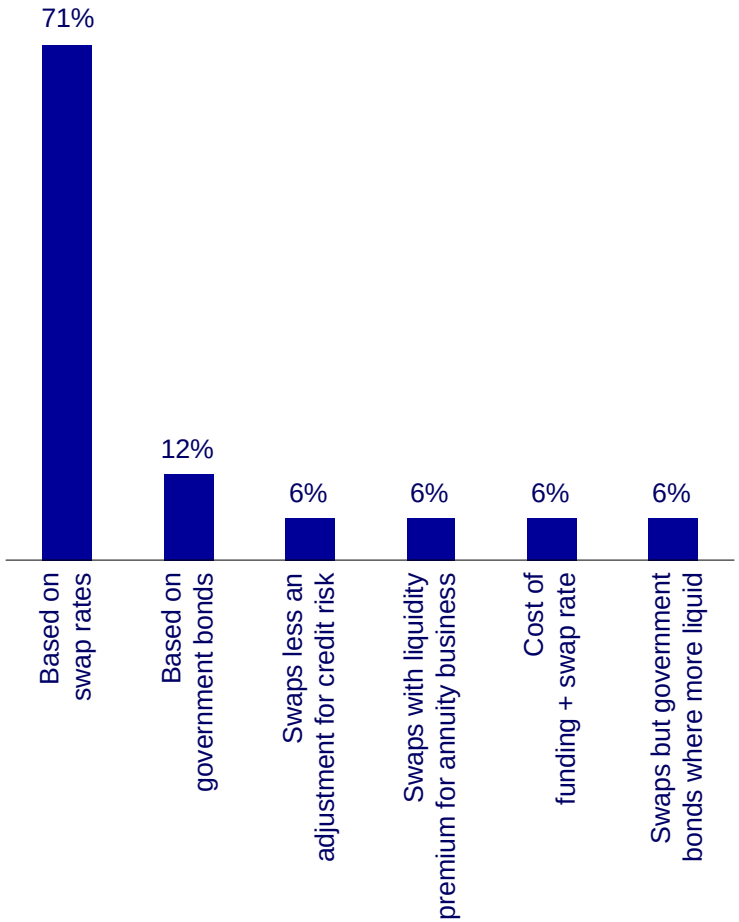
Section 3.2
Upgrades to modelling infrastructure (Pillar 1)
Market-consistent approaches

Key observations addressed in this section

- Although market-consistent approaches are widely implemented, implementation detail varies across companies
  - Significant majority of companies use swap rates as basis for risk free rate, although a number make adjustments (credit risk, liquidity or cost of funding)
  - There is no standard approach to estimating market-implied volatilities, with most companies using vendor models to assist with calibration
  - Market value margins are widely used but nature of implementation varies between companies

Most companies use swap rates as basis for risk free rate

Basis for risk free rate[1] Q24

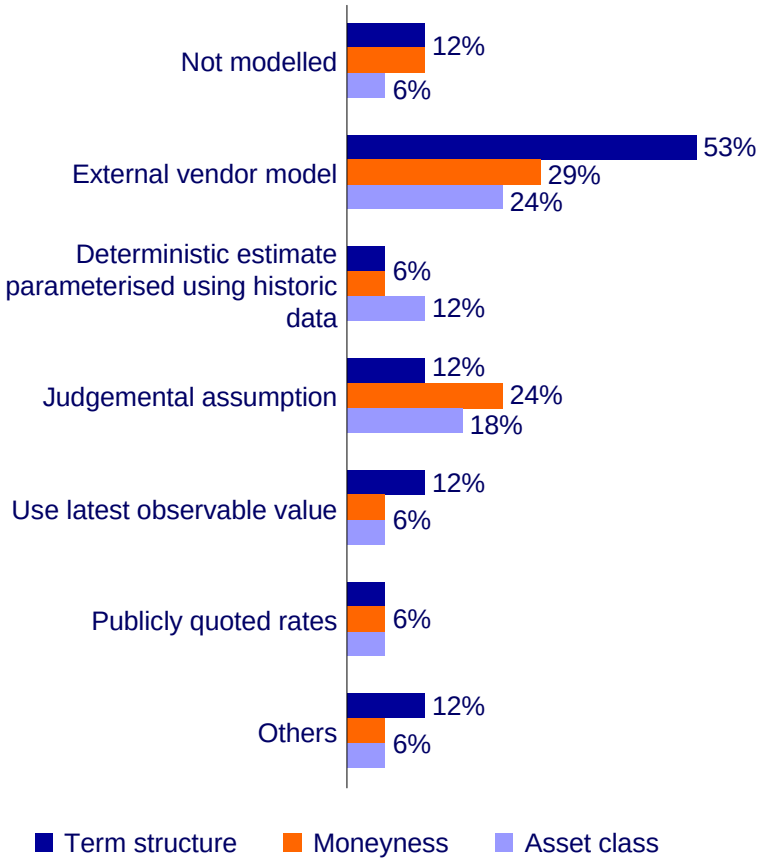


- Majority of companies favour swap rates as basis for risk free rate, although a number make adjustments to swap rate
- One company commented that it was considering moving to government bonds due to the current large spreads on swap rates (one company already uses this approach)

1. One company indicated use of multiple options (hence percentages greater than 100%)

There is no standard approach to estimating market-implied volatilities, with most companies using vendor models to assist with calibration

Methods of calculating market-implied volatilities when limited calibration data[1]

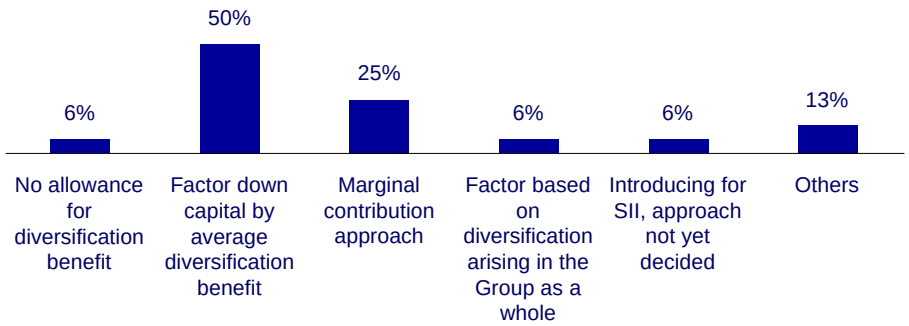


- No standard approach apparent for calibration under limited market data, although use of vended models will drive some consistency
- Significant use of judgment suggests some industry-wide guidance/standards might be appropriate
  - For some respondents, judgment is used as an additional overlay to another approach

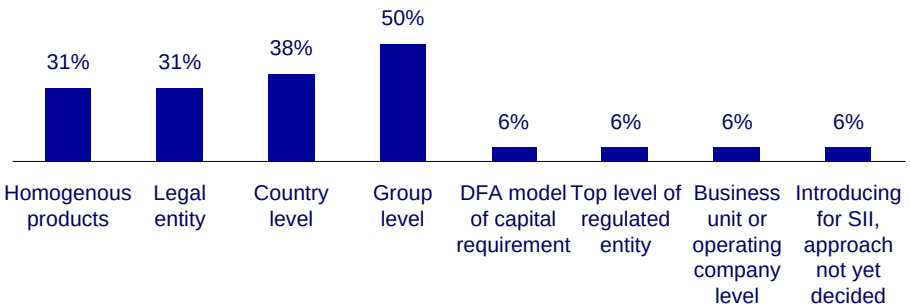
1. Two companies selected multiple options hence percentages do not add up to 100%. Number of responses: 17 (term), 13 (moneyness) and 11 (asset class)

Although market value margins are widely used, nature of implementation varies across companies

Method of allowing for diversification benefit in Cost of Capital[1]

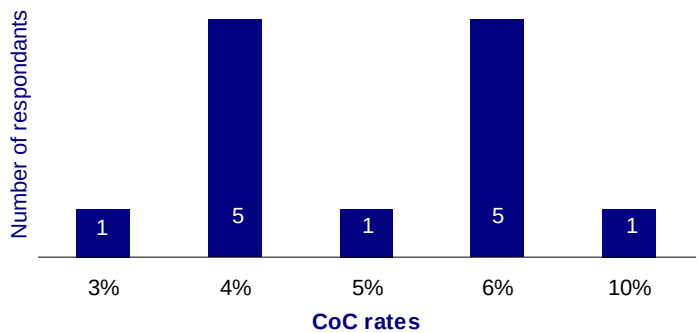


Level at which diversification is considered in calculating Cost of Capital[1]

