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European Actuarial Note on ESAP 3 and ORSA

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1 PREFACE

1.1 DUE PROCESS ON THIS EAN

This European Actuarial Note (EAN) is an educational document on ORSA and ESAP 3 that has been adopted by the Actuarial Association of Europe (AAE) in order to advance the understanding of the subject by readers of the EAN, including actuaries and others, who use or rely upon the work of actuaries. It is not a European Standard of Actuarial Practice (ESAP). This EAN seeks to assist actuaries in complying with an ESAP 3, for example by offering practical examples of ways in which actuaries might implement ESAP 3 in the course of their work. This EAN also assists actuaries when participating on the overall ORSA work, In section 4, Other relevant subjects relating to the actuarial services performed by an actuary in relation to the ORSA process are covered in order to help actuaries with this tasks.

This EAN is not prescriptive and therefore does not contain words such as "should" or "must". Rather, this is descriptive and will convey meaning by the use of examples of actual practice, without suggesting that these examples are comprehensive.

1.2 THIS EAN ON THE ORSA AND ESAP 3

The intent of this EAN, which supplements ESAP 3 on the ORSA process, is to provide further explanation of the ideas introduced in ESAP 3, e.g., where it was inappropriate to include in the ESAP the level of detail which is contained in this EAN. Explanations and examples are provided with the hope of elucidating generalised topics or complex ideas.

This EAN is envisaged as a "living document" that will reflect developing good practice and address actuaries' doubts and questions as they relate to the requirements set out in ESAP 3 and more widely in actuaries' responsibilities in supporting the ORSA within their company and their profession. Therefore updated versions of this EAN can be expected.

The following sections may be read *en face* with the ESAP 3. Section 2 below of this EAN clarifies definitions from the ESAP 3. Section 3 and its subsections correspond directly to the sections of the ESAP 3 with the same indices. Section 4 provides detailed examples and explanations, which are relevant to the ORSA and the ESAP 3, but not directly attributable to specific sections of the ESAP 3.

1.3 LIST OF ABBREVIATIONS USED

In this document, many different abbreviations are used to keep the text more readable. All the abbreviations used, with explanations, are listed in the table below.

Abbreviation	Explanation
ALM	Asset and liability management
AMC	Asset management charge
BAU	Business as usual
BEL	Best estimate liability in Solvency II
BE	Best estimate
BPP	Business planning period
CF	Cash flow
ERM	Enterprise risk management
ESG	Economic scenario generator
GDP	Gross domestic product
IAIS	International Association of Insurance Supervisors
IFRS	International Financial Reporting Standards
IM	Internal models in Solvency II
KPI	Key performance indicator
LACDT	Loss absorbing capacity of deferred taxes
LLP	Last liquid point in Solvency II
M&A	Mergers and acquisitions
MA	Matching adjustment in Solvency II
MCR	Minimum Capital Requirement in Solvency II
MECE	Mutually exclusive and collectively exhaustive
MV	Market value
ORSA	Own Risk and Solvency Assessment as defined in Solvency II
OSN	Own solvency needs
PVFP	Present value of future profits in Solvency II
QE	Quantitative easing
RW	Real World
SII	The Solvency II directive, and associated delegated acts and guidelines
SCR	Solvency Capital Requirement in Solvency II

SF	Standard formula in Solvency II
SaST	Stress and Scenario Tests
TBS	Total balance sheet
TP&C	Technical provisions and capital
TVOG	Time value of options and guarantees
UFR	Ultimate forward rate in Solvency II
VA	Volatility adjustment in Solvency II
VaR	Value at risk
VIF	Value of in-force

2 SUPPLEMENTARY NOTES TO ESAP 3 DEFINITIONS

In this section, some of the ESAP 3 definitions are covered and additional explanations and clarifications are offered to help better understanding. Not all definitions have been supplemented, e.g. those which are covered sufficiently in the ESAP are not supplemented here.

2.1 ADDITIONAL MATERIAL RELATING TO "RISKS", "UNCERTAINTIES" AND "EXPOSURES"

Within the ESAP, there is a distinction between "risks", "uncertainties" and "exposures". The distinction between "risks" and "uncertainties" is to facilitate the inclusion of "things" (for lack of a better word) which may not be well-defined or well understood but may still affect the company, for example, via its exposures, via its operations, or via its accounting, reserving or capital calculation methods. For this last area, it may be that errors in accounting or reserving, after being corrected, may adversely affect the company's balance sheet or solvency position. "Risks" are intended to be those "things" which are more commonly understood and dealt with on a regular basis, i.e. those "things" that the company manages and analyses as a core part of daily work. In more common parlance, a "risk" poses a risk to the company…an identifiable, immediately comprehensible risk. An "uncertainty" *may* pose a risk to the company, although it may not be immediately clear precisely *how* it does pose a risk, may pose a risk, or might eventually pose a risk. For an "uncertainty", the trigger, event or consequence may be unclear or unknown. For the remainder of the EAN, the term "risk" is used to cover both risks and uncertainties unless the distinction is particularly relevant[1].

In academia, economics, and industry, the notions of Knightian risk and Knightian uncertainty are often used to distinguish risk and uncertainty in general. There are various interpretations of Knight's *Risk, Uncertainty, and Profit*. One interpretation is to distinguish risk as relating to outcomes which can be insured against and uncertainties as relating to outcomes which cannot be insured against. Knight himself distinguished the two as quantifiable and unquantifiable (among other descriptions drawing out the differences). Another interpretation is to distinguish three categories involving the "state space" (collection of all possible outcomes) and the probabilities of those outcomes: first, where all potential outcomes and there probabilities are known (e.g. a fair coin); second, where all potential outcomes are known but there is incomplete knowledge of probabilities (a common coin); third, there is incomplete knowledge of the state space and hence the unconditional probabilities are unknown or unknowable (while probabilities conditioned upon a known subspace of the state space may be knowable). Note that the fourth pairing (unknown state space, known probabilities) is impossible. Knight mentioned the impossibility to fully identify and classify outcomes which leads to irresolvable uncertainty[2].

"Exposures" are distinguished from "risks" and "uncertainties" in order to facilitate a cause-and-effect view of potential-loss-causing events. It is useful to distinguish "risk as cause" from "risk as consequence" to explain the intended meaning of "exposures". "Risk as cause" might be thought of as movements in equity prices while "risk as consequence" as the consequence effect on the insurer's balance sheet and profit and loss account *due to its exposures*. For example, a company may have complex exposures to movements in the equity markets. A life insurer's exposures to equity risk through its unit-linked products may be linear and one-for-one—in that a 40% fall in equity market values decreases policyholders' unit-linked equity holdings by 40% and the insurer's future expected asset management charges are reduced in line with asset values. For a life insurer's participating guaranteed savings, the insurer may have direct equity investments, equity futures to increase equity exposure efficiently and equity put options to protect from the downside and ensure that policyholders' guaranteed benefits can be paid in the future. In the case of guaranteed benefits, the insurer's exposures to equity risk are much more complex. Distinguishing

[1] Hansson provides a useful overview of the main uses of the term risk across academia, industry and common parlance, http://plato.stanford.edu/entries/risk/.

[2] See Langlois & Cosgel's "Frank Knight on Risk, Uncertainty, and the Firm: A New Interpretation", Economic Inquiry Vol XXXI (July 1993). They provide an analogous classification of three cases albeit using different terminology.

between "risk" (the collection or distribution of potential events—both causes and consequences) and "exposure" (the nature or propagation of various potential consequences—adverse and positive—causally relating cause to consequence) enables the actuary to follow the effects of a risk event through the business to determine the effect on asset holdings, liabilities, the balance sheet, et cetera.

There may be additional uncertainty introduced by unknown or underappreciated imprecision in the modelling of a company's exposures (i.e. the modelling of the connections between "risk as cause" and "risk as consequence"). This might be described as uncertainty or imprecision and in common parlance as part of "model risk".

2.2 ADDITIONAL MATERIAL RELATING TO AN "ORSA-TRIGGERING EVENT"

An ORSA-triggering event is a material change in the nature of the uncertainties or exposure thereto, or in the understanding of those uncertainties or exposures. An event which would trigger an update to the ORSA (an "ORSA Run") would have such an effect as to change a company's exposure to areas of known uncertainty (risks already included in the ORSA) or areas of new uncertainty (emerging risks). It is the role of the company to determine how and by whom business understanding should be applied in order to know when a re-run of the ORSA may be needed and also whose role it is to develop entity-specific limits or thresholds which provide objectivity and structure to "ORSA-triggering events". It should be considered whether such limits or thresholds are scheduled to be reviewed regularly in light of experience.

Examples of ORSA-triggering events

- A macro-economic event which materially increases or decreases a company's exposures, e.g. a fall in equity markets, credit spread widening or tightening, movements to a central bank's base rate or risk-free rates, a change in inflation, GDP or employment - insofar as these affect the company's exposures
- Change in the state of the world, such as government action to change the economic outlook, e.g. UK government removing the compulsory purchase of an annuity on retirement or a legislative change allowing banks and asset managers to provide unit-linked savings products directly to consumers
- Change in the nature of a company's exposures, e.g. deciding to cease selling new business on a certain product line, or purchasing reinsurance to reduce exposures hence changing the company's aggregate exposures
- Change in the nature of an underlying risk or area of uncertainty, e.g. a cure for cancer, driverless cars, changes in the nature, extent or focus of cyber risk attacks
- Combined movements in multiple areas of uncertainty which materially change the company's aggregate exposures
- A change in the understanding of uncertainty – for example as a result of model improvement – which materially alters a company's exposures, e.g. looking at surrender rates or a move from using only historical experience data to modelling surrenders dynamically, for example via a causal map to model policyholder behaviour
- Default of a material counterparty, e.g. a reinsurer, with a material loss to the insurer's own funds
- Otherwise, any events which may change the aggregate exposure, or the acceptable levels thereof, or include changes to: risk appetite, risk limits, risk tolerance, ERM/RM strategy, business plan, new business strategy, nature of the business (M&A), etc.

It is important to note that events triggering ORSA runs may be specific to the company, e.g. a fall in equity markets causing an increase in the value of policyholder guarantees or a spike in surrenders on a certain insurance product, or may be shared by many companies in the market, e.g. 2008/9 credit crisis type event. In both cases, the company may wish to evaluate whether an event causes a material change in exposures or uncertainties which would require an ORSA run.

Structured thresholds to identify ORSA-triggering events

Examples of objective and structured thresholds to identify ORSA-triggering events in the normal day-to-day running of the business might include the following aspects. This list is in general terms and is followed by a list of corresponding real-world examples.

1. Links to risk appetite, risk limits, and risk tolerances (or any such related measures)
2. Risk movements: changes in quantifiable risk exposures, isolated or combined
3. Monetary Loss: actual, expected or potential losses which are quantifiable in money terms
4. Non-Monetary Damage: actual, expected or potential damage which is not quantifiable (reliably) in money terms
5. Change in the State of the World as we know it
6. Breaching limits: e.g. SCR ratio, MCR, internal risk limits

Examples:

1. Links to risk appetite, risk limits, and risk tolerances (or any such related measures)
    - Risk Limit breach;
    - Risk Tolerance breach;
    - Change to Risk Appetite, Limits or Tolerances
    - Breaching SCR Ratio appetite, e.g. falling below 120% of SCR)
    - Breaching MCR
2. Risk movements: changes in quantifiable risk exposures, isolated or combined
    - Mix of new business materially different from what is assumed in the SII SF/IM or ORSA, so that SII SCR changes by a threshold amount.
    - Mix of in force business materially changed (e.g. experiencing a mass lapse on a certain product), which changes SII SCR or SII Available Own Funds by a threshold amount.
    - Economic downturn, characterised by any of: equities -20%, properties -15%, credit spreads ±50 bps, change to the shape of the yield curve, inflation ±1%, etc.
    - More extreme economic movements which move the subsequent, updated ORSA "baseline" (defined in section 3.1.1) outside of the range reliably covered by the collection of stress and scenario tests comprising the ORSA
3. Monetary Loss: actual, expected or potential losses quantifiable in money terms
    - Actual or expected gain or loss (due to risk events which have occurred) above a certain threshold
    - Potential losses due to policyholder options or guarantees caused by change in the underlying risk(s) above a certain threshold
    - A change in markets, risks, or events requiring a material injection of funds into reserves or capital
4. Non-Monetary Damage: actual, expected or potential damage not quantifiable in money terms
    - Actual, expected or potential damage to reputation, affecting volume and quality for future new business and persistency on in force business
    - Actual, expected or potential damage to the business following loss of key personnel
    - By "potential" in this context, we mean that following some actual or hypothetical event, the likelihood of a subsequent, damaging event has increased materially.
5. Change in the state of the world as we know it which signals
    - Underlying exposures need to be updated/reconsidered
    - Revisiting some existing SASTs or reverse stress testing scenarios in light of new information or new understanding
    - Adding a new SAST which incorporates a new potential understanding of the state of the world (e.g. identification of a new, material area of emerging risk to the business), for example a change in central banks' approach to monetary policy and managing inflation and the consequent potential effects on a company's contractual obligations (liabilities) or the nature of risks to assets.

Certain ORSA-triggering events may not require a full end-to-end re-run of the ORSA process. The company, the risk management function and the actuary, as appropriate, may need to determine which parts of the ORSA process require revision.

3 SUPPLEMENTARY NOTES TO ESAP 3 TEXT

In this section, each of the ESAP 3 articles is covered in order to offer additional views and aspects for the actuary when reading ESAP 3.

3.1 ESAP 3, SECTION 3.1 "DESIGN OF THE ORSA PROCESS"

One purpose of the both paragraphs in section 3.1 is to communicate the extent to which an actuary working with the ORSA is responsible for complying with ESAP 3. Section 3.1 suggests that the actuary will be held to high standards while being commensurate with the actuary's responsibilities regarding the ORSA. It could also be highlighted that an actuary's limited responsibility does not absolve him or her from acting with professional excellence and raising concern with the ORSA where appropriate. On the other hand, the actuary's involvement is not required in every aspect of the ORSA. It is important for an actuary working with the ORSA to understand and fulfill the appropriate amount of responsibility.

3.1.1 ESAP 3, Section 3.1.1 "Establishing a structured approach to uncertainty"

Some of the key purposes of the ORSA (processes, models, etc) are to understand the reality of the business, increase a firm's understanding of its risk, exposures, activities and strategy, and to formalise that into a set of processes and capture learnings. One of the key challenges is to maintain that knowledge within the business without an unnecessary proliferation of documentation. As the actuary's understanding of the insurer's risks and exposures improves over time, the ORSA may need to adapt to incorporate these improvements. The economic and commercial environments and the company's risks are not static and the actuary may need to verify that the ORSA adapts accordingly.

Ensuring the ORSA assumption-setting process incorporates management plans

- *The business planning process and the ORSA*

The ORSA is likely to be consistent with the company's future business plans, including new business strategy, strategy for in force business, and long term considerations. This facilitates the ORSA forming an integral part of the business's business planning process especially as relates to risk (quantifiable and qualitative) and capital (adequacy, availability, etc.).

