SOLVENCY II
DETAILED GUIDANCE NOTES
MARCH 2010

SECTION 4 - STATISTICAL QUALITY STANDARDS

LLOYD'S

SECTION 4: STATISTICAL QUALITY STANDARDS

Overview

This section outlines the Solvency II requirements for statistical quality standards under Article 121 of the level 1 text. These consist of detailed technical standards relating to the methodologies, assumptions and data used within the internal model, as well as the processes surrounding their use.

Managing agents will be required to explain, document and justify all of the methodologies and assumptions used within their internal model. Agents will also need to meet requirements relating to the use and quality of data within the organisation. These requirements are likely to be significantly more onerous than current practice.

Guidance

Managing agents should note that this guidance represents Lloyd's best view of current requirements but is subject to ongoing discussion and change as both CEIOPS proposals and FSA requirements become finalised and Lloyd's own development on Solvency II progresses. Lloyd's will continue to monitor and review progress in these areas and seek to update the guidance as appropriate.

The commentary on proposed level 2 measures attached highlights the relevant sections for the dry run and does not reproduce the full level 2 text. Any additional guidance provided in this document is intended to supplement the level 2 measures, not repeat them, and agents must therefore ensure that they are familiar with all of the requirements and do not rely solely on the additional guidance provided here.

Whilst this document refers to general Solvency II requirements, this guidance is specific to Lloyd's and managing agents in many areas. Due to the unique structure of Lloyd's and the application of the Solvency II directive at society level, some of this guidance will not be relevant to non Lloyd's firms.

Contents

This section includes the following

- Level 1 directive text and commentary on application of proposed level 2 requirements to Lloyd's managing agents
- Guidance on statistical quality standards

LEVEL 1 AND LEVEL 2 MEASURES

The Level 2 measures set out here are based on CEIOPS paper Doc-48/09 (formerly CP 56), published October 2009. These measures may be subject to modification before they come into force

Statistical Quality Standards also apply to group internal models, used to calculate the group SCR.

Directive Article 121

1) *The internal model, and in particular the calculation of the probability distribution forecast underlying it, shall comply with the criteria set out in paragraphs 2 to 9.*

2) *The methods used to calculate the probability distribution forecast shall be based on adequate, applicable and relevant actuarial and statistical techniques and shall be consistent with the methods used to calculate technical provisions.*

   The methods used to calculate the probability distribution forecast shall be based upon current and credible information and realistic assumptions.

   Insurance and reinsurance undertakings shall be able to justify the assumptions underlying their internal model to the supervisory authorities.

3) *Data used for the internal model shall be accurate, complete and appropriate.*

   Insurance and reinsurance undertakings shall update the data sets used in the calculation of the probability distribution forecast at least annually.

4) *No particular method for the calculation of the probability distribution forecast shall be prescribed.*

   Regardless of the method of calculation chosen, the ability of the internal model to rank risk shall be sufficient to ensure that it is widely used in and plays an important role in the system of governance of insurance and reinsurance undertakings, in particular their risk management system and decision-making processes, and capital allocation in accordance with Article 120.

   The internal model shall cover all of the material risks to which insurance and reinsurance undertakings are exposed. Internal models shall cover at least the risks set out in Article 101(4).

5) *As regards diversification effects, insurance and reinsurance undertakings may take account in their internal model of dependencies within and across risk categories, provided the supervisory authorities are satisfied that the system used for measuring those diversification effects is adequate.*

6) *Insurance and reinsurance undertakings may take full account of the effect of risk mitigation techniques in their internal model, as long as credit risk and other risks arising from the use of risk mitigation techniques are properly reflected in the internal model.*

7) *Insurance and reinsurance undertakings shall accurately assess the particular risks associated with financial guarantees and any contractual options in their internal model, where material. They shall also assess the risks associated with both policyholder options and contractual options for insurance and reinsurance undertakings. For this purpose, they shall take account of the impact that future changes in financial and non-financial conditions may have on the exercise of those options.*

8) *In their internal model, insurance and reinsurance undertakings may take account of future management actions that they would reasonably expect to carry out in specific circumstances.*

   In the case set out in the first subparagraph, the undertaking concerned shall make allowance for the time necessary to implement such actions.