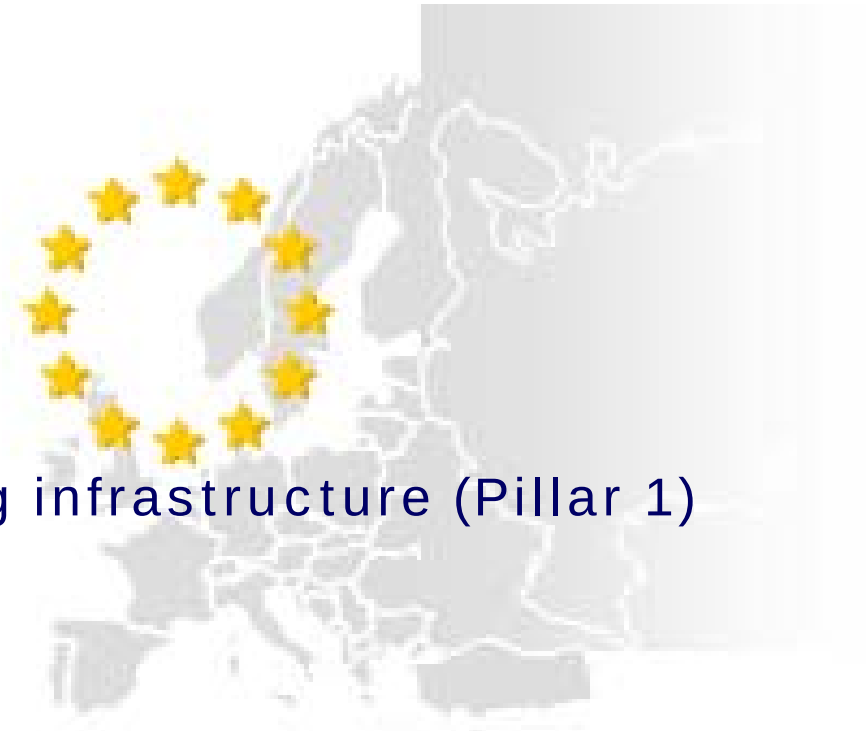


- 76% of companies use a Market Value Margin (MVM) when valuing cashflows exposed to non-hedgable risks
- However approach to certain implementation choices varies between companies
  - No standard approach to calculation of Cost of Capital (COC) diversification benefit
  - Level at which diversification is considered varies, with Group or country level being the most popular
- CRO Forum believes, based on the *'Market Value of Liabilities paper'* published in July and this later study we should begin to see more convergence in the COC spreads used by companies

Assumed COC rates are generally around 4-6%[2]



1. Answers from 16 companies using COC approach. Companies provided multiple responses
2. COC rates assumed gross of tax. Answers from 13 companies specified COC rates used



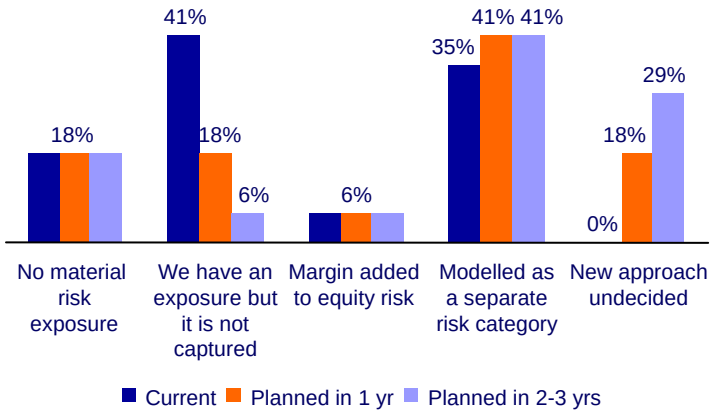
Section 3.3
Upgrades to modelling infrastructure (Pillar 1)
Risk-type capture

Key observations addressed in this section

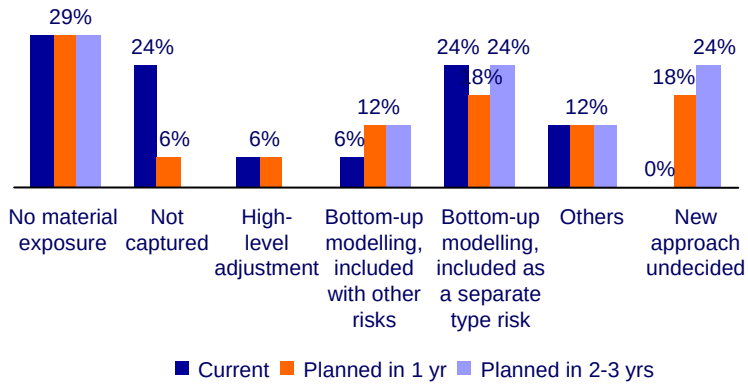
- Sophistication of modelling is generally improving
  - Most insurers are modelling (or implementing) implied volatility risks within their EC models for liabilities with financial options and guarantees
  - Models are capturing dynamic hedging, but some approaches may need further refinement (particularly around capture of hedging sub-risks)
  - Within 2-3 years the majority of insurers with P&C business expect to be able to model the insurance cycle in their economic capital models
- However in some areas progress has been less than expected
  - Contrary to expectations in 2006, we have not observed advances in operational risk modelling
  - Companies continue to have diverse approaches to the modelling of business risk

Majority of insurers are modelling (or implementing) implied volatility risks for liabilities with financial options and guarantees

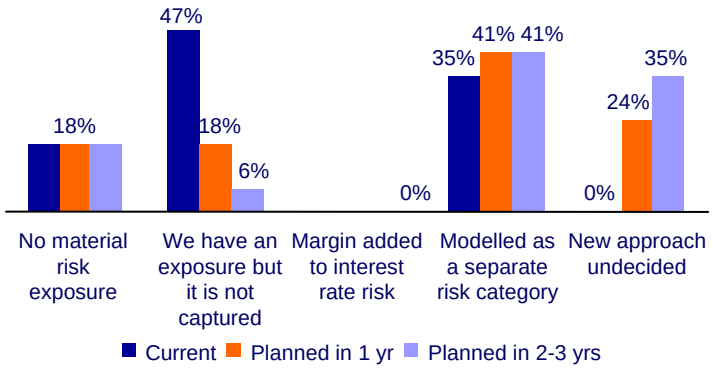
Modelling of implied equity volatility



Modelling of credit spread volatility



Modelling of interest rate implied volatility

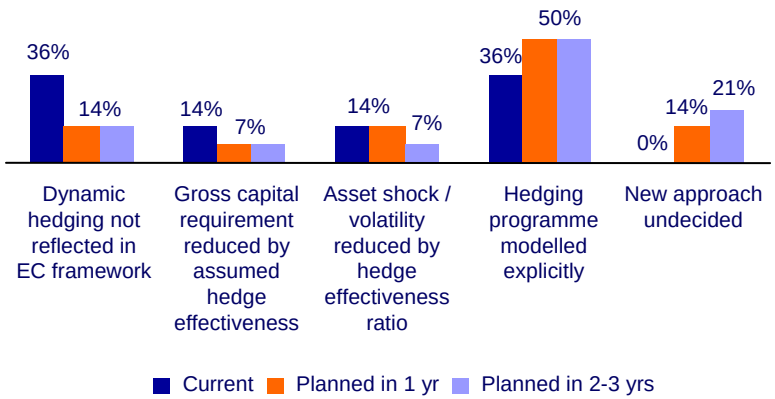


- Insurers are exposed to implied volatility risks where products include guarantees whose value will vary with volatility (i.e. most Life insurers)
- Companies favour modelling implied volatilities as separate risk types, however a number have not yet decided on approaches

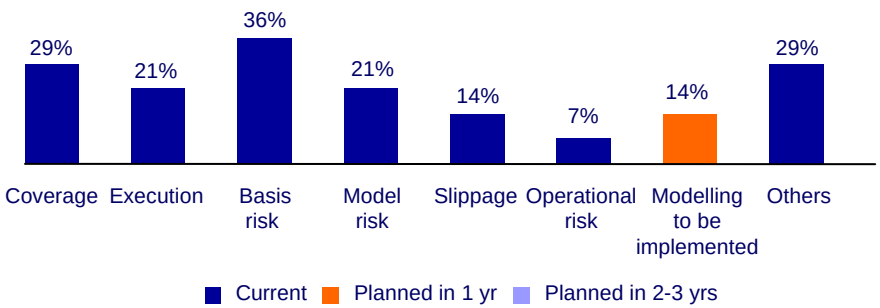
1. 93% of Life insurers who have exposures to implied volatility risks are intending to capture implied volatility in their EC models. Analysis excludes pure P&C insurers (i.e. % based on 17 companies)