The "baseline scenario" (or in fact multiple plausible baselines) is the collection of best estimate assumptions regarding the development of future risks and uncertainties, including quantifiable risks such as market risks or insurance risks as well as qualitative risks such as those related to business strategy or reputation. The baseline is the company's best estimation as to how the business will evolve in the future, including all relevant and material risks and uncertainties. The baseline is used to assess the business plan and as a point of reference for other scenarios (adverse or positive), which enables the company to investigate the resilience of the business plan, the approach to risk management, and the various effects on the business of the risk events explored through the ORSA. Normally, the baseline scenario would be consistent with the business plan, unless the business plan assumptions are considered to be so inconsistent or unrealistic that the resulting ORSA report would be misleading (in which case the validity of the business plan is questionable). If this is the case, it may be advised to disclose this, document the reasons for inconsistencies between the baseline scenario and the business case and outline potential implications.

The business plan, the BPP, and related processes, protocols, decisions and committees are important to the ORSA. A company may have a strategy, company policies, and key performance

indicators for monitoring the business. The ORSA could take into account, as far as possible and appropriate, the business plan—in its entirety as well as the various components. Actuaries may work to check that the ORSA is consistent with business strategy, policies, KPIs, KRIs, and other policies. This may aid the actuary in getting all the relevant information into the ORSA process[3]. Co-operation with the risk management function and other functions involved in the ORSA process might also be needed.

The BPP is the natural time horizon over which the firm's strategy and business plan are considered into the future. It may be 5 years if the firm has a "5-year plan". A "10-year plan" necessitates a 10-year business planning period. Projection assumptions 10 years into the future (or further or shorter) may be too uncertain to be credible. Different aspects of the business plan may be credible over different time horizons. The significance of each aspect, the credibility thereof, and the potential for misleading results may need to be considered for each aspect and in aggregate.

Additional timeframes for the BPP may be necessary and valid, especially in testing specific aspects of an insurer's business plan. For example, the German regulator BaFin requires life insurers with long term guaranteed products to perform an additional longer-term "prognosis" within their ORSA. The prognosis extends the BPP through the end of the SII Transitional Period (2031) in order to assess the insurer's projected solvency position when the SII Transitional Measures have run off completely.

The BPP may be different for different types of product (e.g. term life assurance, motor insurance, participating savings) and for consideration of in force business as opposed to new business. The company's overall BPP would incorporate all of these.

The business plan could be developed as with everything else ORSA-related - in a way which is appropriate to the business in question. This may include such activities as horizon scanning for forthcoming changes in the "world as we know it" and potential emerging risks—to the extent that these could reasonably affect the business or its plans in the "near" future. The business plan and the period over which it is considered, may be influenced by known changes coming in the future, for example IFRS, IAIS capital standards, or key policy documentation rules.

- *Extending the ORSA beyond the assessment of risk and to the overall ORSA process, the business and the company*

A common desire of regulators and objective of insurers is the integration of the ORSA within the day-to-day and prudential management of the business. Some companies may already have processes similar to those envisaged with the ORSA, with these processes perhaps having preceded the ORSA. Some insurers may be in the process of building up the processes, methods and capabilities to support their ideal ORSA. In either case, flexibility in adapting the approach, processes and methods is essential to the successful management of risk in a changing world.

The ORSA under SII provides an opportunity to review, revise and optimize the means by which integration is achieved. One such review might assess the "business coverage" and "risk coverage" of the processes used to achieve integration. "Business coverage" might include assessing whether the processes support other essential business functions such as strategic and business decision making, capital management, business plans, product pricing and underwriting[4], and profitability measurement. "Risk coverage" might include assessing whether all material risks are addressed. A useful exercise is to ask what happens beyond the 1-in-200 likelihood 1-year event. That comprises a variety of questions, e.g.

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[3] EIOPA discusses similar topics in its 2017 ORSA "First Experiences" paper, https://eiopa.europa.eu/Publications/Supervisory%20Statements/EIOPA-BoS-17-097_ORSA_Supervisory__Statement.pdf

[4] The IAA provides a very useful resource in its online "Risk Book". See the ORSA chapter, section 5: https://www.actuaires.org/LIBRARY/Papers/RiskBookChapters/Ch10_ORSA_8March2016.pdf

- has the insurer assessed the consequences of various extreme tail events?
- do the outcomes sit within the risk appetite?
- do such extreme tail events necessitate the use of reinsurance, adapting underwriting or product terms and conditions looking forward?
- What about events beyond the 1-year time horizon? Has the insurer assessed the potential outcomes of moderate or extreme adverse scenarios which develop over a longer time frame?

In order to assess the "business coverage" the actuary may wish to create a "map overview" of the various processes supporting the ORSA, and those supporting the strategic management of the company, the business functions, and information flows involved. If the actuary is performing the SII "Risk Profile Assessment", the investigations and discussions form a natural starting point in building such an overview.

- *Projected Reserving and Capital Assumptions and an Aggressive Business Plan*

The assumptions underlying a business plan may differ from those of an objective best estimate or those underlying the SII balance sheet. Even an aggressive business plan (e.g. extreme cost savings, unrealistic future new business levels) may be run through the ORSA process to estimate the effects on the business of that scenario. The main potential issue is that these aggressive assumptions affect the SII Technical Provisions or capital, either within the ORSA projection or at a standard valuation date not connected to the ORSA. A related material issue would be the lack of reliability of adverse stresses relative to an overly-optimistic baseline, whereby the effects of the adverse stresses are understated due to the unrealistic starting point.

If running an aggressive business plan through the ORSA the actuary might need to check that the underlying aggressive or optimistic assumptions do not unduly affect the “time-zero” SII balance sheet and that the incorporation into future SII balance sheets is done with a focus on the credibility of information. An actuary would not blindly incorporate future predictions into experience analyses feeding into the assumption setting process for actuarial, investment or business assumptions. Put another way, it is important that the company cannot “monetise” an optimistic strategy (e.g. cost savings) simply by committing to do something in the future without having credible historical experience data. For this reason, it may be necessary to assess the extent of credibility of such aggressive assumptions being incorporated within the SII assumptions (within or without the ORSA process). In the absence of other guidance or regulation, it is the responsibility of the actuary to use forward-looking assumptions in a credible manner within the ORSA.

In order to reflect a cost-savings plan, for example, it may be appropriate to adjust future assumptions in one of the three following manners:

- Situation: initial capital outlay of €1 million, cost savings of 10% after 1 year, an additional 10% after 2 years, and the final 20% savings after 3 years
- ORSA real-world assumptions reflect the business plan
- Option 1: reserving and capital assumptions reflect future cost-savings plans as the “Best Estimate” within the underlying calculations of reserves and capital. Future periods’ reserves and capital fully reflect the forward-looking assumptions. This is the more aggressive option.
- Option 2: reserving and capital assumptions reflect new retrospective data fully to reflect a credible cost-savings plan. *Future* forward-looking assumptions are not reflected in future periods’ reserves or capital.
- Option 3: reserving and capital assumptions reflect new data partially to reflect a potentially overly-aggressive cost-savings plan. There is a question whether cost-savings will be achieved in reality. Hence, forward-looking assumptions are assessed to be overly-

aggressive and are made more prudent as they feed into the calculation of future periods' reserves and capital. This is the more prudent option.

The company and the actuary will decide the most appropriate option for the company's business plan and ORSA. However, it would not be appropriate to reflect the first option in the calculation of regulatory reserves and capital under SII outside of the ORSA process, i.e. for the calculation of the reported SII balance sheet. That is, it would not be appropriate to release reserves or capital in respect of future business plans before those plans have been shown to be credible. This detail can be fundamental to the prudent management of an insurance business.

Incorporating Aggressive Assumptions into the ORSA and Future Periods' Reserves and Capital						
ORSA Projection Period (years)	0	1	2	3	4	5+
Cost-Savings Business Plan						
Capital Outlay	€1m	-	-	-	-	-
Cost savings from expenses	-	10%	10%	20%	-	-
Future expenses (as% of t=0 Best Estimate)	100%	90%	80%	60%	60%	60%
Option 1: Reflect future cost-savings plans as the "Best Estimate"						
T=0 TP&C	100%	90%	80%	60%	60%	60%
T=1 TP&C	N/A	90%	80%	60%	60%	60%
T=2 TP&C	N/A	N/A	80%	60%	60%	60%
T=3 TP&C	N/A	N/A	N/A	60%	60%	60%
T=4 TP&C	N/A	N/A	N/A	N/A	60%	60%
T=5 TP&C	N/A	N/A	N/A	N/A	N/A	60%
Option 2: Reflect only retrospective data of future cost-savings plans as the "Best Estimate"						
T=0 TP&C	100%	*100%*	*100%*	*100%*	*100%*	*100%*
T=1 TP&C	N/A	90%	*90%*	*90%*	*90%*	*90%*
T=2 TP&C	N/A	N/A	80%	*80%*	*80%*	*80%*
T=3 TP&C	N/A	N/A	N/A	60%	60%	60%
T=4 TP&C	N/A	N/A	N/A	N/A	60%	60%
T=5 TP&C	N/A	N/A	N/A	N/A	N/A	60%
Option 3: Overly-aggressive assumptions are tempered for use in the "Best Estimate"						
T=0 TP&C	100%	*100%*	*100%*	*100%*	*100%*	*100%*
T=1 TP&C	N/A	*95%*	*95%*	*95%*	*95%*	*95%*
T=2 TP&C	N/A	N/A	*90%*	*90%*	*90%*	*90%*
T=3 TP&C	N/A	N/A	N/A	*80%*	*80%*	*80%*
T=4 TP&C	N/A	N/A	N/A	N/A	*70%*	*70%*
T=5 TP&C	N/A	N/A	N/A	N/A	N/A	*70%*

The underlying assumptions of option 3 are that only about half of the planned cost savings will materialize and that only a maximum of 30% savings is realistic after four years, as an example.

Where there is unresolvable uncertainty around the BE, it may be appropriate to perform two (or more) alternative baseline scenarios where the outer scenarios differ and the inner assumptions (regulatory reserving and capital basis) are set consistently with the world view formulated in the baseline. In many times the inner assumptions remain prudent where there is unresolvable uncertainty. The company or the actuary may wish to investigate other scenarios, such as the effects on projected reserves and capital where the prudence is removed from the inner assumptions. This is a valid and valuable scenario test, but may not be the best option for a "baseline".

A structured approach to uncertainty

One of the aims of this section, 3.1.1, is to guide the actuary in the right direction: a robust approach to dealing with uncertainty, which is, of course, structured and documented. The intent is not to prescribe the approach, but to let the actuary develop an approach as appropriate or required by the business.

Other related aims include encouraging the actuary to increase his or her knowledge and to be more familiar with the overall process, and to promote the sharing thereof within the business, especially with users of the ORSA and other professionals in similar activities.

If the actuary is involved in designing the ORSA process, ESAP 3 guides the actuary to establish a structured approach to uncertainty and to document it. Where the actuary is involved in the ORSA process, but not in its design, the actuary may wish to contribute to ensuring that the approach to uncertainty is structured, documented and sufficient given the business needs, complexity of the business, and the materiality and proportionality of risks and exposures.

In addition to the points of section 3.1.1 of ESAP 3, the ORSA process might:

- facilitate the sharing of new information and best practices within the ORSA team and wider business
- need to be adapted when the approach to or understanding of areas of uncertainty changes

Where the ORSA process and/or ERM framework change, the approach to uncertainty may need to be adapted. Good practices would encourage the use of new or different methods to quantify or qualify uncertainty, especially where these methods may be an improvement. Where materially improved methods are known about, but not used, the actuary may wish to document the reasoning.

A structured and documented approach to uncertainty might have some of the following components, according to the needs of the business.

- Differentiation among "types" of uncertainty
- Distinction between the real world and the modelled world
- Feedback loops and several points for capturing feedback
- Comfort in dealing with uncertainty
- Distinctions among past, present and future

More detail regarding the components of a structured approach to uncertainty can be found from Institute and Faculty of actuaries[5].

Differentiation among "types" of uncertainty

- *Errors vs uncertainties*

The AIAA (American Institute of Aeronautics and Astronautics) defines "errors" as recognisable deficiencies of models and algorithms and "uncertainties" as potential deficiency due to lack of knowledge.[6]

- *Aleatoric uncertainty vs epistemic uncertainty*

Physicists often distinguish between aleatoric and epistemic uncertainties. "Aleatoric uncertainty (also referred to as variability, stochastic uncertainty or irreducible uncertainty) is the physical variability present in the system being analysed or its environment. It is not strictly due to a lack of knowledge and cannot be reduced. Epistemic uncertainty (also called reducible uncertainty or incertitude) is a potential deficiency that is solely due to a lack of knowledge."[7]

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[5] See https://www.actuaries.org.uk/documents/managing-uncertainty-principles-improved-decision-making

[6] Stanford Uncertainty Quantification Laboratory, "YouQ: A self-guided tour of Uncertainty Quantification". Web. Stanford. Accessed 12 February 2016. http://web.stanford.edu/group/uq/uq_youq.html

[7] Ibidem

- *Non-immediacy, non-specificity, entropy-like uncertainty, and fuzziness*

This distinction is borrowed from mathematics and information theory. "Non-immediacy" is characterised by lack of knowledge locally where sufficient knowledge exists elsewhere. "Non-specificity" is characterised by lack of precision, perhaps due to the dimensional size or the complexity of a system. "Entropy-like uncertainty" is characterised by the unpredictability of information content. "Fuzziness" arises from information loss due to interpretation and use.[8]

These are examples of classifications of uncertainty due to origin, properties or characteristics. In practice, it would be useful for such a classification to be mutually exclusive and collectively exhaustive (MECE), but it is not a requirement. The third grouping from above may be translated to actuarial work as follows:

Non-immediacy: lack of knowledge within the local team (e.g. actuarial or modelling team) where this knowledge exists elsewhere (e.g. personal tax rules, precise policy terms and conditions), for example, incomplete knowledge by a junior modelling actuary.

Non-specificity: incomplete understanding of the situation or system, a system which is too large or too complex to model completely, too many sources of uncertainty or "randomness", for example, modelling equity prices as a random process and ignoring the potential effects on equity prices of, for example, changes in interest rates, forward guidance, QE, or equity analysts' recommendations.

Entropy-like uncertainty: in an actuarial situation, entropy-like uncertainty might be best understood as the uncertainty arising from the reliability (or lack thereof) of information, data and model output. A common actuarial example of entropy-like uncertainty is the "funnel of doubt" associated with the increasing imprecision of financial projections with increasing distance (time) into the future.

Fuzziness: loss of content of a given piece of information when only a portion of that information is extracted for use; for example, not leveraging the knowledge or intuition of policyholder behaviour which may be known by the salesforce or "front line", but unknown to the modelling actuary.

Core traditional actuarial work lies in the reduction of non-specificity via analyses, calculations and sophisticated modelling. Actuarial work may also include reducing non-immediacy in the implementation of actuarial models. Reducing entropy-like uncertainty has come to the forefront of actuarial work with the introduction of SII and the focus on data reliability and model validation. Actuaries collaborating with other business functions often work to reduce fuzziness.