9) *In their internal model, insurance and reinsurance undertakings shall take account of all payments to policyholders and beneficiaries which they expect to make, whether or not those payments are contractually guaranteed.*

Application of proposed level 2 requirements to Lloyd's managing agents

Probability distribution forecast

Article 121.1/CEIOPS Doc 48/09: 5.8, 5.47-5.57

Article 121 sets out the requirements that an internal model must fulfil and states that these requirements apply in particular to the calculation of the probability distribution forecast.

"Probability distribution forecast" means a mathematical function that assigns to a exhaustive set of mutually exclusive future events a probability of realisation (Framework Directive Article 13(38)).

The generation of a probability forecast is a key feature of an internal model.

The probability distribution must refer, among other things, to a quantity of monetary value such as profits and losses. Accordingly, any methodology that estimates the value of the financial impact of future events is also subject to statistical quality requirements.

The statistical quality standards set out in Article 121 apply not only to the probability distribution forecast's calculation framework but to all quantitative methods and techniques associated with it.

The richness of the probability distribution forecast should be maximised by basing it on all relevant information available.

The exact nature of the probability distribution forecast may include a wide range of distributions from continuous ones to ones with few data points, subject to the conditions below.

The internal model needs to consider the entire probability distribution of outcomes, not just the 99.5th percentile over one year outcome.

Probability distribution forecasts need to be produced at syndicate level, with all risk types aggregated.

Probability distribution forecasts with more data points provide a stronger basis for a syndicate's risk management. However, care should be taken in fitting distributions to data points so as to ensure that the fitting process does not introduce unfounded richness into the forecast.

A probability distribution forecast involving only a few key points may be acceptable if:

- it is based on up-to-date techniques or if the failure to use up-to-date techniques can be justified on the grounds of proportionality or materiality;

- more sophisticated alternative methods do not yet exist or if the failure to use a more sophisticated alternative is justified on the grounds of proportionality, materiality or applicability;

- the method is consistent with or better than, generally accepted market practice, where this exists; and

- any material shortcomings are addressed by appropriately high standards elsewhere, particularly with regard to validation and governance.

A managing agent does not have to follow generally accepted market practice exactly. The chosen modelling technique must be adapted to the syndicate's risk profile and therefore agents may have to deviate from generally accepted practice.

Internal models that generate probability distribution forecasts with fewer data points may need more intensive validation and stricter governance.

Statistical quality shortcomings at individual risk level carry up through any aggregation of risks and must, therefore, be addressed at the topmost level too.

Risk ranking

Article 121.4/CEIOPS Doc 48/09: 5.220-5.221

A managing agent must provide evidence that the ability of its internal model to rank risk is sufficient to ensure that it is widely used, and plays an important part, in governance, particularly in risk management, decision-making and capital allocation.

Such demonstration shall cover the following criteria.

Coverage: risk-ranking ability shall exist for all material risks within the internal model.

Resolution: differentiation between risks is sufficiently precise to allow senior management to take appropriate decisions.

Congruence: the structure of different kinds of risk-ranking reflects the structure of risks or risk categories and the risk management system.

Consistency: similar risks are ranked consistently. Capital allocation is reconciled back to risk-rankings.

Methodological adequacy

Article 121.2/CEIOPS Doc 48/09: 5.101-5.103

A managing agent must provide evidence that the actuarial and statistical methods used are adequate. Demonstration of adequacy may be based on the following criteria.

Applicable: a managing agent must have the necessary resources (people, technology, etc) to implement, test and maintain the methods chosen.

Relevant: a managing agent must choose methods such that the internal model and its results can act as aids to risk management, particularly from a decision-making perspective.

Appropriate: a managing agent must choose methods that are suitable to the modelling goals and accurately reflect the syndicate's risk profile. Any shortcomings in the methods must be recognised and accounted for.

Transparent: the methodology should reveal the logical connection between inputs and outputs, i.e. not a "black box".