Models incorporate dynamic hedging, with some additional hedging sub-risks (e.g. non-linear impacts) also captured

Reflection of dynamic hedging in EC models[1]



Hedging sub-risks captured within EC models[2]



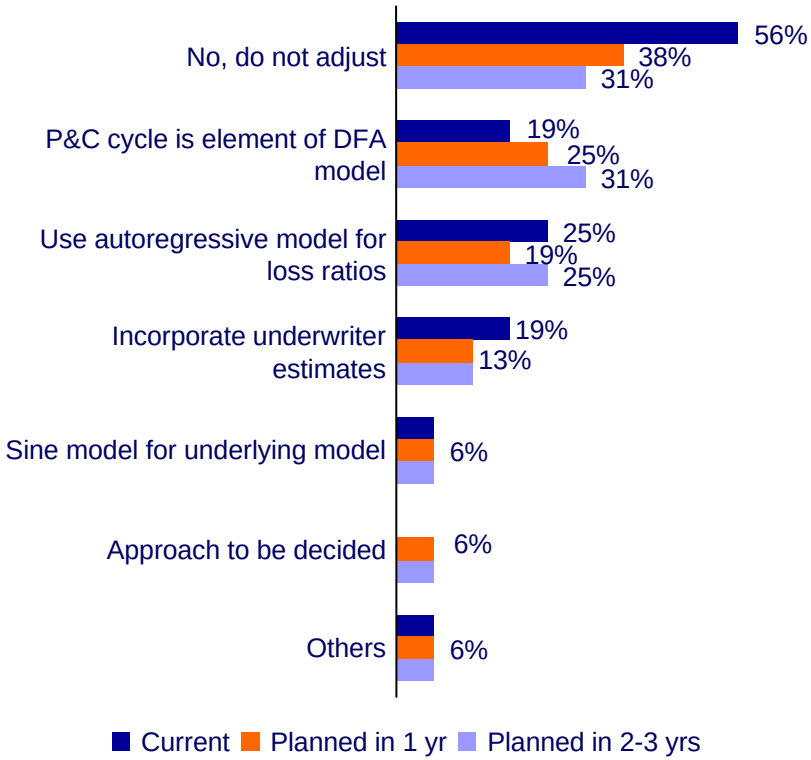
Modelling of dynamic hedging

- A number of insurers use dynamic hedging to manage risks (particularly to manage guarantees in Life products)
- Majority of companies with a dynamic hedging programme are currently able to/planning to model the hedging programme explicitly, although a number are undecided about future approach
- Hedging programmes can have non-linear impacts and introduce additional hedging sub-risks, such as
  - Coverage (not all risk factors captured in hedge)
  - Execution (impact of rebalancing hedge at discrete time intervals rather than continuously)
  - Basis (imperfect mapping of hedge to guarantee)
  - Model (model unable to fully capture complex options)
  - Slippage (cashflows on which hedge is based are out-of-date)
- Some companies model selected hedging sub-risks explicitly within their EC models, but coverage is patchy

1. Analysis based on 14 companies who answered this question. Same number is used in the analysis of the next question below
2. Analysis exclude companies who do not have dynamic hedging approach (i.e. % based on 14 companies who answered the previous question. Answers from 2 companies excluded, as they did not answer the previous question)

Within 2-3 years majority of insurers with P&C business plan to model the impact of insurance cycle on new business profit in their economic capital models

Methodology to adjust for the insurance cycle[1]



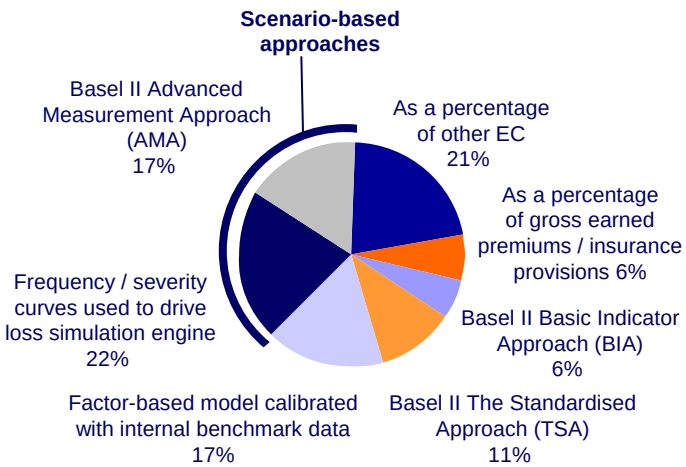
Adjustments for P&C insurance cycles

- Some firms explicitly allow for anticipated new business inflows in their EC model, thus requiring assumptions on future pricing level
- Insurance (underwriting) cycles have been shown to exist across many classes of business, but cycles are difficult to predict, and are not aligned across classes
- Impact of insurance cycles introduce additional uncertainty into estimates of the profitability of any new business which is included in economic capital frameworks
- A number of insurers already capture the insurance cycle within their EC models 44%, within 2-3 years the majority expect to allow for the insurance cycle to some degree

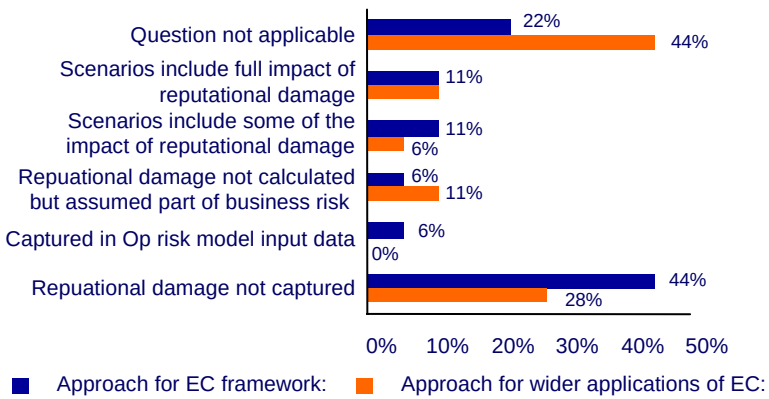
1. Options are not mutually exclusive, for example DFA model allowance for insurance cycle may involve autoregressive model for loss ratios. Analysis excludes Life companies

Contrary to expectations in 2006, we have not observed advances in operational risk modelling

Operational risk modelling approaches[1]