Some of the most common actuarial techniques address different types of uncertainty. The following list of examples lists some of these:

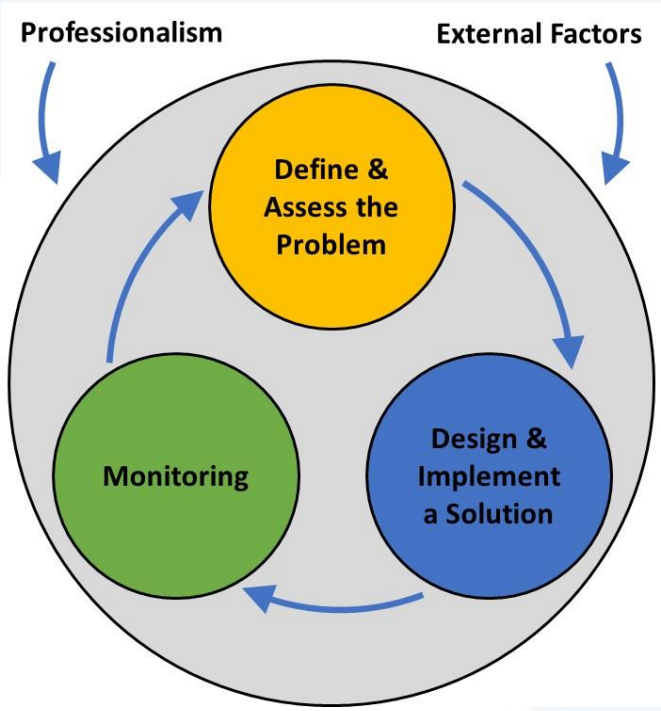
- Working to understand causal factors affecting policyholder behaviour and claims
- Building coherent macro-economic stresses for use in stress and scenario testing
- Specifying dependency relationships (e.g. copula or covariance matrix) among different risks
- Analysing data to understand the way risks have been affecting the business
- Estimating future trends and using expert judgement to get better estimates for the risks the insurer is facing today and in the future

[8] Dubois & Prade, Fundamentals of Fuzzy Sets. Print. Springer, New York, 2000. Chapter 8 "Measures of Uncertainty and Information."

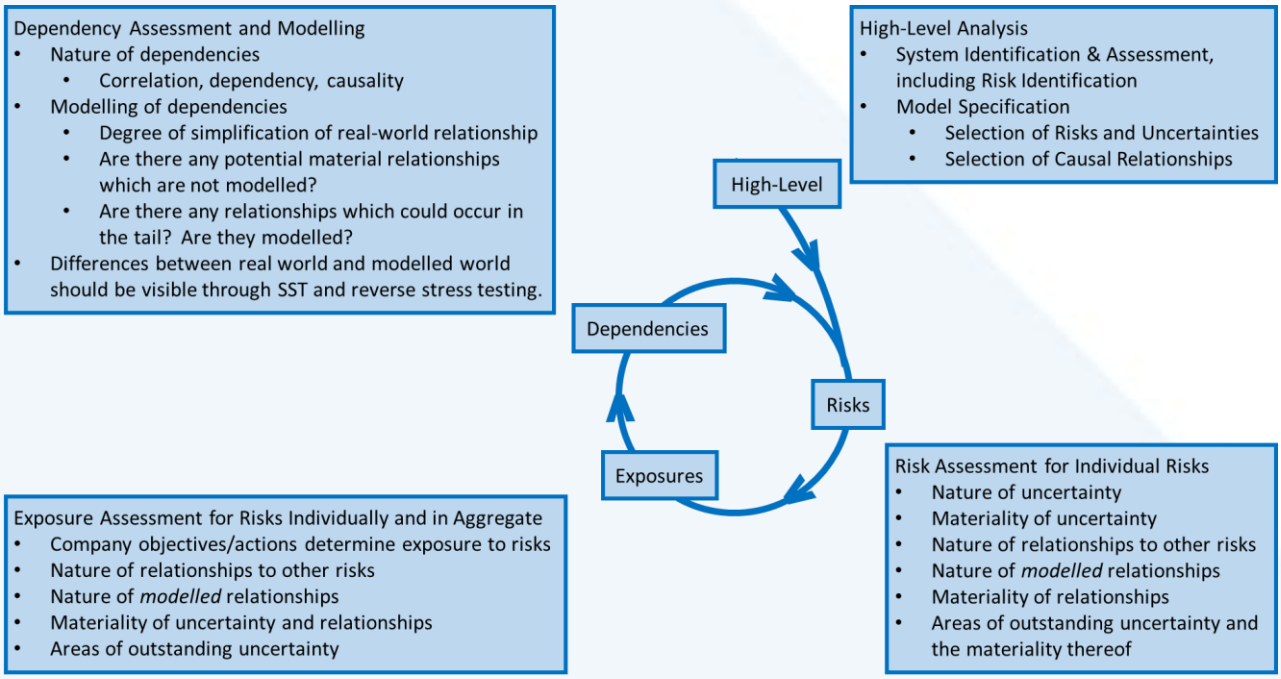
Feedback loops and several points for capturing feedback

At the very least, there may need to be a connection between business objectives and business actions, e.g. via Objectives, Actions, Feedback ("OAF"). This is a minimal feedback loop which may be expanded depending on the situation.

For many actuarial processes or investigations, the traditional cycle doesn't fully capture the adaptive process undertaken by an actuary.

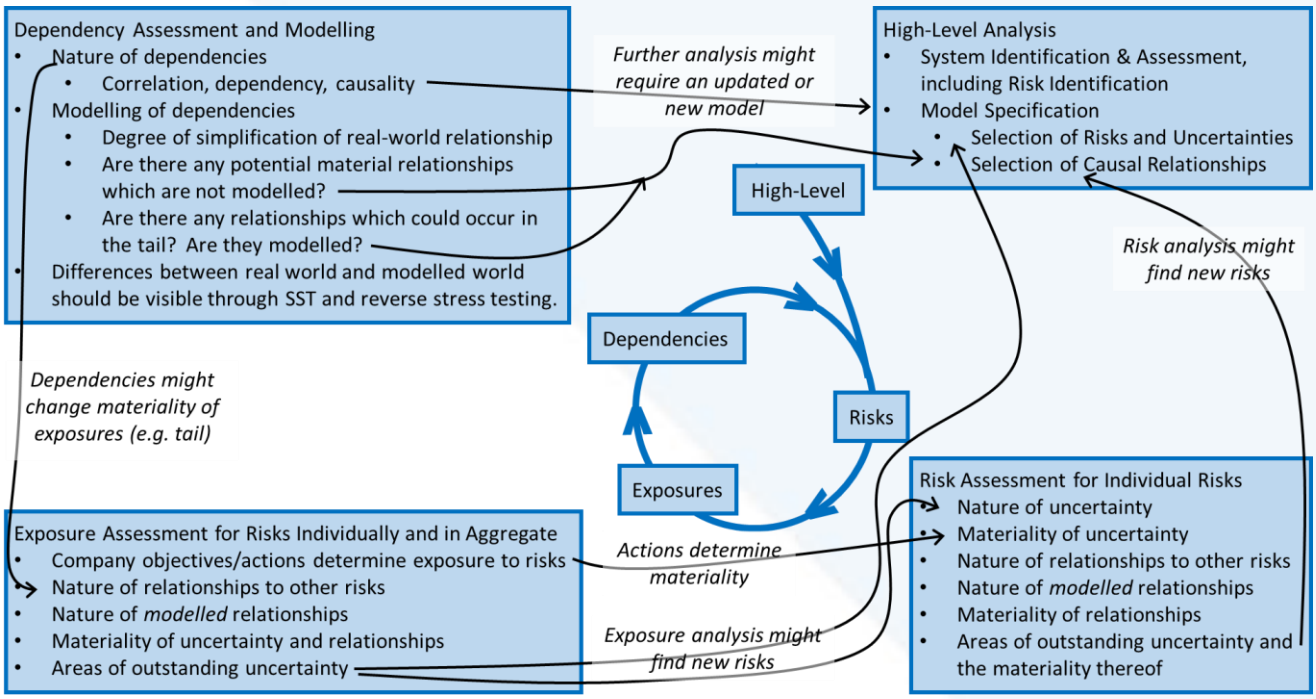


A more detailed example for risk modelling would be the following:



The "high-level analysis" is portrayed outside of the loop as this is commonly what happens in practice. For example, risks not included within the model are unlikely to be incorporated at a later date unless very material. From experience, it is the logical interactions among risks and cash flows that are the most difficult (or time consuming) to change once a model has been implemented. This is often an impediment to the improved modelling of risks or of the contractual terms of an insurance policy.

The following variation on the above diagram illustrates a more adaptive process, due to the depiction of "live feedback points", a bit like chutes and ladders. Each "live feedback point" could result in a note being made (perhaps to be addressed at a later date) or an immediate action, e.g. returning from exposure assessment to risk assessment to analyse a risk which has increased in materiality.



Comfort in dealing with uncertainty

There will be incomplete knowledge within the actuary's understanding of a given system, within the modelling thereof and within the risk system capturing (some of) that information. The materiality and proportionality of the areas of uncertainty could be captured, even if not modelled, so that this information is not lost in the flow of "risk information".

Different types of liability models or ALM models, risk models and risk aggregation models may deal with uncertainty in different ways. Some models may deal with uncertainty using probabilities, some stochastically, and some without regard to likelihood may deal with uncertainty via stress and scenario testing. Different approaches may be appropriate to meet different needs. The actuary may wish to strive to be comfortable that the uncertainty is captured materially within the risk system and is communicated as necessary, e.g. within the ORSA process.

Uncertainty might be due to an incomplete understanding of the situation or system or the incomplete capture of the system within the models (uncertainty in the parameters, models, or algorithms). If possible, for each area of uncertainty the sources of uncertainty and levels of materiality could be assessed and communicated as necessary. Where material, it could be valuable to communicate the downstream *compounded* uncertainty.

Distinctions among deduction, induction and abduction

Logical thinking and reasoning may be split into deductive reasoning, inductive reasoning, and abductive reasoning[9]. With deductive reasoning, the underlying assumptions are axiomatic, unquestionable or held as generally sound. From this assertion, the consequences are highly reliable and highly certain. An example is the SII reserving and capital framework. If we assume that the methods and assumptions underlying the SII SF are valid, then from the results of the various models we can deduce the effects of changes to the risks to which the insurer is exposed.

With inductive reasoning, there is more inherent uncertainty with the premises and hence more uncertainty with the consequences. Relaxing the premises makes deductive reasoning more difficult, but there are two potential benefits: broadening the methods and assumptions and expanding the collection of potential consequences. This increases the likelihood that a valid and reliable basis will be investigated and that the future eventual outcome will be represented within the collection of multiple uncertain consequences.

Abductive reasoning aims to narrow down the variations explored by inductive reasoning. The starting point is either an incomplete set of consequences or a selected "most likely outcome". Working backwards from that outcome, abductive reasoning aims to identify the best explanation or explanations. Note that abductive reasoning is the key method underlying *reverse* stress testing. That is, abductive reasoning selects a specific outcome (e.g. solvency ratio falls to 100% or new business volumes down 50%) and reasons backwards in terms of causality to find the most likely set or sets of assumptions and precedent events which would bring about the specific outcome.

As regards the ORSA, it is important to understand where each type of reasoning is necessary and where it is and is not valid. Deductive reasoning is essential in the quantitative assessment of risk via the reserving and capital framework while inductive and abductive reasoning are essential in formulating and investigating the effects of uncertainty and the outcomes of various scenarios. Stress and Scenario Testing combines both modes of reasoning by assessing, to the extent possible, the outcomes of the scenarios through the quantitative models. It relies upon inductive reasoning where risks or uncertainties are difficult or impossible to quantify.

[9] Deductive, Inductive and Abductive Reasoning, Butte College.
http://www.butte.edu/departments/cas/tipsheets/thinking/reasoning.html

Distinctions among past, present and future

Data is from the past, even the immediate past (e.g. current market data). When using past data to project future events (e.g. probabilities of life/death, cash flows, asset returns, defaults), the distinction between past data and future projection may either be reflected in the model or noted as an assumption.

For different areas of uncertainty, there is a *range* of validity of the assumption that past data can be used for future projection or prediction. It is not "either/or", i.e. that it "is valid" or "it is not valid", but rather a *range* of validity.

It is the actuary's judgment as to whether such an assumption is sufficiently valid. This may depend upon the inherent validity of the assumption, relative validity of any alternative data available, alternative modelling methods, resource and time constraints, materiality and proportionality of the assumption itself or its potential affects downstream.

3.1.2 ESAP 3, Section 3.1.2 "Deviation from Solvency II balance sheet approach and methodology"

A company's motivations in deviation in the ORSA process from its Solvency II methodology may be to seek a better understanding and hence management of the company's risks and exposures, facilitated by methods which cover all material risks, especially where the SII methodology may miss some risks, or measure them differently from how those risks are perceived by the company or any of its stakeholders. Deviations may occur in how quantitative risks are assessed, measured, and how stresses are calculated. Other deviations may be in the accounting methods, methods for calculating technical provisions and capital, and methods for assessing the appropriateness thereof. In order to do this, it may be useful to distinguish between the "modelled world" and the "real world", as well as between the SII methodology and an otherwise objective assessment of risk, if appropriate.

Distinction between the real world and the modelled world

Strictly speaking there are three reference points here: the real world, our understanding thereof, and the modelling of our understanding. Between points, information is lost: we do not understand the world completely and our models either do not capture or do not need to capture our full understanding of the real world. For example, when assessing the suitability of the models underlying the ORSA, it is important to re-evaluate the extent to which those models are able to reflect reliably the risks and uncertainties of the business and to accommodate fully the complex stress and scenario tests appropriate to the business. As the ORSA requires the business to include all material risks, the actuary may want to assess the materiality of any risks or uncertainties which cannot be quantitatively accommodated by the ORSA process or supporting models.

The actuary may want to evidence his or her understanding of (and document) the key similarities and differences between the real world and ORSA model. In considering this the actuary may wish to consider:

- the appropriateness of the risk measures used;
- the appropriateness of the risk modelling, especially where the modelled risk may differ in nature from its counterpart in the real world, and what this means for the ORSA;
- whether there are alternative models which enable the actuary to explore a risk or combination of risks more thoroughly;
- the stresses and scenarios used and the appropriateness of the results;
- management actions assumed as mitigating factors, their associated time delay and any track record of their effectiveness;
- the risks not covered by the model;
- the reasonableness and robustness of the business assumptions underlying the baseline scenario used for the projections;

- whether there are any concerns over the appropriateness, completeness and accuracy of the data used; and
- reasons for use of professional judgement (to be documented).

Consistency or inconsistency of the ORSA with the Solvency II principles

A convincing argument for adopting methods or assumptions which may differ from SII in calculating capital needs (at fixed points in time), for example for Own Solvency Needs or an internal "objective economic capital" basis, is to facilitate the identification of any and all material risks and exposures over the ORSA consideration period. This is especially important where the company may wish to assess the potential upsides and downsides of, for example, removing the Ultimate Forward Rate from the SII discount curve or assessing the credit spread and default risks arising from sovereign bonds.

In order to facilitate the discussion of deviations from SII, a brief discussion of "business projection models" and SII's Risk Profile Assessment follows.