Up to date: the methodology must be based on the best evidence available at the time the model is built, taking into account subsequent developments and trends. The methodology must be reviewed at least annually and, when necessary, modified or replaced.

Detailed and parsimonious: the methodology used must result in a model structure that is as simple as possible, while still capturing all essential characteristics. The methods must allow for the essential and necessary level of detail. There is a balance between the inclusion of additional characteristics and the need to keep the model manageable, interpretable and evidence-based. .

Robust and sensitive: the methods used shall be suited to the internal model, enabling it to provide results that are stable and at the same time indicate changing conditions in the surrounding world.

In assessing the adequacy of techniques, managing agents and Lloyd's shall have regard to the principle of proportionality.

Managing agents shall ensure that the assumptions and methods used are consistent between internal models for all managed syndicates.

Methodological consistency

Article 121.2/CEIOPS Doc 48/09: 5.104-5.108

A managing agent must:

- Be able to demonstrate that the methods used to calculate the probability distribution forecast are consistent with those used to calculate technical provisions. This requirement extends to other areas where valuations or models are used.

- To this end, the agent must identify and document any differences in actuarial and statistical techniques used and the underlying assumptions made.

- In checking consistency, special attention should be given to key assumptions underlying the internal model and to its parameterisation.

- Explain, justify and document all deviations concerning methodology and assumptions.

- Develop and document its own criteria for consistency between the internal model and the calculation of technical provisions. Any deviations identified must be assessed for materiality qualitatively and, if possible and proportionate, quantitatively.

In judging levels of consistency, Lloyd's will take due account of the principle of proportionality.

Methodological credibility

(Article 121.2/CEIOPS Doc 48/09: 5.109-5.114)

A managing agent must:

- Demonstrate that the methods it uses to calculate the probability distribution forecast are based on up-to-date and credible information.

- Regularly review the data, assumptions and methods underlying it model, to ensure they remain credible, make appropriate use of available information and reflect the latest developments and trends in internal modelling.

- Update data used in the model in line with model usage. Any other data which may affect the methodological basis of the model and information on model assumptions should be collected in line with the model validation process.

- Demonstrate that it keeps track of recent progress in the development of methods and takes these insights into account in the assessment.

- Provide evidence that the information basis underlying the methodology of the internal model is credible, based on appropriate criteria, which may include:

    o Consistency: there are no internal contradictions.

    o Objectivity: a sufficiently large set of information sources is used, characterised by a high degree of independence form the undertaking. Known exclusions are suitably justified.

    o Competence: the source and provider of the information are qualified and its quality is verified.

    o Transparency: the process of generating, processing and providing the information is well-documented, and any ambiguities in it are known.

Issues arising from the validation process that cast doubt on the adequacy of the model should normally lead to a review of its methodology.

Assumptions

Article 121.2/CEIOPS Doc 48/09: 5.115-5.118

A managing agent must:

- Identify all assumptions inherent to the internal model.

- Be able, at any time, to explain and justify in detail those assumptions to Lloyd's, taking account of all the following factors:

    o their significance;

    o how they limit the model, whether in terms of application or performance;

    o their implications for model risk, i.e. deviations between the model and reality;

    o possible alternative assumptions and their implications.

- Assess the materiality of assumptions chosen and possible alternatives. This requires a qualitative assessment. In line with the proportionality principle and where practicable and reasonable, an agent must conduct a quantitative assessment in addition.

- Document all internal model assumptions, their justifications and the corresponding procedure.

Data directory

Note: the data requirements for technical provisions apply, where applicable, to internal model data in addition to these requirements. See under "Technical Provisions".

Article 121.3/CEIOPS Doc 48/09: 5.174-5.176

Scope of data quality standards

Data quality standards apply to all data used to operate, validate and develop the internal model, including external data.

A managing agent must compile a data directory, specifying source, characteristics and usage.

Data policy

Note: the data requirements for technical provisions apply, where applicable, to internal model data in addition to these requirements. See under "Technical Provisions".

Article 121.3/CEIOPS Doc 48/09: 5.177-5.187

Interpretation and specification of the data quality criteria

The data used by a managing agent for its internal model must be accurate, complete and appropriate (Article 121.3):

"Accurate" refers to the degree of confidence that can be placed in the data. Data must be sufficiently accurate to avoid material distortion of the model output.