Treatment of reputational risk

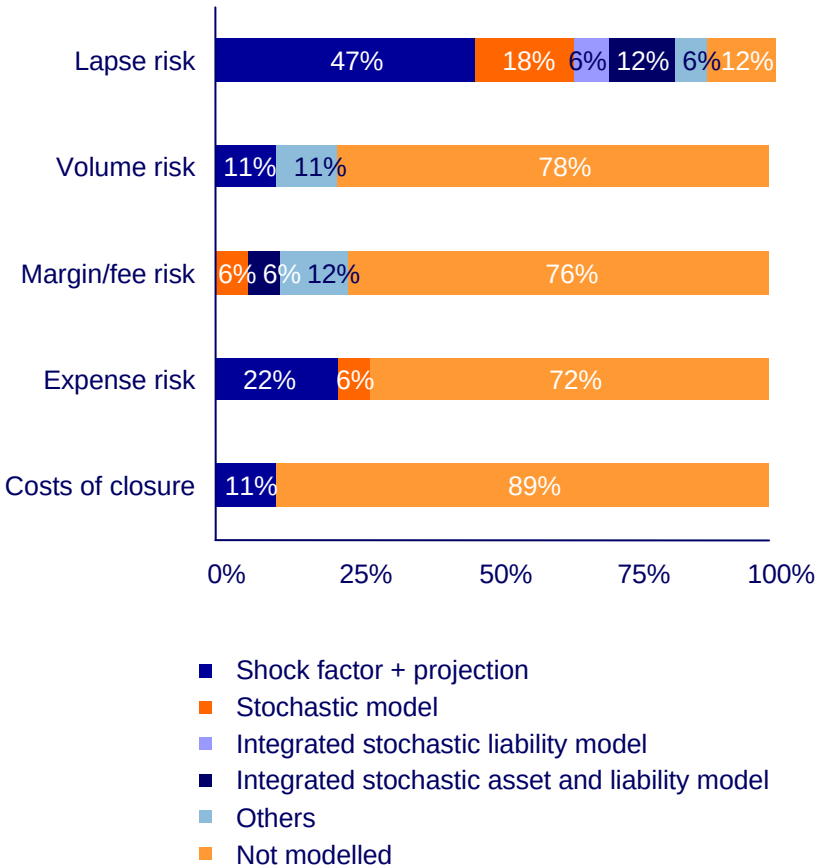


- At the time of the 2006 survey operational risk was expected to be a focus of development, with increasing harmonisation of approaches
- Although companies have been improving the sophistication of their modelling of other risk-types this has not generally happened for operational risk
  - The CRO Forum believes that holding capital for Operational Risk is just one part of a broader risk management approach, and therefore the nature and extent economic capital modelling should be seen in light of the overall management framework (cf. working paper under preparation on operational risk)
- Majority of participants in 2008 have comparatively simple operational risk models
  - Factor-based approaches: Basel II Standardised Approach (TSA), other factor-based models
  - Percentage approaches: Basel II Basic Indicator Approach (BIA) (percentage of income) and setting op risk equal to a % of EC
- 44% of companies make no allowance for reputational risk within their EC model, and a further 22% answered “not applicable”
  - For many participants, risk on reputation is rather seen as an opportunity loss rather than a risk type and no capital should be held for something that is not on the balance sheet in the first place. Reputation loss is caused by another risk such as compliance, fraud, processing/admin, etc.

1. The changing mix of participants has some effect on results shown here (when new participants are excluded, 54% of companies use scenario-based approaches which is in line with the 2006 result)

Companies continue to have diverse approaches to the modelling of business risk

Business risk modelling approaches[1]



- 2006 survey found that companies had diverse approaches to modelling of business risk – with various coverage of some business sub-risks (particularly non-lapse risks)
- This remains the case in 2008, with limited coverage of business risks other than lapse or policyholder behaviour
  - We note that the impact of these risks should be captured only to the extent that the underlying value drivers are captured as part of the balance sheet/AFR (e.g. future business volumes or margins)
- QIS4 addresses lapse and expense risk explicitly within the “Life risk” category, rather than as a separate “Business risk”

1. Analysis for Lapse risk and Margin/Fee risk excludes pure P&C insurers (i.e. percentages calculated based on the total of 17 companies

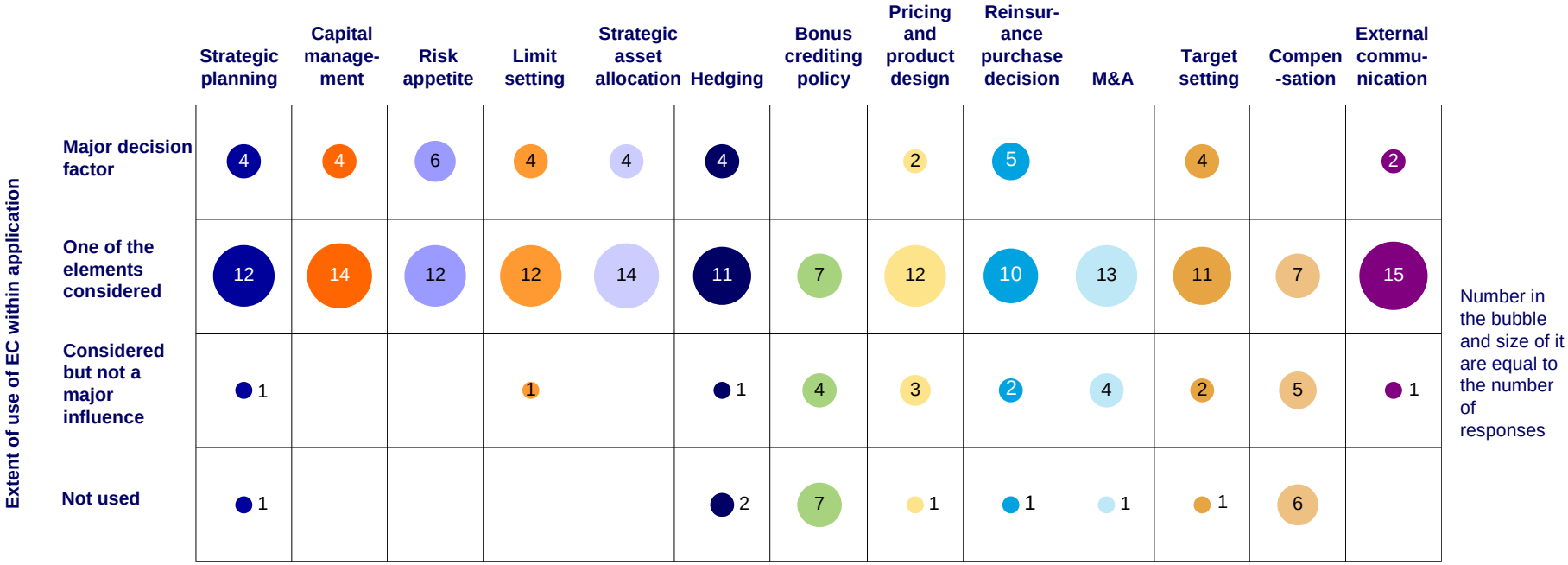
Section 4
Embedding of economic capital concepts (Pillar 2)

Key observations addressed in this section

- Most companies are using/intending to use economic capital insights amongst the elements considered for a range of business decisions
- In many cases planned use of economic capital has already been implemented
- However companies see ensuring an appropriate level of Business “use” and Executive engagement with economic capital as the major challenges to further embedding
- Lack of clarity or progress regarding the role of Business Units and Executive may be hampering further embedding
  - For some companies, role of BUs in economic capital is restricted to providing model input data – for many firms BUs could be more involved
  - Executive management is generally involved in setting the risk analysis framework and signs-off the EC result – for some firms, greater involvement in these 2 areas might deepen understanding of results

Overall range and nature of use of economic capital is in line with 2006 – with most companies considering EC for many business decisions

Current or planned use of economic capital and related measures

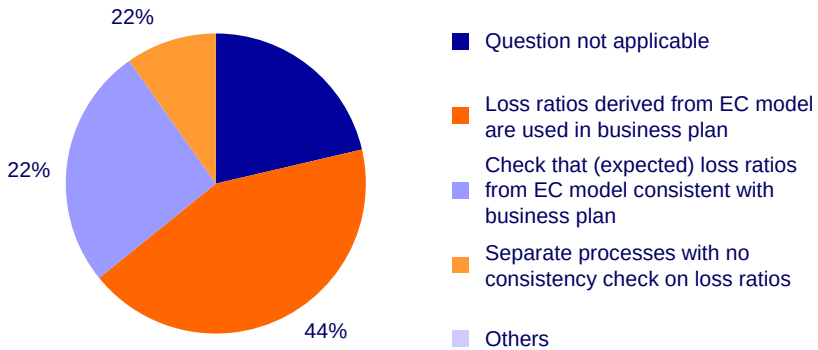


- Companies are using or intending to use across a wide range of business decision-making processes
  - [61%] of respondents are using/intending to use EC across all the management processes specified in the question – mostly as “one of the elements considered”
- Answers are in line to 2006 survey results suggesting that the overall level of EC use has not changed markedly between the two surveys – and also that companies have no immediate plans to change the level of use significantly)[1]

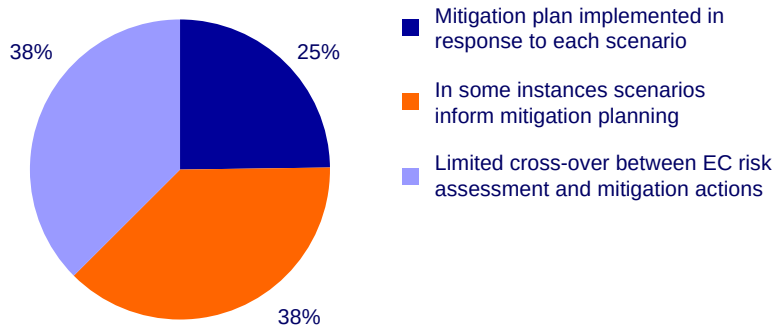
1. Excluding new participants in 2008 from the analysis of 2008 use vs. 2006 does not change the result (note 2006 question asked about actual use in last 6-12 months, 2008 asked about current and planned use of EC