The ORSA as a simplified “business projection model”

The ORSA is also a “business projection model”; it looks to project the balance sheet (and perhaps annual accounts) and the underlying business into the future. This necessitates the calculation of the expected SII position and SII balance sheet components at given points in the future. The ORSA may project the business on solely the SII basis or it may include all balance sheet and accounting bases relevant to the company (e.g. local accounting rules, IFRS, ratings agency capital).

In projecting the SII balance sheet into the future periods of the ORSA, the company may wish to calculate future balance sheet components on the SII SF (or Internal Model) basis, i.e. consistently with current methods. The ORSA then serves to project the future SII capital position (and other balance sheet components) as the company expects it to evolve in reality. This may provide insight into, for example, movements in the solvency ratio, reserve or capital injections or releases, future dividends, and the drivers of profit and loss.

In order to get the full picture of future profit and loss, the company may need to project the full accounts on all bases used by the company. While useful, this extends beyond the requirements or suggestions of the ORSA.

In addition to, or in lieu of, the regulatory basis (SII SF or SII IM), the company may wish to reflect risk on an objective basis (commonly known as “an internal economic capital framework” or, specifically for the ORSA, the “Own Solvency Needs”). Projecting the ORSA on the SII SF (or SII IM) basis may be considered a necessity. Projecting on an additional basis may be useful for managing or understanding the underlying risk exposures. Some of the areas of deviation from the SII principles are described below.

Underlying the projection of the business into future ORSA periods is a set of assumptions of how the business and world may evolve in the near future (5-10 years). One such set of assumptions may reflect a “Best Estimate” scenario, another may reflect the management’s business plans, and additional scenarios may test other positive and adverse future scenarios.

The SII Standard Formula and OSN are used for calculating the total asset requirement (reserves plus capital) of a company while the ORSA is used to project the balance sheet items into the future, perhaps annually for the next five years.

Annual profits for limited companies versus mutual companies—ORSA considerations

The modelling involved in the projection of the SII balance sheet within the ORSA (and other bases, as appropriate) may necessitate defining rules for the annual declaration of surplus. For limited companies paying dividends this involves the necessary accounting bases and is likely fully defined. For some mutual insurers, the emergence of surplus is likely well-defined, but the mechanics for the reinvestment and reallocation of the common "estate" in the long term may not

be fully specified. In order to implement the ORSA, or indeed the Total Balance Sheet approach of SII Pillar 1, it may be necessary to settle upon reasonable rules for the re-allocation of annual surpluses. Where uncertainties or multiple methods exist, the actuary may need to assess the effects and communicate appropriately. Similar modelling uncertainties may arise due to the re-allocation of the inherited estate (legacy estate which may not be directly attributable to current policyholders/members of the mutual) within the actuarial projection underlying SII Pillar 1 or within the business projections supporting the ORSA.

However, the actuary and the insurer need to remain aware that the chosen modelling rules are an interpretation of real-world legal situation and may be subject to uncertainty. It would be inappropriate for the regulatory guidance to force the crystallisation of allocation rules for a mutual where there is otherwise uncertainty or discretion.

From another perspective, ignoring the above uncertainties, for a mutual insurer, a comprehensive business projection model may provide the most reliable projection of the individual product portfolios—as they must be projected within the same model, and any surplus transfers within the mutual will be reflected. In this manner, a comprehensive business projection model is more likely to give a reliable picture of the Total Balance Sheet—both at a point in time (Pillar 1) and projected into the future (Pillar 2).

The Risk Profile Assessment: Assessing the Appropriateness of the Standard Formula

As part of the ORSA, the actuary may assess the extent to which the risk profile of the undertaking or group concerned deviates from the assumptions underlying the Solvency Capital Requirement[10].

The results of the assessment may lead the actuary to judge that the Standard Formula is suitable for the company or that the company could consider calculating its Own Solvency Needs. Calculating OSN may range from adjusting the stress factors applied the individual sub-modules or otherwise adjusting the parameterisation of the Standard Formula, to a complete reworking of the methodology. Potential variations to parameters, methods and modelling is provided in Section 4.

Potential deviations from the Solvency II principles

As regards consistency, or inconsistency, of the ORSA methodology, process or modelling with the SII principles and rules, the actuary may need to understand and communicate the effects thereof. In some cases, consistency with SII principles and rules may mean that the ORSA does not reflect otherwise objective assumptions. In some cases, consistency may be the best or only option. Examples of the main areas of potential discrepancy are given below.

In principle, SII is risk-based. However, the Level 2 legislation deviates in various respects, both for Standard Formula (SF) and Internal Model (IM), from otherwise objective assessments of risk. One of the fundamental goals of the ORSA is to reflect reliably the reality of the business, currently and in the future. For this reason, it may be useful to project, within the ORSA, the SII standard basis as well as an additional basis intended to more reliably reflect the risk exposures of the company.

There are some areas of the SII SF and IM legislation, which deviate from an objective best estimate, for example, the ultimate forward rate (UFR), cash flow matching and discounting at other than the net yield. If the actuary wishes to use alternative objective assumptions (which are credible in their own right), s/he may wish to justify and explain the deviation and the effects thereof, i.e. difference between the ORSA run on SII assumptions and the objective best estimate assumptions which aims to reflect reality.

Insofar as SII capital is projected within the ORSA, it should be consistent with the SF or IM. However, the underlying projection assumptions for the ORSA (a best estimate baseline, the business plan, or a sensitivity) need not be consistent with the SII Pillar 1 or 2 assumptions. That is, the projection for the ORSA may be a real-world projection (if the SII IM/SF is not) to reflect RW

[10] https://eiopa.europa.eu/Publications/Standards/EIOPA-14-322_Underlying_Assumptions.pdf

expected defaults, RW investment yields, which may not be specified in the SII guidance (as some are overly prudent when compared to a RW BE). This may be appropriate in two respects: the "outer scenario" for the projection between future ORSA periods (e.g. to take the company from the current valuation date, e.g. year-end 2018, into future year-end reporting dates) as well as the "inner scenario" as used within the calculation of the SII balance sheet components at future ORSA periods (e.g. future year-end reporting dates).

Another way to distinguish "inner" and "outer" assumptions is that "inner" assumptions are used as at a specific point in time, e.g. year-end 2022) to calculate the components of a balance sheet (or multiple balance sheets and P&Ls, whereas the "outer" scenarios define how the outside world evolves (is expected to evolve within the given ORSA scenario) to get us from one reporting period to the next. Inner assumptions are reserving and capital assumptions needed to evaluate balance sheets and other financial statements at fixed points in time (e.g. YE20, YE21, YE22, etc.) whereas outer assumptions define how the world evolves between those fixed points in time.

In this manner, the "inner" assumptions, especially when they are used in calculating future periods' SII reserves and capital, are point-in-time snapshots of market data, risk data, variability, volatility, etc. These inner assumptions may be determined in line with SII guidance and do not allow for expert judgment in the evolution of stressed scenarios. This is precisely the purpose of the outer scenarios: to allow the actuary and the business to explore the longer-term, developing effects of various positive or adverse scenarios. For example, experts may believe that following a 40% loss, equity markets will recover fully over the following two years. While it is inappropriate to incorporate that information into the calculation of the SII risk capital for equity risk, it may be incorporated via the outer scenarios in the projection of the balance sheet(s).

Additionally, there may be a "core set" of assumptions (an "objective best estimate") from which to derive the various sets of assumptions to support SII reserves and capital, IRFS accounts, local accounting rules and reserves.

Importantly, SII capital should be projected consistently with SII guidance. This means that the company needs to project the SII balance sheet and capital into the future as it expects it will calculate the SII components in the future. For instance, the company may be considering moving to an Internal Model and may wish to allow for the impact of this.

The ORSA provides for the company to use an alternative measure of capital needs, specifically within the ORSA projection, which the regulation refers to as the "Own Solvency Needs" (OSN). The assumptions feeding into OSN may be distinct from those underlying the SII Standard Formula (and Technical Provisions) in both the calculation of reserves and of capital. In this case, the entity may wish to describe the deviations and the effects in isolation and in aggregate compared to the SII balance sheet.

The outer scenarios driving the ORSA projection may also differ from the assumptions underlying reserves and capital. Some of the main areas where SII and ORSA assumptions may differ are summarised here and discussed below. The groupings are not perfect and one such area may logically belong to multiple groupings.

Topics are given here, with details provided in the next section.

Differences in methodology:

1) Risk measure: VaR, CVaR, TVaR, burn-through, long term ALM & liquidity, etc.
2) Risk measurement time frame: 1-year, 1-day, 5-year plan, policy lifetime, etc.
3) Projection basis: what is Best Estimate and why?
4) Total Balance Sheet approach to risk capital versus policyholders' protective risk capital
5) Fungibility of capital
6) Nature of stresses: isolated stresses + aggregation vs causal SAST vs combined stresses
7) Risk-neutral ESG implementation
8) BEL assumes risk free (MA&VA relax this a bit), SII capital addresses the risks, but some BEL > Economic BEL

Differences in modelling:

9) Nature of the market stress model: causal or combined vs silo'ed
10) Longevity-mortality model: combined vs separate
11) Longevity-mortality-morbidity(-disability) model: combined vs separate
12) Lapse model: SII simplistic, SII strict vs coherent
13) Interest rate up/down model: single model (e.g. Monte Carlo) vs "worst-of" two stresses model
14) Interest rate stresses & the UFR
15) Dependencies & correlations
16) Loss absorbing capacity of deferred taxes
17) Defaults, downgrades, credit spreads, and market values: modelling needs and risk exposures (different exposures to different SII TBS components)

Differences in assumptions:

18) Contract boundaries
19) Counterparty default
20) Future new business
21) Transitional measures (equity type 1, transition on technical provisions)
22) Equity symmetric adjustment
23) Discount curves:
    - The ultimate forward rate
    - The last liquid point
    - The credit risk adjustment
    - The volatility adjustment or the matching adjustment
24) Sovereign credit risk: spread movements, MV movements, risk capital, etc.
25) Cash flow matching
26) Reinvestment risk (implicitly hidden between CF matching and the RFR)
27) Risks not covered in the SII SF/IM
28) SII SCR (SF/IM) stress magnitudes (e.g. mortality, longevity, lapse)
29) The SII Best Estimate is benign. Could a market crash feature in a Best Estimate?

3.1.3 ESAP 3, Section 3.1.3 "The ORSA consideration period"

The ORSA is an assessment of the company's ability to maintain solvency over the "ORSA consideration period", allowing for the company's plans and the risks and uncertainties to which it is exposed. The "ORSA consideration period" needs to be long enough to test the resilience to the company's stated plans and strategy, and to give sufficient advance warning to allow the company to address any projected "squeeze" on capital resources.

The "ORSA consideration period" as used in ESAP 3 is intended to encompass (1) the overall time horizon over which the ORSA process (and all of its individual ORSA "runs") is considered or applied as well as (2) the individual ORSA runs. That is, when considering how far into the future the ORSA is to be used, the points in ESAP 3 section 3.1.3 may need to be considered. Also, within an individual ORSA run, the same considerations may need to be made, i.e. section 3.1.3.

The actuary need not be constrained by how he or she thinks about time periods and the ORSA. The actuary can distinguish among various time horizons relevant to the ORSA and offer some definitions and terms, being as precise as possible.

In theory, and in the minds of regulators, the ORSA is a vital tool in managing an insurance company. The ORSA may not be fully integrated within the business or within its business planning processes. Especially in that case, it's suggested to consider the following discussion points and their applicability to the company's current situation as well as future state.

Time horizons related to the ORSA

There are numerous timeframes, time horizons and time periods relevant to the ORSA. These might include: the business planning period; time periods and horizons within actuarial, capital and risk models; risk-related timeframes such as measurement periods, timeframes for the evolution or treatment of risk events; timeframes for policyholder considerations such as security of benefit

payments, inter-generational equity, company solvency—which may extend well beyond business plans or the ORSA.

The ORSA aims to project the business, its plans, as well as the current state and thinking into the uncertain future. Hence, the ORSA aims to predict what will be business as usual (BAU) in, for example, three years' time. At that point in the future, the company would use its actuarial and capital models, think about its risks, risk appetite, strategy, etc., and revise them appropriately given what has transpired in the theoretical past, i.e. three years of deterministic, assumed a priori, modelling.

The following gives an overview of such timeframes, with the focus being on the distinction of timeframes specific to the ORSA.

1. Liability-related timeframes

    - "Actuarial projection horizon": e.g. 50 to 100 years for some life assurance products, 5 to 10 years for some non-life insurance products

    - "Horizon for long term considerations": run-off of existing portfolios (and planned new business) and associated considerations (cross-generational equity, fairness, security of benefit payments, company solvency, Prudent Person Principle, etc.)

2. ORSA-related timeframes

    - "ORSA projection period": each of the ORSA projection terms from 1 year, 2 years,…, 5 years, i.e. the amount of time that is assumed to pass before the company would rethink its strategy, plan its business and run its actuarial models. For example, there may be an ORSA run with an "ORSA projection period" of 1 year into the future, another ORSA run with an "ORSA projection period" of 2 years, and so forth.

    - "ORSA projection horizon": the maximum term the ORSA is used over, something like five years. The ORSA projection horizon is fixed as the longest "ORSA projection period".

3. Business planning timeframes

    - "Business planning period": this could reflect what it is actually in the business. If the company has a 5-year plan that feeds into its strategy, that's it. If it has a 10-year plan which reliably feeds into its planning, that may form part as well. This leads to what one might call the "business's strategy horizon".

    - "Business's strategy horizon": given where a company is today, how far are they looking into the future as it relates to their strategic initiatives and moves? Let's say they look about 10 years into the future. This ten-year focus could be considered within the ORSA at each future time point in the ORSA process (e.g. 1,2,3,4, and 5 years into the future). That is, with a 3 year ORSA projection period, the company could consider what their strategy would look like between 3 years in the future (the "present time" in that future scenario, i.e. it is known what has happened in the first 3 years) and 13 years in the future.

Regarding that last point, a company may think that applying a 10-year strategy horizon on the end of a 5-year ORSA projection period is insufficiently credible. However, if a company has a "10-year plan" today, it will likely have a 10-year plan next year and the following year. Hence, it would be more appropriate to retain the full strategy horizon at each point in time for the ORSA. While it may be difficult to decide what the 10-year plan may look like five years into the future, this is precisely the task set to the business under the ORSA, among other tasks. There may be aspects of a company's current strategy which the ORSA "runs through", e.g. the company's plans to achieve cost savings over the next 3 years. It would be inappropriate to consider this as always three years into the future for each ORSA projection period. However, more general aspects of strategy, e.g. a forward-looking 10-year focus on the reliability of future dividends and debt affordability may need to be projected forward as suggested in point 3(b) above. The extent to which it is necessary to fully incorporate the full strategy horizon within the ORSA is left to the discretion of the company.

The liability-related timeframes above may also be projected forward, for example, in that during the 3rd ORSA projection period, a 50-year "actuarial projection horizon" would apply between future years 3 and 53.