In many cases planned use of economic capital in business decisions has already turned into reality (example results)

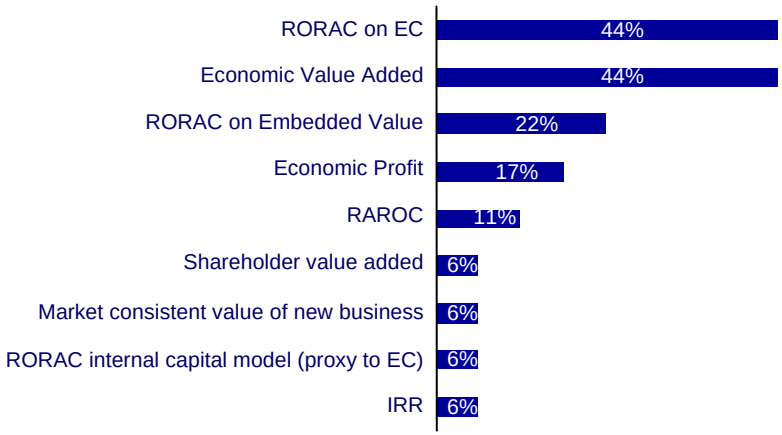
Use of Expected Loss ratios (from EC) in planning (P&C)



Use of EC operational risk scenarios in mitigation decisions[1]

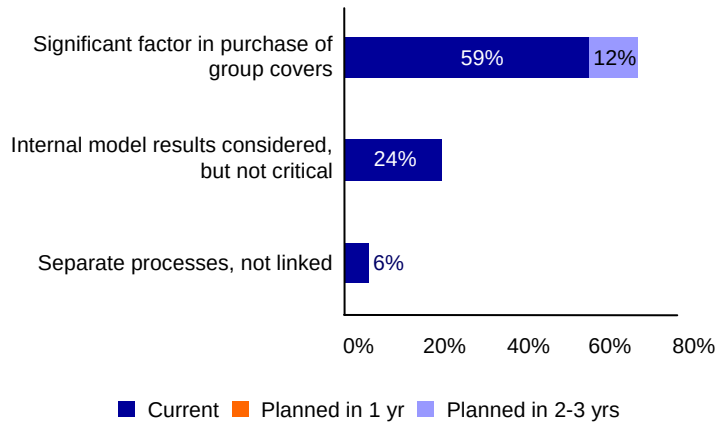


Use of risk adjusted performance measures



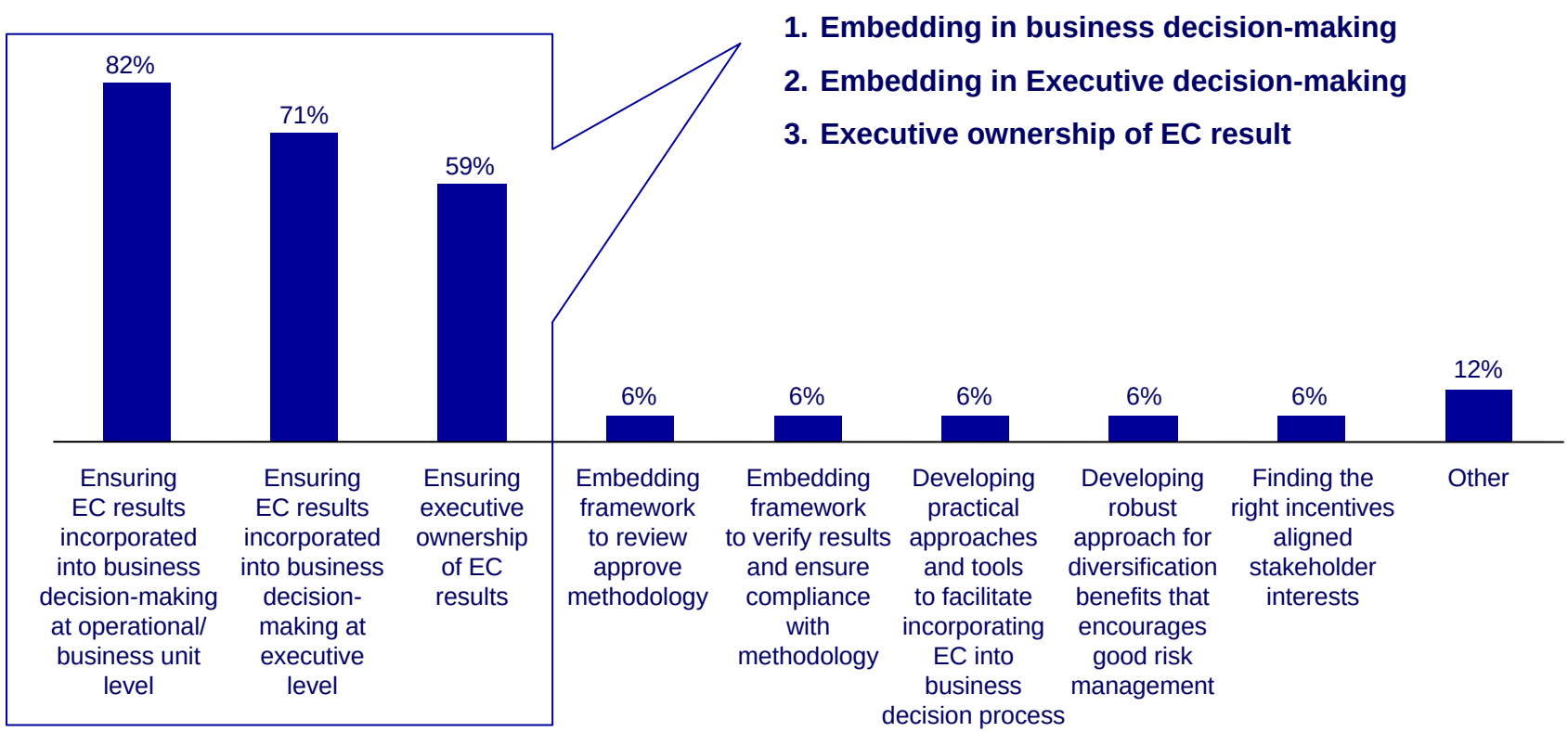
1. Analysis based on 8 companies that answered this question
2. Analysis based on 17 companies that answered this question

Use of EC to inform reinsurance purchase decisions[2]



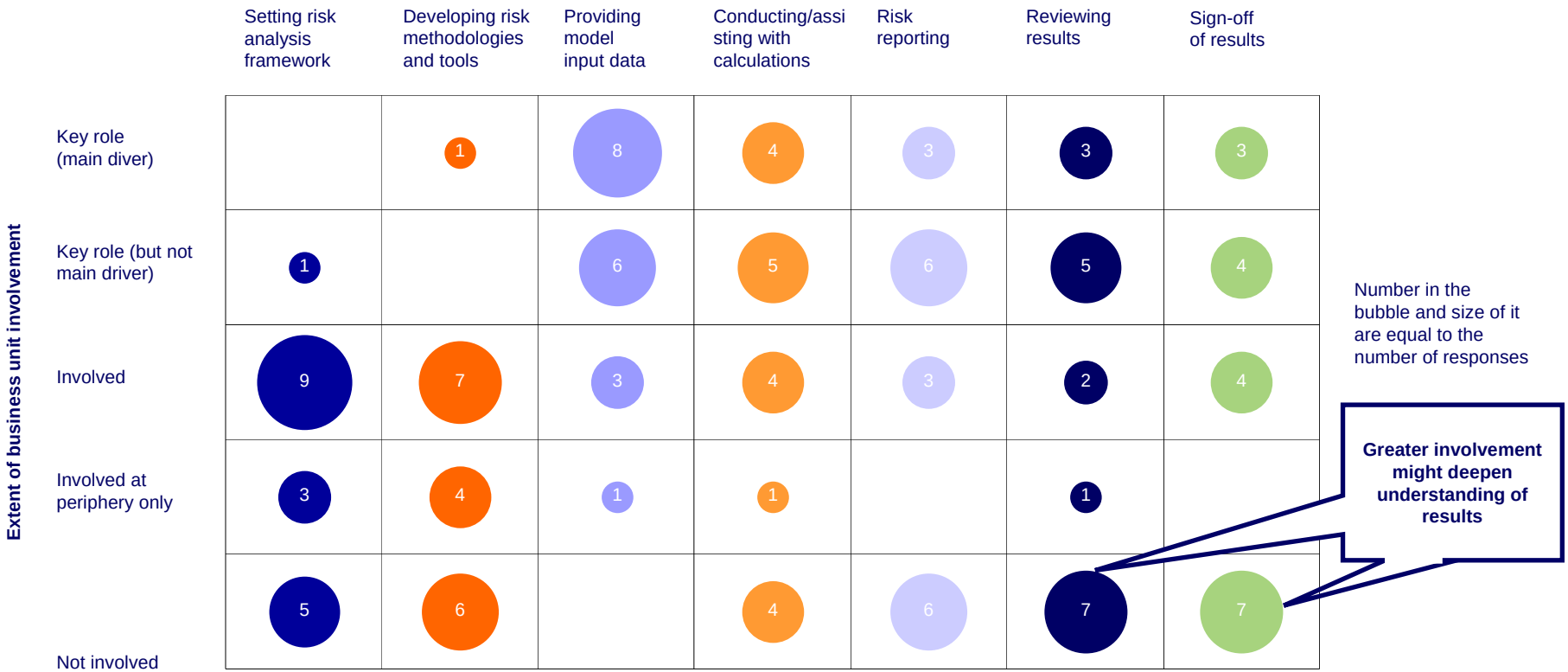
Companies see ensuring Business “use” and Executive engagement with economic capital as the major challenges to further embedding