There is an important distinction between business planning and long term considerations: the business's strategy horizon may not extend as far into the future as some long term considerations need to, for example security of policyholder annuity payments. However, it is vital that the long term considerations be addressed at each point in time when the business plan is revisited (both in the real world and within ORSA projections). Some of the long term considerations will naturally be included as the focus of regulations while other long term objectives, goals and considerations are not required to be addressed, i.e. by legislation or regulation. The actuary may find it necessary that all significant long term considerations, explicit and implicit in the business's plans and strategy, are included within the business planning process and within the ORSA. Emphasising this focus and the distinction may give comfort to regulators and the business itself that the business is being managed well and prudently.

3.1.4 ESAP 3, Section 3.1.4 "Inconsistency with the undertaking's risk management approach"

Models, including those supporting the ORSA, will be necessary simplifications of reality. For example, for actively traded asset portfolios or complex hedging strategies, the actuarial projection models will likely simplify the ALM approach used in reality. Where a simplification either causes risks to be ignored or for the ORSA to differ from business reality, the actuary may need to assess the significance of the deviation.

For example, some asset and hedging strategies may be too complex to incorporate into actuarial or ALM models. The actuarial or ALM model may serve as an input into asset selection and hedging, but the reflection of asset and hedging strategies within the actuarial or ALM model is likely to be a simplification. Where the actuarial or ALM model does not capture fully the asset and hedging strategy, it may fail to capture the extent or nature of the underlying risks, either within the calculation of SII capital or in the projection of the ORSA. In this situation, the actuary may need to work closely with the asset and hedging professionals to understand the real-world risks and exposures and incorporate these into the ORSA.

The risks related to complex hedging strategies or tactical derivatives strategies may not be captured within the risk capital models—SII SF, IM or the company's own internal risk model. Even where models capture all underlying risks arising from hedging or derivatives, this may be in the form of trading risk (e.g. 95th percentile VaR over 1 day or 1 year). In this case, the risk models may not fully capture the worst case scenario (or collection thereof) for the individual risks of individual derivatives, all risks of a single type of derivative, or all risks in aggregate for a full derivative portfolio. Examples of such risks include the loss on default of a counterparty, the forfeiture of collateral posted as margin following technical default, and the resulting liquidity and solvency risks arising from these.

Another example of where the models supporting the ORSA may not fully capture the company's risk management framework is in its reinsurance arrangements. Reinsurance may be complex and the company's actuarial models may not incorporate the full detail thereof. In this situation, the actuary may wish to assess the materiality of the deviation between the models and the company's actual risk management practices arising from reinsurance.

The business strategy considered within the ORSA may also deviate from the company's risk appetite or underwriting policy, for example a strategic plan to achieve greater market share may cause the company to break certain risk limits or it may not be clear whether the strategy is feasible given the stringency of underwriting requirements.

The company's use of management actions (both those narrowly defined per SII and those more widely used but not within the first group) needs to be realistic and credible given the company's past performance, past reactions to risk developments, and planned strategic reactions to potential future events. For example, when constructing and performing an adverse ORSA scenario, the hypothetical management actions serving to mitigate the adverse ORSA scenario should be

credible and achievable. Where they are not, the actuary might consider raising concern over the reliability of the outcome of the adverse ORSA scenario in question.

3.2 ESAP 3, Section 3.2 "Performance of the ORSA process"

The intent of this section can be considered threefold: to encourage the actuary to be steadfast in his/her attention to detail as it relates to the assessment of risk and how it flows through the company; to encourage the actuary to address both quantifiable risks and non-quantifiable risks appropriately giving consideration to the downstream use of risk information; and to encourage the actuary to take a broader view or the ORSA beyond the assessment of risk and to extend to the overall ORSA process, the business and the company[11].

3.2.1 ESAP 3, Section 3.2.1 "Quantitative risk assessment and financial projections"

This section of the ESAP touches on simplifications and reliable representations of risk; the use and derivation of assumptions; and the appropriateness and completeness of stress-testing, reverse stress-testing, and scenario-testing. For ease in understanding, these three topics are addressed individually in the reverse order from the preceding sentence.

Appropriateness and completeness of stress and scenario testing

The projections, or point-in-time stresses, used in the ORSA process may include a baseline scenario and several plausible adverse scenarios. Each scenario may take into account not only in force policies or contracts but also those assumed to be sold during the projection period (where applicable). It may also be useful to include positive scenarios in order to understand the potential upside of future decision making and to investigate potential outcomes of achieving the company's corporate strategy, including the effects and potential increased need for capital.

The baseline scenario may reflect a realistic set of assumptions used to forecast the expected financial position over the projection period. However, the actuary may need to be cognisant that the past relationships between assumptions may be different from those applicable in the future.

In determining the stresses and scenarios to be considered, the actuary might take also into consideration whether the exposures of the particular entity to risk concentrations is material.

Where there is a significant risk exposure, the actuary may also consider stresses and scenarios that may be considered more extreme in the current environment or that have not occurred in the recent past.

In determining the stresses and scenarios to be considered, the actuary may want to be aware that:

- Risks and exposures may exhibit non-linear, unexpected behaviour and interactions, especially under stress;
- Risk measures exhibit non-linear behaviour, especially when various individual risks are aggregated.

The actuary may need to document the approach used and its justification. The actuary may want to set out his or her justification for the use of particular scenarios.

Reverse stress tests may be considered to identify various combinations of risks that may lead to the failure of the business, whether that failure is defined as insolvency, loss of a certain credit rating, parental difficulties, serious business failure, loss of confidence in the company by markets, or other outcome. These reverse stress tests may be more extreme than plausible scenarios.

[11] Ibid. See "EIOPA's Supervisory Assessment of the Own Risk and Solvency Assessment - First experiences"

In testing variations in the outcomes above, the actuary may need to allow for plausible management actions. The actuary may also pay heed to stress and scenario tests issued by insurance and/or banking supervisors and other relevant bodies.

Scenario testing is in the very core of ORSA and therefore it is vital to use realistic assumptions in the baseline scenario. This might be done by using models allowing also for future trends, non-fixed correlations (e.g. copulas), real world ESG data and management actions that are in line with the way business is managed. Also, the assumptions regarding new sales is important and helps to give the needed realism to the model, for example what products are being sold and how aggressively. After the baseline scenario is ready and modelled then the focus can be applied to the scenarios.

Appropriate use and derivation of assumptions

The actuary may wish to understand whether the company has robust processes for the analysis of relevant data (historical policy data, market data, etc) in the setting of assumptions feeding into both the ORSA process as well as the day-to-day actuarial processes of setting assumptions for insurance-related risks. With the ORSA, the actuary may also wish to assess the robustness of the processes used to set economic assumptions (i.e. those assumptions used to determine "market" risks, business risks, operational risks, etc). Part of this assessment may include understanding how different risks and uncertainties might depend on each other, either causally or in a correlated manner.

A plausible adverse scenario is a set of adverse, but plausible, assumptions about matters to which the Company's financial condition is sensitive. Plausible adverse scenarios will vary between companies and may vary over time for a particular company. These scenarios could normally include plausible combinations of adverse developments in multiple factors as well as adverse developments in individual factors. In constructing or reviewing plausible adverse scenarios and the underlying assumptions, the actuary may need to consider the potential impact of shareholder, policyholder, cedant and broker behavior (if applicable) in adverse conditions.

Certain assumptions, in particular those which are a consequence of the economic environment, may need to be treated as a coherent set rather than in isolation. The company's ability to withstand a period of inflation or recession, rising or falling stock markets, increasing market sizes or increasing competitiveness, is normally investigated using coherent sets of assumptions. Where non-economic assumptions are expected to react in a certain manner to changes in the economic environment, these changes might also be incorporated into the scenario test.

Simplified or approximate calculations and the potential downstream effects on the understanding of risks in Deterministic, stochastic, and approximate calculations

For the appraisal of some risks, the projections can be on a deterministic basis. However, the actuary may need to consider, depending on the circumstances and nature of the risk profile, whether stochastic techniques are necessary to exhibit the variability in outcomes that could take place in the future. For the calculation of SII technical provisions where the underlying products contain financial options or guarantees, stochastic methods may be needed, but there may also be accurate approximations such as closed-form option pricing formulae (e.g. Black-Scholes). Deterministic methods may suffice where the underlying policies do not contain non-linearities with respect to the underlying risks. Deterministic methods may also suffice where the exposure to the average risk (formal mathematical expectation of the risk distribution) is equivalent to the average exposure (expectation of the outcome of the risk distribution fed through the actuarial model). Some form of proxy model[12], such as closed-form approximations of stochastic calculations, may

[12] "All models model something; however, it is useful to distinguish between those models which approximate reality and those which simply approximate a more complex model. The distinction of a proxy model, therefore, is that it models another model." UK Actuarial Profession Proxy Model Working Party, http://www.actuaries.org.uk/documents/heavy-models-light-models-and-proxy-models-working-paper

suffice where policy features are simple enough to permit the use thereof. Where policy features are very complicated or dynamic, full stochastic calculations may be needed.

3.2.2 ESAP 3, Section 3.2.2 "Qualitative risk assessment"

Ensuring difficult-to-quantify risks are incorporated in the ORSA

Material risks, which are difficult or impossible to quantify can be incorporated into the ORSA using qualitative methods regardless of:

- whether reliable probabilities can be assigned to various outcomes, e.g. via a discrete probability function or a continuous probability distribution,
- whether the whole range of outcomes can be understood, or
- the extent to which the company's exposures can be measured accurately.

Some risks may be too difficult to quantify but merit the holding of capital – or the other way around, risks may be possible to quantify but be treated (at least depending on the time horizon) with something other than capital.

The difficulty in assigning a probability to a given scenario (e.g. removal of compulsory purchase annuity in the UK prior to the budget announcement, or the change in the relevant discount rate for lump sum personal injury awards) should not prevent the scenario being included as a stress test, in order to understand the effects on the business.

Scenario testing and "what-if" testing do not necessitate precision in measuring a company's exposures to a risk or an area of uncertainty, which is difficult to quantify. If the risk or uncertainty is difficult to measure or if the exposure thereto is difficult to ascertain, an approximate (back-of-the-envelope) calculation may suffice. The need for such approximations may be reduced over time as the company's understanding of the risk or the exposure evolves.

Regarding probabilities and qualitative risks, it may be inappropriate to utilise continuous probability distributions for qualitative risks. Qualitative risks need to be incorporated as appropriate. In some cases, it may be most appropriate to assign discrete probabilities to representative risk events. In other cases, it may not be appropriate to assign probabilities at all. Consideration may need to be given to the ultimate use or users of aggregated risk information and how the inclusion of qualitative risks may affect this.

While it is desirable to understand all possible outcomes relating to an area of uncertainty, it may not always be possible. Incomplete understanding of a risk need not preclude its inclusion in the ORSA.

Combining quantitative and qualitative risks coherently

The actuary may need to determine which risks can be quantified and which cannot easily or might not be quantifiable. In the case of the latter, the actuary may need to be aware of the qualitative tools to identify, describe and report those risks and might consider whether it would be appropriate to carry out separate scenario tests to demonstrate the effect of particular scenarios on the group or entity. The actuary could ensure or contribute to ensuring, whichever is appropriate, that these scenarios are coherent and can allow for management actions. These scenario tests could include scenarios the entity can survive in terms of MCR or SCR and which it cannot.

Proxy models aim to replicate a given risk metric (gain/loss, cash flow profile, change in Basic Own Funds, etc) that would be produced by the company's normal liability or ALM models ("heavy models") under a variety of risk stresses. Proxy models include polynomial approximations, radial basis functions, Least Squares Monte Carlo, replicating portfolios, replicating polynomials, and Delaunay triangulation.
See also, http://www.theactuary.com/features/2014/04/erm-proxy-models/

Consideration may need to be given to the ultimate use or users of aggregated risk information and how the inclusion of qualitative risks may affect this.

The actuary could quantify risks to the extent possible, taking account of the precision required for the intended purposes. Where the required precision is not possible, risks may need to be handled qualitatively. The qualitative measurement thereof may consider the nature of the remaining uncertainty as well as the need for precision (proportionality).

With regard to incorporating qualitative risks coherently within the ORSA:

- Professional judgment may be used when incorporating qualitative risks into the ORSA or the models supporting the ORSA;

- Material risks which cannot be quantified reliably, may be incorporated into the ORSA using qualitative methods. This applies especially when quantification of a risk is not sufficient in comparison to qualitative methods, and qualitative methods manage the risk more efficiently.

- It would be inappropriate if the inclusion of such risks and exposures introduced spurious accuracy into the ORSA; and

- When risks could be captured quantitatively but are captured only qualitatively, then a proper explanation may need to be given and documented.

The actuary may wish to document the process involved and justification for the conclusions.

4 OTHER RELEVANT SUBJECTS RELATING TO ORSA WORK

4.1 DIFFERENCES IN METHODOLOGY

4.1.1 A business projection model and multiple bases

This section provides details of potential deviations from the SII methodology, which may be appropriate to use within the ORSA, the outer assumptions, or the Own Solvency Needs calculation. Discussions are divided into methodology, modelling, and assumptions. An alternative division could be between the comprehensiveness of risk coverage within the ORSA, on one hand, and assessments of the adequacy of technical provisions and capital, on the other.

Different methods and assumptions provide for regulatory, prudential reserves and capital while other methods support product pricing, cost of capital and profitability measures. The ORSA model, or a closely related model, may support both aspects, as well as others.

The following discussion aims to explore the utility of multiple reserving and/or capital frameworks (or bases) in the calculation of reserves, of capital, for risk, of profitability, and to clarify the components which could form part of a capital/reserving framework and those components which aide in the comprehensive coverage of risks facing the insurer.

For multinational insurers, the use of multiple reserving and capital bases may be business as usual. For example, a listed French multinational with a Spanish subsidiary may need IFRS for its annual accounts, French GAAP for the accounts of its French insurer, Spanish GAAP for its Spanish insurer, possibly one more for tax basis and then SII for its regulatory reserves and capital. In order to calculate profits, costs of capital and support product pricing, the multinational insurer may need a business projection model[13] which incorporates all bases and their interactions in the declaration and release of profits (dividends), or for a mutual the emergence and reinvestment/reallocation of annual surplus. For a smaller, local insurer, two bases may suffice: local GAAP and SII. In some countries, the accounting balance sheet may be based on the SII balance sheet. In general, the bases should include all regulatory, statutory, accounting and other bases which define reserves (and the balance sheet) as well as all annual profit and loss accounts.

A business projection model which includes only the SII basis may be valid *and sufficient* to project future solvency needs but is not likely sophisticated enough to support product pricing or profitability measures.

4.1.2 Own Solvency Needs

There has been a push from regulators regarding insurers' development of their own internal view of their current and future capital needs, their "Own Solvency Needs"[14].

Given the complexity of SII and the difficulty of implementing Pillar 1 and Pillar 2, some insurers may be in the "early days of their journey of discovery" into OSN. Insurers may be reticent to establish their own view and thus commit to an additional reserving/capital framework before they fully understand it and how it may move over time in response to movements in markets and other risks or uncertainties. The lack of understanding poses an impediment to investigating potential bases that might serve as the insurer's OSN. The actuary may provide assistance to the insurer and its management by communicating the specifics and sensitivities of any potential OSN bases, as well as a comparison to Pillar 1, including how the balance sheets (reserves + capital) evolve over time within the projection of various scenarios.

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[13] Oliver Wyman & Morgan Stanley "Generating Cash in a Volatile Solvency II World", https://www.oliverwyman.com/our-expertise/insights/2015/jun/generating-cash-in-a-volatile-solvency-ii-world.html

[14] Ibid. See "EIOPA's Supervisory Assessment of the Own Risk and Solvency Assessment - First experiences"

A company's OSN assessment may incorporate risks not captured by the SII SF (risk coverage) and may utilise methods distinct from SII regulation in assessing capital needs (adequacy).

In investigating and selecting an OSN basis/framework, the actuary might find it useful to go through these aspects:

1. Risks:
    - Given the collection of insurance products offered (historically and currently), risks arising from the insurance policy itself, risks arising from regulatory requirements, and the overlap and differences
    - How the OSN can support the identification, assessment and prudential management of those risks
    - The identification and scenario-based investigation of fundamental uncertainties or assumptions (e.g. future reinvestment risk, expected asset returns, and the UFR)
    - What are the special needs in managing risks that are arising e.g. from the ALM, product management or underwriting side
2. Reserves:
    - The measurement of the adequacy of reserves in covering insurance liabilities
    - How the reserving methodology of the OSN can support other business functions such as strategic planning and product pricing
3. Capital:
    - A comprehensible definition of capital components, their sources or nature, their purpose and which aspects of the insurer's balance sheet they protect
    - A basis to investigate whether capital (money) is an appropriate measure to protect against a risk and when it might not be
    - How the OSN capital basis assists with the prudential management of the insurer and ensures the insurer's continued solvency under stress
4. Product pricing & profitability:
    - Whether the OSN can play an integral part in product pricing and profitability analyses

Developing alternative risk/capital/reserving assessment frameworks may be very beneficial to the insurer. Investigation various approaches may be time consuming. The eventual adoption of additional frameworks by an insurer will be most useful in measuring risk if the additional frameworks are *non-binding*. One risk regarding an insurer's OSN is the potential for an insurer's assessment methods to become binding if communicated to the regulator. That is, with a binding OSN, the insurer may be prevented from declaring profits or paying dividends if, for example, their OSN suggests a reserve strengthening while all other accounting and regulatory bases are compliant and positive. As an insurer may be a long term business, the OSN may be useful as a non-binding, long term risk management tool rather than a means to crystallise an annual (or more frequent) balance sheet and profit and loss account.

The following sections explore potential differences in methodology, modelling, and assumptions. Discussions include, but are not ordered by other relevant topics such as: the comprehensiveness of risk coverage within the ORSA, assessments of the adequacy of technical provisions and capital, and other subjects relating to OSN.

4.1.3 Risk measure

An essential component of the specification or assessment of capital is the risk measure. The risk measure generally calculates capital as a shortfall arising from one or several sensitivity or scenario tests.

The undertaking may decide to use something other than the 1-year 1-in-200 likelihood Value-at-Risk measure of Total Balance Sheet risk. There are four components here which are specified by SII which the undertaking may decide to adopt or change to suit its needs in managing its business and its risks: confidence level, timeframe, risk measure (e.g. VaR), and extent of exposure (e.g. the SII total balance sheet or a subset which only protects policyholders, but not PVFP).

The undertaking will likely use the SII risk measure (1-year, 1-in-200 likelihood VaR) for its SII SCR capital and may which to use this as well within the ORSA. The undertaking may wish to supplement or replace the VaR with a measure of risk which suits its business and strategy, its risks and risk management policies and objectives, and its capital policy. Ideally, the risk measure (VaR, TVaR, etc.) would support the undertaking's approach to capital allocation as reflected in the business, for example in the pricing of various insurance products, as used in remuneration, or as used in assessing profitability. That is, the return on capital, if used, would reflect the manner in which capital is allocated within the undertaking.

The undertaking may wish to use additional or alternative risk measures for the assessment of reserves and capital. For example, the undertaking may wish to incorporate a long term risk measure such as "burn-through"[15] to set or assess capital levels and compare this to SII reserves and capital.

The undertaking may also wish to vary the confidence level or likelihood of the stress, e.g. the 99.5th or higher percentile adverse stress. This may arise from the undertaking's desire to attain or maintain a certain credit rating. However, there may be non-trivial interaction of risk as viewed by the credit rating agency compared to risk as viewed through a SII lens.

4.1.4 Risk measurement time frame

The undertaking may utilise different risk measurement timeframes within its business, e.g. daily or weekly market risk VaR's, and risks may be viewed on a shorter or longer timeframe than one year. For example, the undertaking may also focus on, for example, the risks over the same timeframe as its five-year strategic plans, or on a timeframe more suited to the nature of its products, which may differ among portfolios.

Risks with distinct measurement periods need to be brought onto a consistent measurement period, where possible. It is important that the risk measurement period is incorporated into the ORSA coherently (e.g. via a multi-year projection using 1-year risk distributions).

In 2013, Kiln Group provided a useful overview of their risk and capital framework, most notably the collection of 7 distinct, but inter-related risk metrics and the methodology for extending the common 1-year capital calculation to their 3-year ORSA projection horizon and the business planning period[16]. While Kiln's ORSA process has undoubtedly improved, their diagrams from 2013 are useful:

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[15] The risk-neutral likelihood and magnitude of potential future reserve injections needed to support guaranteed policy benefits. This burn-through would likely be calculated using stochastic methods for an isolated ring-fenced or segregated fund, with no risk diversification except the implicit diversification arising from the dependency structure (e.g. copula or correlation matrix) among the market risks within the stochastic model.

[16] https://www.theirm.org/media/429599/ORSA-presentation-IRM-290513-Hitchcox.pdf

Kiln's 7 views of risk capital

3 views	6 flavours – existing basis, pre SII	New basis – post SII
Regulatory	(1) ICA: 99.5% VaR DFB Risks to ultimate GAAP reserves	SCR: 99.5% VaR DFB 1-year emergence Tech provs: disc, RM
Rating agency	(2) ECA: 99.5% VaR DFB * 1.35 (3) 99.9% VaR DFB	No change
Economic	(4) Buffer: ECA + 80% TVaR DFM (5) HO carry: 99.93% VaR DFB (6) HO allocation: 99% TVaR DFM	No change

Kiln's approach to their 3-year ORSA projection horizon

Step 1: **1-year capital calculation: fully stochastic DFA model**
Step 2: **Chain together 3 consecutive 1-year calculations: trends on volume, exposures, PRI, loss ratios, the insurance cycle ➔ financing of preferred path for the business**
Step 3: **Apply shocks to central capital forecasts ➔ contingency capital planning** **➔ studies of plan ROE and variability of ROE**

The risks, uncertainties and time frames in general (re)insurance and reinsurance may differ substantially from those of life (re)insurance. While the range of outcomes for general insurance risks may be more widely distributed, there may be more uncertainty in long term life risks. The converse may also be true.

4.1.5 Projection basis: what is Best Estimate and why?

This is a question of what comprises the undertaking's true view of reality. From the collection of assumptions arising from SII, IFRS, local accounting, etc, the actuary may be able to produce an objective combined best estimate set of assumptions, taking aspects from each paradigm as appropriate. The undertaking may opt to use this objective best estimate in two manners: inside and/or outside the SII capital and reserving model.

When used within the SII capital model or within the ORSA, the undertaking may wish to incorporate the objective best estimate in lieu of or in addition to the standard SII SCR (Standard Formula or Internal Model per Pillar 1). In this sense, the capital model is comparable to the SII SF or IM. In this manner, the alternative capital model may be a candidate OSN basis. This basis comprises the "inner" assumptions discussed above. This may be used to calculate the technical provisions in isolation or as the starting point, or baseline, relative to which the SII risk stresses are defined. In this manner, using the objective best estimate supports a variation of SII Pillar 1 which may form the Own Solvency Needs. However, Own Solvency Needs may differ from SII Pillar 1 in other ways.

When used outside the SII capital model (Pillar 2), the undertaking may wish to perform projections into the future of various balance sheets and profit and loss accounts, e.g. SII, IFRS, local GAAP. In this sense, the objective best estimate might be used to move from the valuation date (broadly "the present") to the point in time when the accounts are to be recalculated or restated (i.e. modelled). That is, the objective best estimate can be used to arrive at the future point in time at which, for example, the SII balance sheet is modelled. In this manner, the objective best estimate should feed into the future assumptions bases (as required by regulation) for each set of accounts to be projected into the future. In this sense "outside the SII capital and reserving model", the objective best estimate may be thought of as the "outer scenario" analogous to a stressed ORSA

scenario. Moreover, as within a stressed ORSA scenario, the future Best Estimate (e.g. SII BE) should take into account the experience or assumptions leading up to the point in time when the "inner scenario" assumptions are required. For example, in a scenario where mortality is reduced by 10%, this informs the setting of the mortality (and longevity) basis for the calculation of the SII balance sheet as at, for example, five years into the future. As another example, in deriving yield curves, risk-free curves or discount curves for use in future periods, these may be consistent with the time-zero curves, but not equivalent, i.e. derived as forward curves from the given term structure.

Within the ORSA, reserves and capital might need to be projected consistently with other measures, e.g. the Transitional Measures (if being used). In order to do this, the company might also need to project Solvency I as well as SII reserves and capital within the ORSA (consistent with Solvency I/SII assumptions). However, Solvency I and/or SII assumptions driving the above reserves and capital calculations may differ from what the company chooses to use as the assumptions underlying the ORSA model(s) and process.

For the best estimate ORSA scenario, the (re)insurer may choose the outer ORSA assumptions to be of the following, noting that the best estimate should be fully justifiable:

- Fully consistent with SII BE assumptions; or
- What the (re)insurer expects on an objective best estimate basis—the "true real-world basis". This may mean that some assumptions are the same as the SII basis while others differ. When they differ, it's the actuary's responsibility to explain why.

The latter may form part of the basis for the insurer's Own Solvency Needs.

It is vital to keep in mind the realities in addition to and as opposed to SII modelling, SF/IM, prescribed assumptions (e.g. in SII MA). When evaluating risks, potential risk events both at extremes and as expected, the distribution of risk events (if appropriate), exposures to those risks, as well as related elements such as management actions, regulatory actions, and policyholder behaviour might need to be taken into account.

A vital aspect related to the discussion above is that the actuary will need to understand the differences, both individually and in aggregate, between the SII principles and rules and any deviations appropriate for the ORSA.

4.1.6 Risk capital versus policyholders' protective risk capital

SII takes a "total balance sheet" approach to evaluating an insurance company and its risk. The total balance sheet (TBS) approach incorporates risks from the perspective of various stakeholders, notably policyholders, shareholders and debtholders. The TBS approach aims to assess the risks to the viability of the insurer by evaluating the nature and behaviour of the underlying insurance risks on a market values basis for both assets and liabilities. For an insurer, different risks affect different components of the SII Balance Sheet, depending on the nature of the insurance policies, the assets, the approach to ALM, etc.

An undertaking's risk exposures may be understood by looking at how each risk affects the components of the SII Balance Sheet and how each risk affects the SII capital components. Risk exposures to shareholder capital are different from exposures to future profits through the nature of the capital held, whether additional capital might be required to be injected, what such capital protects and how certain risk exposures are managed.

An undertaking's Own Funds (capital) may include shareholder equity, present value of future profits (PVFP), and subordinated debt. Both shareholder equity and sub debt have the capacity to absorb losses on existing business when such losses require an injection of capital or a transfer of capital to policyholders to meet a shortfall of assets backing liabilities. PVFP is a measure the future profitability of the business and generally does not provide for capital injection. Moreover, capital protecting PVFP generally protects the balance sheet (and hence shareholders and debtholders), but does not protect policyholders directly.

PVFP generally protects the business against business and operational expenses and risks not directly connected to policyholders. It keeps an insurer in business and is what will provide for future salaries, business costs, dividends and debt service, should any of these exceed the Best Estimates already implicit in the SII framework. Within the projection of the business, future profits materialise, if available, and then belong to shareholders, being distributed as dividend or retained as working capital. Shareholder equity and sub-ordinated debt protect against losses not supportable by future profits and protect policyholders in the short term should the insurer have insufficient means to meet its liabilities. The sub-ordinated debt is subordinated to policyholder liabilities.

In summary, different risks affect the components of Own Funds differently and the components of Own Funds protect the business from different risks over different time frames. Hence, within an undertaking's business practices, it is possible to treat different risks and capital components differently. For example, an undertaking's internal view of required capital could focus solely on risk capital which protects policyholders (and not PVFP). Alternatively, the undertaking could apply different risk metrics to different capital components, e.g. a 1-year 99.5th VaR for policyholder protective capital and a 1-year 97.5th VaR for PVFP protective capital. Moreover, the undertaking may wish to distinguish how these distinct risks are managed or how their allocated portions of risk capital are managed or invested.

From another perspective, for a given portfolio of in force insurance business, it may be useful to consider the total assets available to pay those benefits ("policyholder protective capital"), with or without the allocated risk capital, *but without PFVP, VIF or goodwill* especially as arising from other product portfolios. Considering asset-liability "matching" from this perspective should help the actuary identify and assess potential reinvestment risks (as well as all other common risks) without muddying the assessment by including SII capital arising from PVFP or from future premiums on existing business or new business.

This type of analysis may suggest that after a shock, loss-making business may be subsidised by profitable business (going concern). However, this assumption of cross-subsidy might be reviewed, especially given the total level of profit (return on capital) across the business—primarily because the amount of cross-subsidy may not be maintainable as competitors or new entrants may be able to offer similar profitable products *but will not need to subsidise loss-making legacy business*. For these reasons, the actuary may wish to assess the reserve and capital adequacy of a given portfolio of liabilities and corresponding assets noting that this is a basis distinct to that of regulatory reserves and capital[17].

4.1.7 Fungibility of capital

From EIOPA[18]:

> *"Fungibility at group level means that an element of own funds can fully absorb any kind of losses within the group, regardless of the undertaking within which those own funds are held or where the commitments arise (in compliance with the local prudential and legal rules). Fungible own funds in this sense are thus not dedicated to a certain purpose. Fungibility of own funds at solo level doesn't automatically imply fungibility at group level.*
>
> *"Transferability refers to the ability to transfer own funds from one undertaking to another within the group. Transferability leads to increase/decrease of own funds in a solo entity without increasing/decreasing the group own funds, except the likely cost of the transfer. The time and the costs of the transfer have indeed to be taken into account."*

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[17] The IAA provides a very useful resource in its online "Risk Book". See Chapter 12 – Capital: https://www.actuaires.org/LIBRARY/Papers/RiskBookChapters/Ch12_Capital_A_Reg_Mgt_Tool_2017-08-16.pdf

[18] https://eiopa.europa.eu/CEIOPS-Archive/Documents/Advices/CEIOPS-L2-Final-Advice-Group-solvency-assessment.pdf

Within the ORSA, the fungibility and transferability of capital, and funds more generally, within a solo undertaking among business units or liability portfolios, or within a group undertaking, may need to reflect the reality of the undertaking including at least the appropriate local legal, local accounting and regulatory aspects.

The nature of the components of Own Funds may need to be assessed for its ability to meet capital shortfalls within its product portfolio as well as within other business units or group affiliates. The time-related restrictions of fungibility may also need to be considered (e.g. PVFP arising from unit-linked policies cannot immediately and fully absorb overnight losses on guaranteed savings because those future profits will only materialise over time).