Companies’ views on top three challenges to embedding economic capital



For some companies, role of BUs in economic capital is restricted to providing model input data – for many firms BUs could be more involved

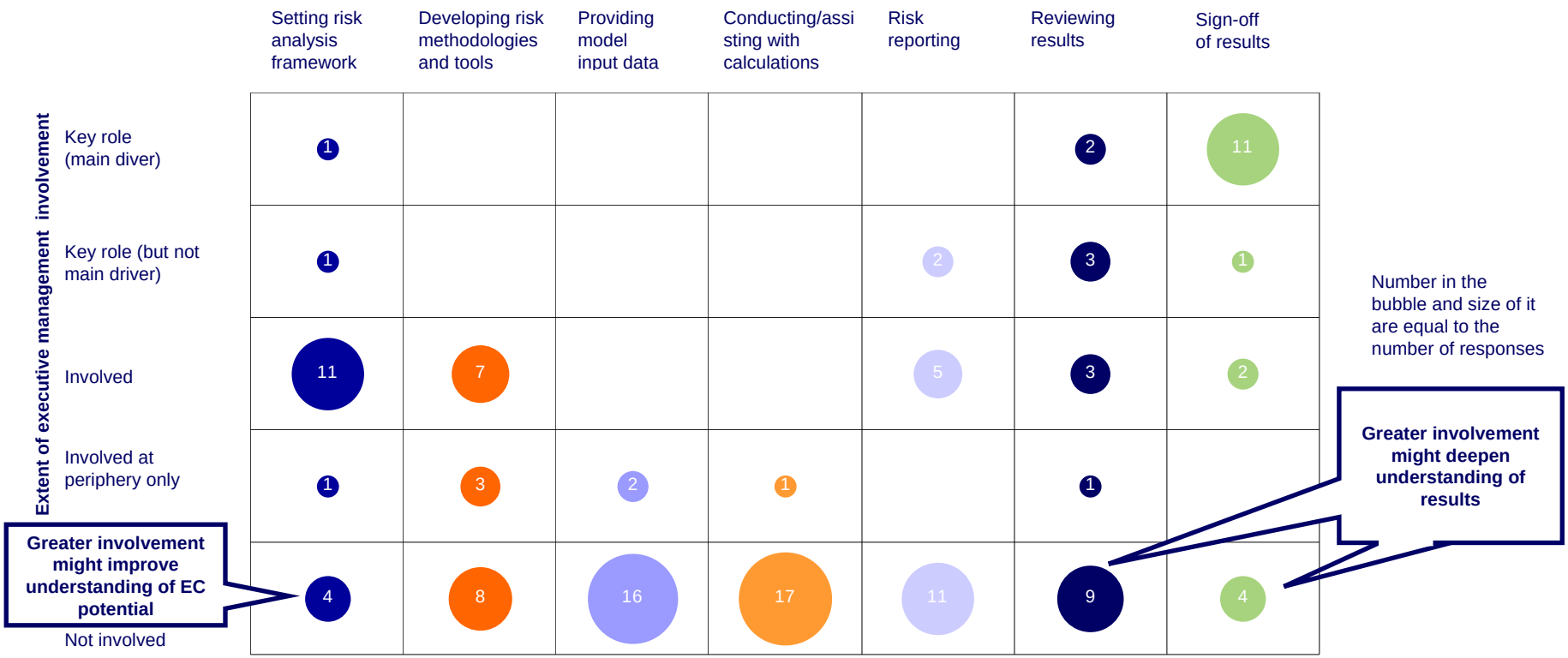
Role of Business Units in EC processes



- Business Units often have key roles in providing input data and performing calculations
- But currently, more limited roles in reviewing and signing-off results (in some cases not involved at all)
- Business Units are sometimes involved in setting the risk analysis framework and developing methodologies and tools, although (consistent with the results) this is an area where Group functions would be expected to take the lead

Companies may be able to improve Executive engagement with EC by expanding roles in setting EC framework, review and sign-off of results

Role of Executive management in EC processes



- In majority of cases Executive management is involved in setting the risk analysis framework and signs-off the EC result
- For companies where Executive management is not involved in setting the risk analysis framework, sign-off of results or review pre-sign-off, it might be possible to improve Executive understanding of and engagement with EC by expanding its role in these areas
- As expected, Executive management has a no significant role in data, calculations or developing methodologies

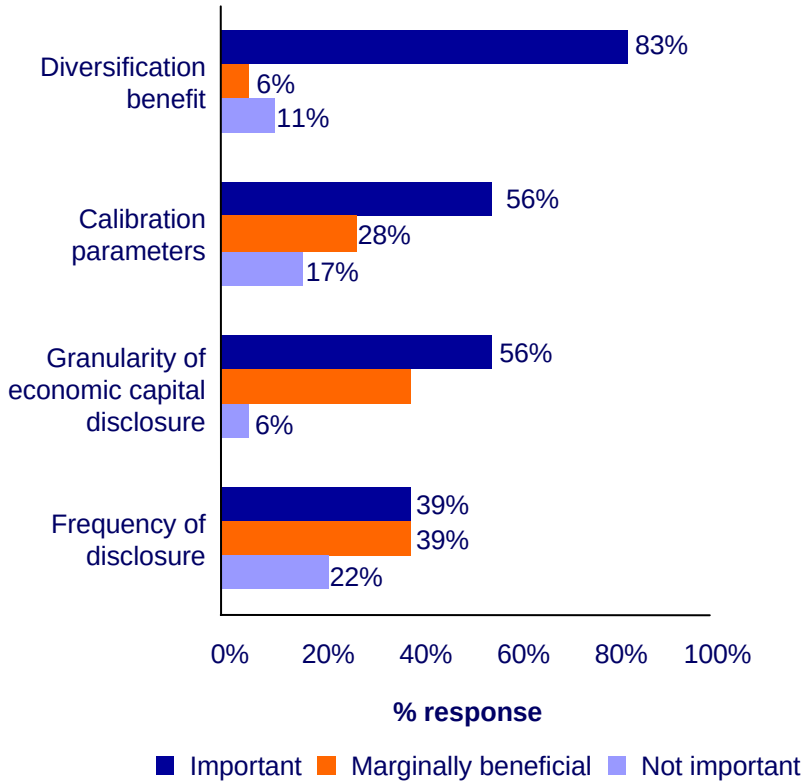
Section 5
External disclosure of economic capital results (Pillar 3)

Key observations addressed in this section

- There is a strong desire for consistency in disclosures (reporting of diversification benefit, granularity and frequency of disclosure and calibration of parameters)
- However further discussion would be needed to obtain consensus on approach for disclosing diversification benefit
- For some companies, scope of internal and external audit lags behind ambitions regarding external disclosure of EC

There is a strong desire for consistency in disclosures across a range of key reporting items

Need for standardisation of EC disclosures[1]