Diversification among risks and among portfolios or entities may need to reflect the real-world fungibility and transferability of capital. For example, where capital is not transferable outside a particular portfolio, the diversification at the level of that portfolio may be the minimum capital amount as seen from a more aggregated level of the undertaking.

4.1.8 Risk-neutral Economic Scenario Generator (ESG) implementation

The SII guidance for the implementation of a stochastic asset model (ESG) requires that the SII discount curve, with or without volatility adjustment or matching adjustment and with the last liquid point and ultimate forward rate, is used as the "risk-free rate" within the ESG. Then this drives the other random asset processes (i.e. the SII discount curve is the "short rate"). This requires careful adjustments to market data (volatilities and market prices) to ensure risk neutrality and correct discounting.

An alternative implementation could use the market risk-free rate (without LLP, UFR, MA or VA) as the short rate to drive the other asset processes. This simplifies calibration and minimises error. In this implementation, the SII discount curve (or all of them, if using MA for some liabilities and VA for others) could be calculated formulaically within each simulation from the market risk-free curve. The VA, MA and UFR are non-market-consistent adjustments arising from SII. It is questionable whether the SII discount curve is most appropriate to use as the stochastic risk-free reference point for other assets.

4.1.9 Economic best estimate liability

On the overriding assumption that liabilities are cash flow matched with risky assets on a net basis (net of expected defaults and net of asset-related expenses), then this portfolio of assets could be viewed as an "economic BEL" as "the amount of assets required to meet liabilities on a best estimate basis." The margin in the SII BEL above this economic BEL is "economic risk capital" and within the Best Estimate projection that margin is expected to materialise and accrue to the undertaking. The size of the margin is decreased by the VA or the MA (as the effective discount rate approaches the net yield).

On the other hand, the UFR may decrease the SII BEL below the economic BEL if there are material long term liabilities. However, beyond the LLP, there may not be available assets to match long term liabilities. In this case, relaxing the assumption of cash flow matching, there are liquidity and/or reinvestment risks which needs to be assessed.

4.2 DIFFERENCES IN MODELLING

4.2.1 Nature of stresses

For the purposes of calculating the SII SCR, the SII SF SCR calculates the amount of required risk capital via the two-tier covariance aggregation of isolated, single-risk stresses. A Monte Carlo SII IM may perform multi-variate risk stresses where the severity of individual risks is jointly sampled according to a dependency structure (e.g. copula). The SCR is then taken by ranking the Monte Carlo Simulations at the correct level of diversification and taking the capital needed for the 99.5th adverse event (or interpolated to the 99.5th percentile).

For the purposes of the ORSA, isolated stresses do not suffice for the outer scenarios. Stress and scenario tests (SAST) are required. SAST usually includes combined-risk events, reverse stress tests, and sensitivity tests[19]. The undertaking may wish to adopt a framework to develop combined stresses[20].

For the calculation of the SII SF, isolated stresses are necessary. For an SII IM, joint stochastic stresses (i.e. many simulations of combined stresses) may be the norm. However, for the investigation of risks and the insurer's exposures, it may be necessary or helpful to perform stresses which are a combination of risks, on an intuitive or causal basis.

Combined risk models may prove a useful tool in assessing the adequacy of reserves and capital in realistic adverse scenarios by providing a potentially more realistic view of cause-and-effect relationships among risks or of likely "correlation" (coincidence) of separate risks in a combined scenario. Such stresses may be run through the SII SF/IM models (Pillar 1) or the ORSA models (Pillar 2) depending on the nature of the stress and the desired items of interest to be measured (e.g. technical provisions, assets, etc.).

Examples of combined risk models useful for investigating combined effects on an insurer's balance sheet and product portfolios include:

- A causal macro or market model (formal model or mental model) which provides coherent combined market risk scenarios;
- A model for investigating the common and distinct risk drivers for mortality, morbidity, and longevity risks;
- A dynamic lapse model incorporating policyholder behaviour and market movements, as appropriate;
- An interest rate model which stresses all portfolios by the same stress (not the worst-of-up-or-down per Pillar 1) to investigate the inherent interest rate diversification or lack thereof arising from the insurer's various product portfolios.

As relates the modelling of lapses (persistency, surrenders, etc.), the SII lapse stresses (the three "sub-stresses" being Best Estimate rates ±50% and the mass lapse event) and the calculation of risk capital arising from policyholder behaviour, there are two potential issues which the actuary may wish to address with distinct modelling or methodology. First, the lapse risk capital amount for each lapse sub-stress is restricted to those policies (or homogeneous risk groups) which cause losses. This means that lapses causing a profit within a sub-stress are zeroed. While this may be a sensible method to calculate prudent regulatory reserves, for the purposes of improved risk management and understanding of the business, the actuary may wish to investigate the effects on the insurer (profits, balance sheet, assets under management, etc.) of not zeroing such policies. Second, the lapse mechanics of the SII SF assume that the policyholder, in exercising an option to surrender or lapse, will act to the detriment of the insurer. For many products, it may be the case that policyholders are more so motivated by personal circumstance. In order to increase the actuary's and insurer's grasp of the potential business realities of policyholder options relating to persistency, the actuary may wish to assess policyholder behaviour with a more sophisticated (or indeed logically simpler) causal, dynamic or Bayesian model of policyholder behaviour. Models of policyholder behaviour may also be useful within ALM, asset strategy, liquidity management, underwriting, and in standard actuarial analysis of policyholder experience data[21].

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[19] IAA's Risk Book, ORSA Chapter, https://www.actuaires.org/LIBRARY/Papers/RiskBookChapters/Ch10_ORSA_8March2016.pdf

[21] https://www.soa.org/research-reports/2014/research-2014-modeling-policy/
Milliman, 2010, "Dynamic Policyholder Behaviour: Analysis, Modelling and Management"

Such models may form part of an insurer's OSN—i.e. to assess capital needs on non-prudential, non-regulatory basis—but may be most useful within the insurer's Stress and Scenario Testing framework to help the insurer understand their products, risks and exposures.

4.2.2 Dependencies, correlations, interactions and cause-and-effect relationships

Correlations (covariances) are prescribed for the SII SF. For the SII IM, companies may use their own correlation/dependency assumptions/models. Insofar as the company believes that correlations or dependencies differ from those used for SII capital (SF or IM), the company may wish to reflect this within the ORSA or via their OSN assessment.

Dependencies within financial markets may differ from those assumed in the SII SF. For example, if a company uses causal models to model certain relationships among areas of uncertainty, this might need to be reflected in the ORSA, if not already within the SII SF or IM.

4.2.3 Loss absorbing capacity of deferred taxes

The "Adjustment for the Loss-Absorbing Capacity of Deferred Taxes" (ALACDT) may be allowed for explicitly within a *business projection model* which projects the appropriate balance sheets and profit and loss accounts into the future, as with the ORSA, perhaps on multiple bases such as SII, IFRS, local accounting as required to reliably model the company's tax reality.

Using a business projection model will enable to company to understand in what circumstances, to what extent, and over what timeframe a loss may be expected to absorbed via deferred taxes. Making the simplistic assumption that loss-absorbing capacity of deferred taxes is the full tax rate may overestimate the relief realisable in the real-world, thus under-stating the SII capital requirement. Such a business model would need to incorporate SII, tax rates, and the company's annual accounts (local GAAP and/or IFRS, as appropriate) in order to calculate reliably the company's future tax liabilities and tax relief.

A simplified calculation of the ALACDT may result in an overstatement of the availability of tax relief in a stressed situation and hence an understatement of capital needs. Such a calculation may ignore the scenario-dependency of the availability of tax relief.

4.2.4 Loss absorbing capacity of technical provisions

Scenario analysis using a business projection model may be useful is assessing the reliability of the adjustment for the loss absorbing capacity of technical provisions. Within the calculation of the SII SCR, this adjustment is formulaic and the use of scenario analysis may give the actuary and the insurer comfort (or concern) as to whether liabilities will be able to absorb losses consistent with the reduction in the SII SCR.

The construction of a business projection model to suit this purpose is no small task and the actuary may need to consider the reliability of a simplified calculation and the cost-benefit analysis of building the sophisticated model. For mutual insurers, the reliable calculation of the loss absorbency of technical provisions poses difficulties similar to the discussion of surplus in section 3.1.2, for many of the same reasons. It may be appropriate to investigate the reliability of loss absorption using other methods and the actuary may need to understand and communicate any reliance's, limitations, uncertainties, and additional risks of doing so.

4.2.5 Defaults, downgrades, credit spreads, and market values

For different types of insurance products, credit risks affect assets, capital, and liabilities (and other balance sheet components) differently. Moreover, there are different aspects of credit risk to which different types of insurance product are exposed. It is useful to separate, as much as possible,

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https://www.actuaires.org/LIBRARY/Papers/RiskBookChapters/Ch18_Policyholder_Behavior_14Feb2017.pdf

asset backing liabilities from assets backing capital. In order to measure the different risk exposures to credit risks arising from different insurance product portfolios, it may be necessary to model multiple risks. For example, changes in credit spreads to model changes in market values of bonds and other credit-risky assets and separately expected (or shocked) credit defaults to measure actual (potential) asset shortfall arising from a long term ALM cash flow matching strategy.

An insurer's exposure to credit risks depends on (1) the risk exposures arising from its insurance policies and (2) the risk and capital framework(s), which define the boundaries of credit risk exposures, i.e. which balance sheet items must be protected with capital due to their exposures to credit risks. In understanding modelling needs for credit risks, it may be useful to assess the risk exposures in three steps: credit risk exposures of the policies or product portfolios *in isolation*; subsequently, assess the risk exposures to the company as a whole (a generic Total Balance Sheet approach); and finally frame the risks of the company and its balance sheet within the SII framework.

As simple examples, consider the risk exposures arising from three common insurance products: unit-linked savings without guarantees; participating (or "with profits") savings a maturity guarantee but no surrender guarantee; and a simpler insurance product such as an annuity in payment or a life assurance policy (wherein the insurer bears all of the investment and insurance risks).

For unit-linked savings product *in isolation*, the policyholder bears all of the market risk. Extending risks to include the insurer's continued business or business model, the insurer is exposed to a reduction in the future asset management charges (AMCs) it levies—both a risk to profits (profit margins) and that the revenues arising from AMCs are insufficient to cover the insurer's related expenses. Formalising these risks within the SII framework, credit risk poses a risk to PVFP via a reduction in the profit margin of AMCs driven proportionately by the fall in the market value of credit-risky assets. SII requires that the net change in Own Funds (in this case only PVFP) is reflected in the capital requirements (i.e., for the SII SF, the BSCR for the credit risk module which then feeds up through the market and overall diversification matrices). Beyond PVFP, the insurer's Own Funds are not exposed to the credit risk of its unit-linked portfolios (unless the assets backing those Own Funds are invested in credit-risky assets).

For participating savings products with maturity guarantee, the credit risks on the portfolio *in isolation* are only crystallised on two events: (1) the losses on the default of a bond held to back the liabilities and (2) at maturity, a shortfall in assets below the guaranteed amount. Extending risks to the insurer's business model, the same two risks are split between any surplus of assets to absorb losses and backstopped by the insurer's own free assets or working capital. Formalising these risks within the SII framework, credit risk poses a risk to the following components of the SII BS, in order of erosion: TP, FDB, PVFP, equity. On the asset side, credit-risky assets are affected via fallen market values. On the liability side, technical provisions may absorb a portion of the MV shock, until the guarantee is triggered. Beyond that FDB are reduced until fully eroded and beyond that the companies PVFP and shareholder equity are at risk. However, if the real risk exposure of the policies is to defaults, it may be difficult to measure reliably the expected effects of a credit spread movement. The SII approach estimates the capital need to protect the insurer against an adverse credit spread scenario over the next year. However, it may not provide sufficient information on the potential long term needs for reserve strengthening due to defaults. For this reason, the actuary may wish to model and assess credit risks both via the 1-year VaR movement in credit spreads as well as longer-term potential for defaults.

For a portfolio of annuities in payment, the progression of risk from policy to SII balance sheet is similar participating savings, except that there's the potential to crystallise a loss with each future set of payments via the sale of credit-risky assets (if not held to redemption) or via the default of a bond, both of which cause a cash flow matching shortfall. Extending the risks to the business model and the SII balance sheet is similar to above, except there is no loss absorbency in the technical provisions themselves or in their FDB.

It is worth noting that the two approaches may create overlapping or distinct modelling needs relating to credit risks. Where distinct, this may necessitate multiple methods of modelling credit risk in order to support the effective risk management thereof.

For Solvency I and in other accounting and regulatory frameworks, an "earned rate" was/is needed. In some cases, for long term illiquid liabilities for example, this means estimating the net earned rate on a portfolio of bonds, taking into account expected defaults over time. This may involve looking at 1-year credit default and transition probabilities, but may also include looking into credit crashes. Large-scale coincident defaults are a not uncommon feature in the past, hence it may be imprudent to assume this would not happen again in the next 30-50 years. This may increase the usefulness of alternative methods to assess credit risks over the long term, in addition to the prudent spread in the SII discount curve and the assessment of credit-default-driven changes to the market value of credit risky assets.

4.3 Differences in assumptions

4.3.1 Contract boundaries

Under the SII Standard Formula and Internal Model, contract boundaries may truncate certain products in various ways. Insofar as SII contract boundaries cause the projection of such products to deviate from otherwise economic, real-world, BE assumptions, these assumptions may be used within the ORSA to project the expected effects (profits, EOF/BOF, future capital needs, etc.) of such products.

This offers various options in terms of the projections and modelling and the inclusion of contract components excluded by the SII contract boundary. The first option is to incorporate the excluded contract components within the "outer scenarios", that is, within the year-on-year projection of balance sheets and accounts within the ORSA projection. That is, using the terminology from section 3.1.3, for each "ORSA projection period" within the "ORSA projection horizon". A second option is whether the assessment of reserves and capital (i.e. a set of inner scenarios or inner assumptions) needs to incorporate contract components outside the SII contract boundary.

If projecting SII reserves and capital, it is important to note that at each point in time within the ORSA projection, SII capital and reserves will be calculated consistently with SII guidance, i.e. applying the contract boundaries rules. Additionally, the company may wish to investigate the effects on reserves, capital and profitability of varying the contract boundary. The company may do so either as a "scenario test", or more formally within a separate basis for the Own Solvency Needs. It may be necessary to manage the business including beyond the contract boundaries to reflect the company's own views of future business levels and future capital needs. Note here that the management of the insurer and its future business levels is a distinct purpose from the assessment of regulatory reserves and capital. As SII takes the Total Balance Sheet approach, the recognition of future profits arising from non-contractual (i.e. beyond the SII contract boundary) would not be appropriate while it may be necessary to some extent in putting an appraisal value on an insurance company should it be sold or bought.