- In general companies would like more and more standard reporting of EC results
- 83% strongly favour a standardised approach to disclosure of diversification benefit, which not surprising given impact of diversification on EC result (QIS4 results suggest diversification reduces EC by ~40%[2])
- However further discussion would be needed to obtain consensus on the approach to diversification (see next slide)
- 56% of companies see benefit in a standardised approach to calibration of parameters. Greater standardisation should be possible
  - Survey found that internal model frameworks are calibrated to different confidence intervals with differences in risk types etc.
  - However experience of Quantitative Impact Studies suggests that recalibration to a standardised confidence interval with a standard set of risk types is possible
- There is also some support for standardisation of granularity (56%) and frequency of disclosure (39%). This should be possible provided requirements aren't too granular or too frequent. (All companies currently calculate EC at least annually)[3]

1. Question focused on need for standardised disclosure of the four categories listed (i.e. diversification, granularity, frequency and parameter calibration)
2. CRO Forum QIS4 benchmarking study, October 2008

There is currently no strong consensus on the best approach to disclosing diversification benefit

Preferred approaches to disclosing diversification benefit[1]

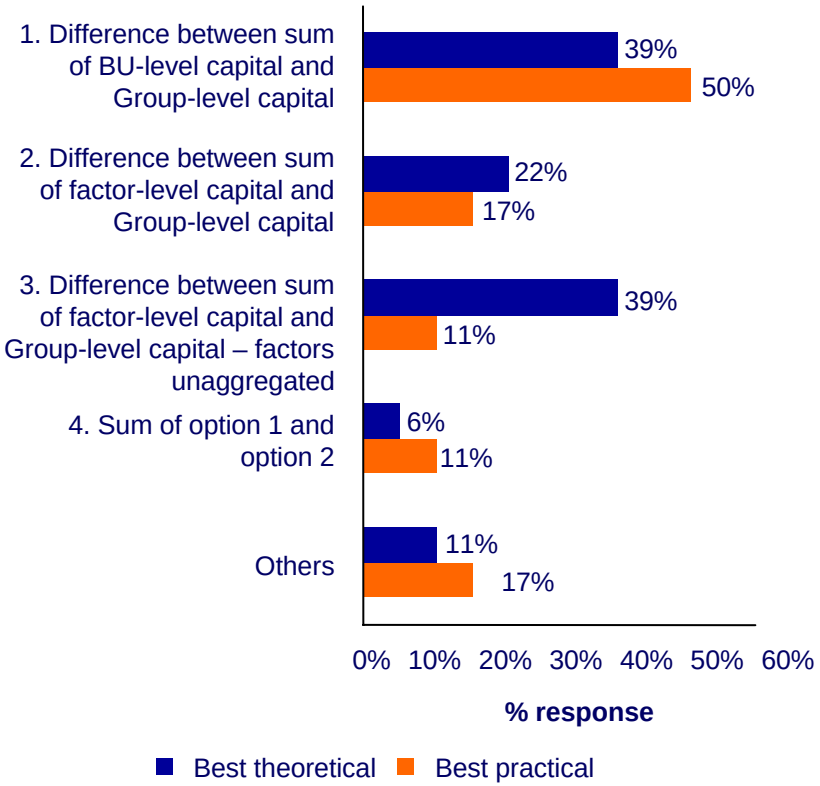
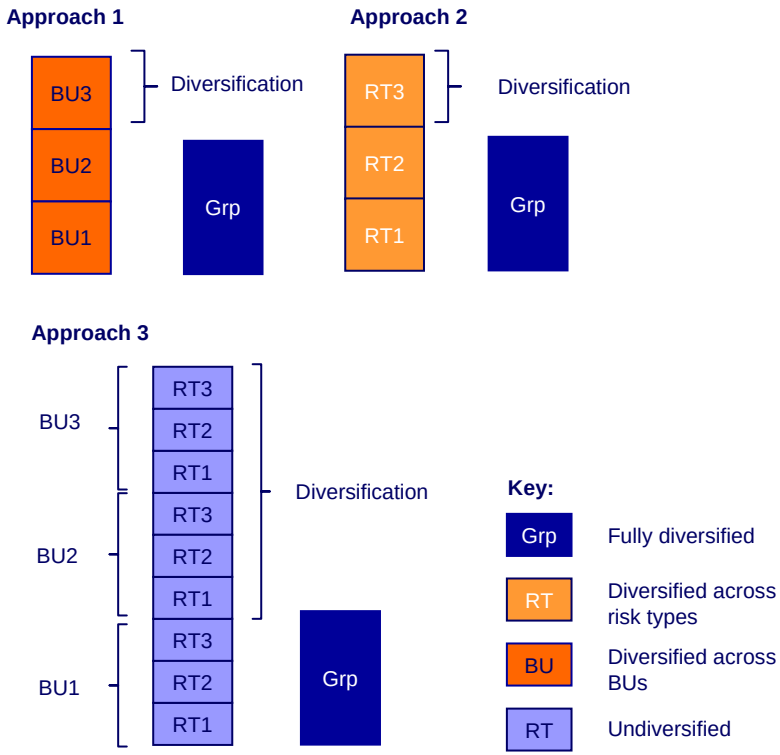


Illustration of approaches

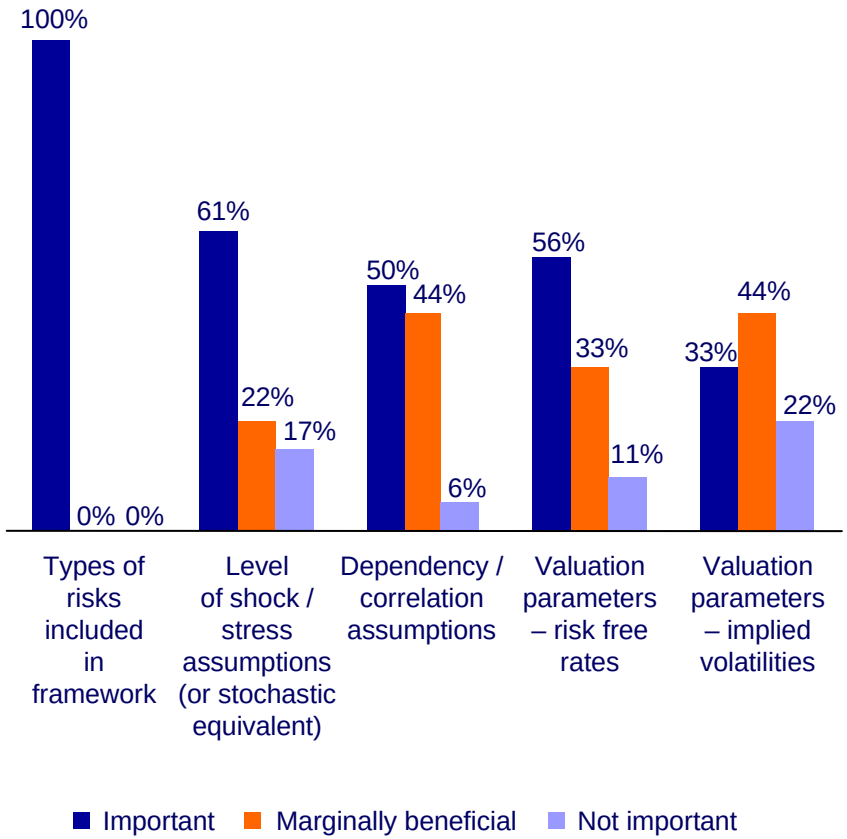


- The different preferences for the best approach to disclosure of diversification benefit may be a reflection of the different model structures used by participants, e.g. whether results aggregated step-wise (corresponding to approaches 1 and 2) or all at once (approach 3)
- Further analysis and discussion is needed to see whether a consensus approach can be established

1 Two companies gave multiple answers so percentages do not add up to 100%

Companies support a standardised approach to disclosure of risk types, views on standardised disclosure of other parameters are mixed