For complicated insurance products with various "risk riders"—e.g. unit-linked retirement savings with non-unit life assurance, critical illness, or health components—it may be a non-trivial task to use the SII contract boundary rules to split risk coverage (i.e. future liabilities) and future premiums. In addition to the difficulty, there may be unresolvable uncertainty due to the incompleteness of the SII rules or the scope for interpretation. In these cases, it is important that the actuary:

- understands the potential distinct interpretations and their consequences in terms of the SII balance sheet as well as the effects on future profitability
- communicates this in a sufficient way to senior management and decision makers such as the product pricing department, and
- checks whether future liabilities accruing within the contract boundary are fully reflected on the SII balance sheet, when appropriate.

As a concrete example, consider a unit-linked savings product which charges annual risk premiums for disability insurance. The product is a combination of a unit-linked savings product and a disability term assurance which pays an annuity until retirement upon the policyholder's

qualified disability status. The policyholder pays an annual premium which the company splits between units and disability risk premium. For the future year of new premiums within the SII contract boundary, there are the cases where policyholders will become disabled within the next year of the SII projection (i.e. for SII reserves and capital in isolation, but also thus within the ORSA). The occurrence thereof is based on the insurer's best estimate disability rates. The important point is regarding the contract boundary of the new disabled policy: although future premiums beyond 1 year arising from the contract are excluded, it would be inappropriate to exclude the liabilities (benefit payments and expenses) arising from the disability claim.

In this example, the ORSA process may aide the actuary and the insurer to ensure that annual risk premiums are measured against the total liabilities which they should cover. Of course, competitive considerations might also be included, but the proper assessment of liabilities will enable the company to identify potential "loss leaders" or loss-making risk riders.

An alternative type of product, and hence nature of risk and exposure, would be to consider the annual disability risk premiums on a portfolio of policies as covering the existing disabled policies as well as those that will claim in the current year. This flexibility presents moral hazard risks and raises the risk of under-reserving. Given the potential for policyholder cross-subsidy, it is questionable whether this might be an acceptable insurance contract. Regardless, in this situation the actuary may need to make the insurer's management aware of the effects of varying the contract boundary and the real-world effects that current practices may have on the evolution of the SII balance sheet as well as the insurer's annual profits.

4.3.2 "Risk neutral" versus "real world"

Assumptions

In distinguishing between "risk neutral" and "real world" assumptions and models, it is important to understand the situations and purposes of each[22]. In general, for assumptions relating to non-market risks (e.g. insurance risks, business risks) there is no distinction between risk-neutral and real-world. The best estimate is based on analysis from the real world and is valid for risk-neutral valuations. For market risks, risk-neutral assumptions and real-world assumptions serve distinct purposes.

Under SII, risk-neutral assumptions are required for the valuation of Technical Provisions, including the valuation of liabilities with complex options or guarantees. Within a risk-neutral valuation, all assets earn the "risk-free rate" (EIOPA's curves with or without VA or MA). For stochastic valuation, this means that all assets earn the risk-free rate (the short rate driving the ESG model) *on average* or that the expected return on assets is the risk-free rate. As such, a stochastic risk-neutral valuation should replicate market prices for relevant assets and other market instruments (e.g. derivatives). While the distributions and statistics of risk-neutral asset price/return processes ensure the replication of market prices, individual stochastic paths—and specifically the period-on-period behaviour—may not be meaningful. Hence, there may be a risk of invalidity is using dynamic models for non-market risks or actions (policyholder behaviour and management actions) which are developed based on risk-factor-interactions *in the real world* within a risk-neutral stochastic valuation model.

A real-world basis aims to provide a realistic projection of assets and liabilities, wherein assets earn their real-world expected return which is expressed as the risk-free rate plus risk premium(s). Within a real-world stochastic projections, the distributions and statistics of real-world stochastic asset/return processes may be reliable representations of future potential paths, depending on the reliability of the underlying models and their applicability to current and future markets. Dynamic models (policyholder behaviour and management actions) may be more appropriate and the analysis of stochastic outcomes more meaningful within a real-world framework.

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[22] https://actuariesindia.org/CILA/CBLI2014/ESG_JonathanLau!.pdf
Society of Actuaries (USA), " Economic Scenario Generators: A Practical Guide" 2016

While it is possible for both risk-neutral and real-world ESGs to be market consistent, it is straightforward for risk-neutral and historically not done for real-world. The purpose of a risk-neutral ESG is the market-consistent valuation of long term insurance liabilities, specifically the embedded options and guarantees. The most common purpose of a real-world ESG is for ALM and asset strategy. This has meant that different types of models have evolved for use in risk-neutral versus real-world. Risk-neutral models are generally no-arbitrage models aiming to replicate market prices for a single point in time (i.e. a valuation date). Real-world models are generally time series models calibrated to historical data which aim to replicate realistic asset behaviour or interactions[23].

It may be possible to use the same underlying collection of stochastic models coupled with a "change of measure" (P measure to Q measure, or vice versa). In this case, there will be a core model producing core output as well as output from the change of measure transformation. The utility and validity of the resulting sets of real-world (P measure) and risk-neutral (Q measure) output depend the appropriateness of: (1) the model's underlying processes (whether arising from risk-neutral models or real-world models) with regards to (2) their intended business uses. The business uses might be for example risk-neutral valuation of options and guarantees, ALM and asset selection, testing dynamic policyholder behaviour and investigating potential dynamic management actions. Such an approach may be valid and the actuary may need to assess the extent of validity and any limitations.

Valuation

Solvency I utilised a "net earned rate" as the discount factor. SII has shifted to using a market risk-free rate, with or without the Volatility Adjustment or Matching Adjustment, as appropriate. Hence, SII BEL may contain assets over and above those which may be expected (within a real-world best estimate projection) to provide sufficient matching cash flows for the liabilities. That is, for stable long term insurance liabilities, such as annuities in payment, calculating the net earned from a realistic and reliable cash flow matching exercise should ensure sufficient assets (in the best estimate) to back the liabilities. Moving to the SII discount rate may increase the required reserves, ceteris paribus, thus providing a margin of implicit risk capital within the SII BEL itself.

As an example, the actuary may want to assess the adequacy of reserves under multiple valuation approaches. Capital under Solvency I and SII is less comparable as Solvency I was factor-based and SII is risk-based. It may be a good exercise to couple a different reserving approach with SII risk-based capital in an assessment of the adequacy of reserves *plus capital*.

Dynamic modelling

For certain types of insurance product, policyholder behaviour (e.g. surrenders, lapses, paid-up) may be dependent upon annual asset returns or market values relative to fund values, with these relationships arising from the experience data. Certain management actions, such as fund re-balancing or de-risking, may also be predicated on certain magnitude events relating to asset returns, market values, solvency ratios, or policyholder retention (or sizeable surrender)[24]. In all cases, the underlying experience data, historical market data, and future expectations of relevant indicators (market data, inflation, wage levels, etc.) are based on real-world data. Applying the dynamic rules developed on real-world data and expectations within a risk-neutral framework may produce unreliable outcomes.

As an example, consider the dynamic surrender rates (“taux de rachats conjoncturels”) formulaically specified by the French regulator (ACPR)[25] for participating savings life insurance products. The dynamic surrender formula aims to reflect policyholder’s surrender sensitivity to

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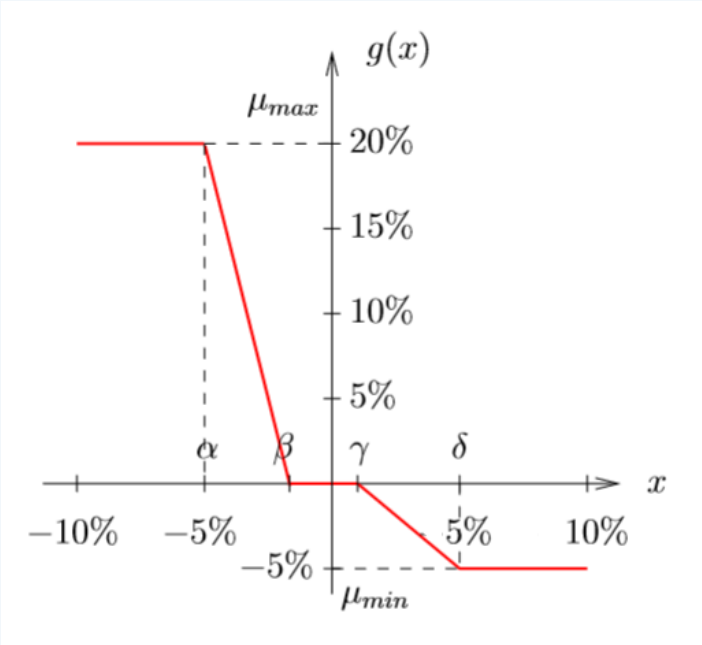
[23] 2017 SoA Life & Annuity Symposium, "Session 48 PD, Real World vs Risk Neutral: Practical Implications on Models"

[24] IAA’s Risk Book, Policyholder Behaviour and Management Actions Chapter, https://www.actuaires.org/LIBRARY/Papers/RiskBookChapters/Ch18_Policyholder_Behavior_14Feb2017.pdf

[25] https://www.institutdesactuaires.com/global/gene/link.php?doc_id=566&fg=1

differences between the earned rate and the desired rate of return. Where the earned rate is lower than expected, policyholder lapses increase, when higher lapses decrease. The relationship is illustrated below[26]:



With the function calibrated to real-world nominal returns, using risk-neutral assets returns (i.e. the risk-free rate) skews surrenders towards increase relative to expected. Moreover, the non-realistic period-on-period progression of stochastic risk-neutral interest rates may produce non-intuitive, non-realistic surrenders. This type of issue arising from the interaction of real-world derived insights and risk-neutral models is not easily resolved and the actuary may need to investigate the potential effects.

For long term reliably matchable liabilities, one approach to gain insight and improve risk management could be to assess reserves with a combination of real-world and risk-neutral assumptions. The non-optional non-guaranteed components of the liabilities could be valued using real-world discount rates (similar to Solvency I, US GAAP, or IFRS 17). The time value of options and guarantees (TVOG)—i.e. the derivative portion of the liabilities distinguishable from the "intrinsic value"—could be assessed using a risk-neutral, market-consistent sub-basis to ensure prudent (market-consistent and not imprudent) valuation of the optional or guaranteed components of those liabilities, at any future time point in the overall projection. This may provide a useful alternative basis to a full risk-neutral basis, especially if the modelling incorporates dynamic policyholder decisions or management actions predicated upon *realistic* levels or movements in annual returns (i.e. discount rates under real-world, but absent from risk-neutral).

4.3.3 Future new business

The ORSA reflects the company's BE expectations of new business in the future, keeping in mind that there is a funnel of doubt the further into the future we go.

The ORSA should also enable the company to understand what the effects on the company (e.g. Solvency Ratio, BOF/EOF, capital requirements, capital strain, and new business financing limitations) would be in various scenarios relating to new business.

[26] https://www.fime-lab.org/wp-content/uploads/2016/07/presentation_IHP_160916_Printems.pdf

It is important to note that within the future projection within an ORSA, once future new business comes onto the books (was written in the projection's past which is future as of today) it should be treated per SII Standard Formula/Internal Model rules in calculating reserves and capital.

4.3.4 Discount curves

The UFR determines the distant end of the SII discount curves (risk-free with or without Volatility Adjustment or Matching Adjustment). In calculating SII reserves, the UFR is used. This includes future points in time within an ORSA projection.

However, within the ORSA, it may be appropriate not to use the UFR in within the projection. For example, an economic scenario generator (ESG) used for the ORSA may not use the UFR. It is important to note that an ESG used for SII reserves and capital uses the UFR within the discount curve, which may or may not be the "risk-free" curve as discussed above. Also, if the ORSA uses inner and outer simulations (inner reflects SII assumptions, outer reflects ORSA), then the inner ESG uses the UFR while the outer may not. That is, there is a choice within the outer ESG whether to use the UFR. The choice might be explained and documented by the actuary. In addition, the actuary may wish to explore the effects (e.g. on BEL, capital and solvency) of varying or removing the UFR from the formulation of the SII discount curve. Similarly, the actuary may wish to explore the effects of changing the VA or MA—either dynamically within a specific stress test or stochastic model or via sensitivity tests of the VA/MA directly without necessitating a causal link.

Pricing and profitability with the SII discount curve

SII uses the UFR in calculating a PV for long term liabilities which fall beyond the longest maturity available in the local asset market. Insurers' technical provisions are partially insulated from adverse movements in the long term rate of return via the UFR's mechanics (i.e. step down by max 15 bps each year). However, there may be a need for a second (objective) basis for the management of interest-rate related risks and reinvestment risks, which is not smoothed as SII in fact is.

For long term insurance products for which the expected maturity extends beyond the last liquid point (LLP), the run-off of the product and the annual unwind of the discount curve require that the assets backing the long term liabilities earn the forward rate(s) in the SII discount curve. Beyond the LLP, this forward rate converges to the UFR. To the extent that the realised earned rate exceeds the unwind, this contributes to surplus. To the extent that it falls short, annual surplus arising from other parts of the business will be needed to increase the reserves backing those long term products.

Hence, for in force business, it is important to measure the annual drag, i.e. returns required to support reserves. For new business and products where pricing is reviewable, —proper product pricing may be supported by including multiple yield bases, including the SII discount curve with and without the UFR.

Solvency II and assessment of long term credit risks

SII is a market-value based regulatory regime wherein the asset side of the balance sheet is determined by Fair Value, which is most often Market Value (i.e. transaction price). Illiquid liabilities are discounted using a discount curve derived from semi-local risk-free assets (combination of swaps, SONIA, etc.) with the addition of a prudent portion of credit spreads (MA or VA) added in certain cases. With EIOPA providing the risk-free curve and the VA, SII removes the reliance upon credit rating agencies, eliminates the need for in-house "asset valuation", and reduces the need to perform long term asset projections. Thus, for insurers using the VA, SII removes uncertainty and discretion from the question of asset valuation, but in doing so removes the need for long-horizon asset valuation and all of the attendant skills, expertise and analyses.

4.3.5 Sovereign credit risk

The SII Matching Adjustment reduces the net investment yield on bonds by the SII Fundamental Spread. This incorporates expected losses due to credit defaults and credit downgrades. Within the ORSA, it may be appropriate to model explicitly and separately the effects (losses, economic risk capital needs, etc.) of credit defaults from the effects of credit downgrades. In a stressed scenario, credit downgrades may not cause losses in their own right, especially if the company's management actions do not disinvest, e.g. in a global market stress.

SII makes an assumption on how sovereign debt will default. Financial markets and companies have certainly their own and different beliefs. When these assumptions differ, the latter (economic assumptions) needs to be incorporated within the ORSA (see the discussion of outer and inner assumptions).

4.4 Risk Maps and the ORSA

The ORSA requires the assessment of all material risks affecting the company over the given timeframe. For Pillar 1, the common risk measurement is one year. In extending the assessment of risks over longer time frames, commonly used risk maps can be extended for use in the ORSA. Some scenarios that can be studied for instance by comparing the impact and likelihood are:

- Exploring killer scenarios
- Exploring effects of a specified scenario
- Exploring contingent eventualities
- Studying climate change and how it might evolve in time
- Thinking how the most important macro-economic drivers change
- Map for UL portfolios
- Map for participating savings
- Map for a GI reinsurer (e.g. nat cat reinsurance etc.)

Risk maps might be a good way to build a picture, preferably holistic, on the insurers risk profile in short term but even in longer horizon.