Parameters which should be disclosed in a standardised format

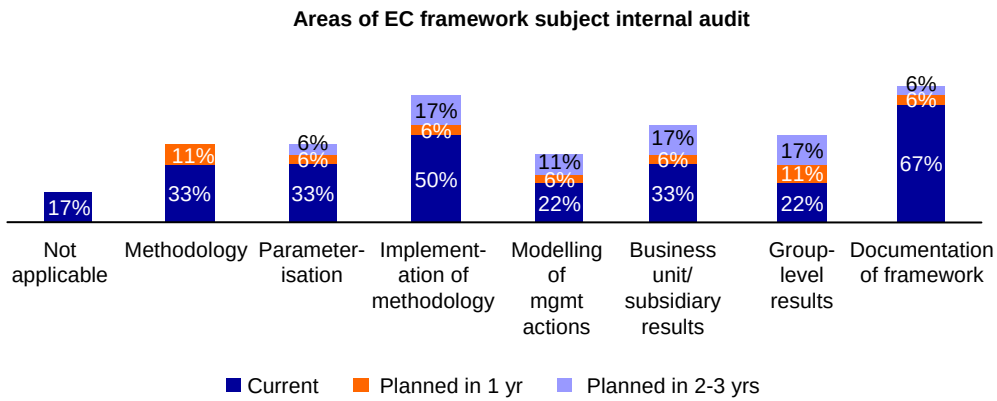


- Companies would like to use a standardised format for disclosure of types of risk included in EC frameworks
- 61% of companies would also support a consistent approach to disclosure of major shock / stress assumptions (or stochastic equivalent) and 50% would support a consistent approach to disclosure of dependency / correlation assumptions
- 56% of companies would support consistent disclosure of risk free rates, whilst 33% support a standardised approach to disclosure of implied volatility parameters
- Results are broadly in line with the recent CRO Forum Public risk disclosure proposal[1] which encourages transparency and facilitates comparisons between companies and over time

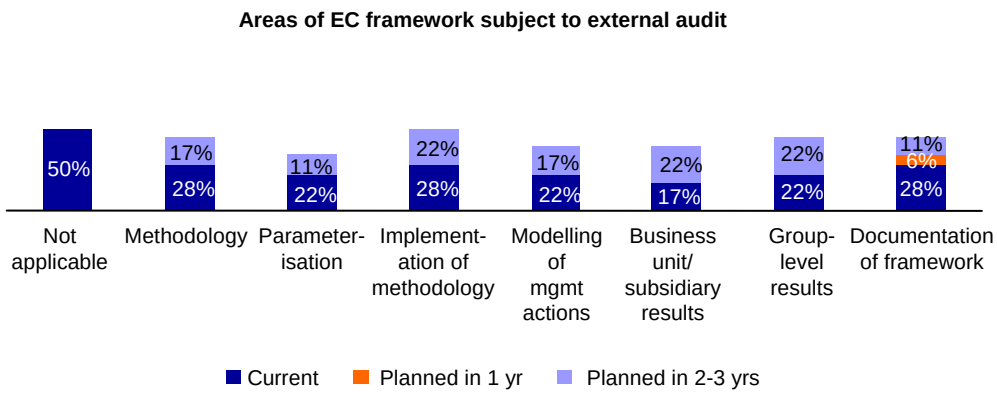
1. Public risk disclosure under Solvency II (CRO Forum, November 2008)

For some companies, scope of internal and external audit lags behind ambitions regarding external disclosure of economic capital

Framework and processes subject to internal audit



Framework and processes subject to external audit



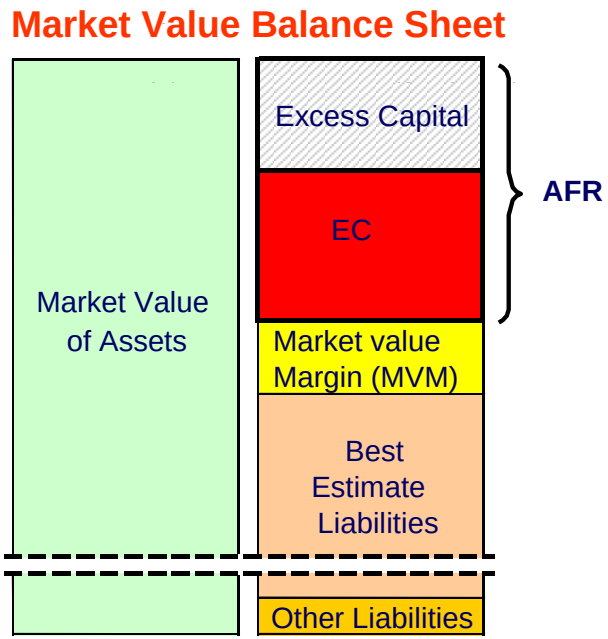
Additional disclosure requirements will drive the further development of internal and external audit processes

- Implementation phases of EC frameworks have involved relatively limited verification and review
- Expectation is that this will change as companies increasingly disclose EC results publicly – or rely on internal models to demonstrate solvency
- Half of all companies expect to have wide coverage of their economic capital framework, processes and results from external audit within 2-3 years
- Companies are working to ensure that (where necessary) processes and documentation are brought up to audit standard

Appendix A
Glossary of terms and CRO Forum interpretation

- **Available Financial Resources (AFR):** The amount of economic capital available to absorb losses in stress events. It is the difference between the market value of the tangible assets and the market-consistent value of the liabilities, including a market value margin (MVM)

- **Market Value Margin (MVM)**: The cost of non-hedgeable risk within insurance liabilities, i.e the present value of the cost of future economic capital requirements for non-hedgeable risks. The MVM is a part of the market-consistent value of liabilities



- **Business risk:** Business risk includes 5 sub-risks, such as lapse risk, volume risk, margin/ fee risk, expense risk, costs of closure. QIS4 addresses lapse and expense risk explicitly within Life risk.

- **Diversification benefit:** Risk offset between entities or risk exposures. It reflects the fact that the risk factors are not perfectly correlated and therefore simply adding different risks together is not a good reflection of economic reality and overstates total risk. As presented in this study, majority of companies (60% of participants) using variance/ covariance for overall aggregation approach, but there is a slight trend towards alternatives (copula approach).

- **Operational risk:** Operational risk means the risk of loss arising from inadequate or failed internal processes, or from personnel and systems, or from external events. Operational risk shall include legal risks, and exclude risks arising from strategic decisions, as well as reputation risks.
  - ***CROF position:*** Management of operational risk is forward-looking and focuses on pro-actively identifying, analysing, assessing and evaluating the organisation's readiness for potential operational risk events (including extreme events). Significant operational risks that threaten the company's strategy and its objectives should be managed through mitigation activities and monitored actively

- **Liquidity risk:** Liquidity risk can be generically defined as the risk that cash sources are insufficient to meet cash needs under either current conditions or possible future environments. At the heart of effective liquidity measurement is a clear understanding of a company's cash sources and cash needs.
  - ***CROF position:*** Liquidity risk is an asset / liability concern; it is neither solely an asset risk nor a liability risk. Requiring capital to provide for liquidity risk is an ineffective means of managing this risk. Liquidity risk is a risk to be managed at all times – before, during, and after any stress event – and no amount of capital can replace comprehensive liquidity risk management.

- **Fungibility:** Fungibility is the ability to move cash/ capital between regulated entities within a group in times of stress. Fungibility takes into account that capital may not be transferred freely between portfolios and entities due to regulatory restrictions.
  - ***CROF position:*** Fungibility of capital (liability side) should be distinct from liquidity of assets: it is possible to have intrinsically fungible capital but no liquid assets, or the other way round. Fungibility impacts should be mitigated by capital/ liquidity management in general.

Appendix B
Survey participants and analysis

Survey participants and analysis

		2008	2006
CRO Forum members	Aegon	Yes	Yes
	AIG	Yes	Yes
	Allianz	Yes	Yes
	AVIVA	Yes	Yes
	AXA	Yes	Yes
	Eureko	Yes	No
	Fortis	Yes	Yes
	Generali	Yes	Yes
	Groupama	Yes	No
	Hannover Re	Yes	No
	ING	Yes	Yes
	MetLife	Yes	No
	Munich Re	Yes	Yes
	Prudential	Yes	Yes
	Swiss Re	Yes	Yes
	ZFS	Yes	Yes
Associate members	ManuLife	Yes	No
	RSA	Yes	Yes
Participants in 2006 only[1]	Converium (now part of Scor)	No	Yes
	Winterthur (now part of AXA)	No	Yes

Number of participants included in analyses

- Unless indicated in the footer analyses show results for all 18 participants in the survey, those not answering the question are recorded as “Not applicable”
- One company did not provide answers to questions 1-43. Analyses of these questions are based on 17 participants

1. 2006 survey was joint with IFRI, however results from banking survey were kept separate from insurance survey. Participant list relates to insurance only.