"Complete" means that databases provide comprehensive information.

"Appropriate" means that data does not contain biases which make it unfit for purpose.

Data quality control/monitoring

A managing agent must develop its own concept of data quality, starting from its interpretation of the terms "accurate", "complete" and "appropriate" and consistent with the basic interpretations given. Qualitative and/or quantitative criteria should be set for all data sets which, if satisfied, qualify them for being used in the internal model. These criteria are not necessarily the same for all data sets.

A managing agent must demonstrate that data used to operate, validate and develop its internal model is accurate, complete and appropriate. To this end, it must perform regular data quality checks.

A managing agent must establish a data policy, setting out its requirements on data quality and data update. This policy is subject to agreement with Lloyd's, and any major changes to it require prior approval from Lloyd's.

Accuracy, completeness and appropriateness must be demonstrated against these criteria:.

- data used is free from material mistakes, errors and omissions (accuracy);
- data is to a large degree consistent in time such that the model output refers to a well-defined point in time (accuracy);
- it has at its disposal comprehensive data for all business lines under consideration and, where possible, all relevant model variables (completeness);
- no relevant data available is excluded from consideration without justification (completeness);
- the granularity of data is sufficient to allow for adequate actuarial and statistical techniques to be used (appropriateness);
- data used is relevant to its business and the portfolio of risks being analysed (appropriateness);
- data used for prediction exercises is a good guide to the future (appropriateness).

Data update

Data updates must be related to the frequency of model use, but all data needs to be updated at least annually. In stressed circumstances, more frequent updates will be required.

The SCR should be updated promptly following any material change in risk profile, in order to ensure that it remains appropriate. This does not necessarily require a run of the full internal model.

Data and expert judgement

A managing agent must document all instances in which data quality may be compromised as well as the implications. The agent must address the interrelationship between data and expert judgement and it may use expert judgment to complement or substitute the data. Such judgment must be reconciled with any relevant data.

Where expert judgment applied in respect of data deficiencies has a material impact, its use must be well-founded and is admissible only if its derivation and usage follows a scientific method, as defined below:

- The expert judgment must be falsifiable, i.e. circumstances under which the expert judgment would be considered false can be clearly defined even though they may only be realised at a point in time far in the future.

- The expert judgment must be able to make transparent the uncertainty surrounding the judgment, e.g. by providing the context of the judgment, its scope, basis and limitations.

- Standards concerning the operation of the methodology used must exist and be maintained.

- The expert judgment must be documented. In particular, a track record of the expert judgments used must be available.

- The expert judgment must be validated. Validation may include assessing the track record of expert judgments to assess reliability; challenging the expert judgment using scrutiny from other experts; comparing the expert judgment with existing and emerging data.

Data policy

A managing agent's data policy must cover at least the following areas:

- The agent's specification of what it means by "data quality" and the standards it applies in judging data quality.

- Detailed descriptions of the processes used to validate data quality and actions to be taken should data fail those checks.

- The methodology followed to validate expert judgment, especially in the event that data quality is poor.

- Detailed descriptions of the processes in place for the update of data, with particular focus on data used to calculate the probability distribution forecast

  Standards for the frequency of regular data updates, the circumstances in which unscheduled intermediate updates will be made and the timeliness of any such unscheduled updates.

  The circumstances in which a data update does not automatically lead to a full or partial re-run of the model.

  The process specifications should include a precise description of the various methodologies in use, the determination of responsibilities and the frequency of application.

Dependencies

Article 121.5/CEIOPS Doc 48/09: 5.252-5.257

Determination of risk categories

A managing agent must determine its own risk categorisation for each managed syndicate, but must ensure that similar risks are categorised together and ensuring consistency with the attribution of profits and losses.

Adequate system for measuring diversification effects

A managing agent must do the following, as a minimum, to demonstrate an adequate system for recognising and measuring diversification effects:

- identify the key variables driving dependencies;

- provide support for the existence of diversification effects;

- justify the assumptions underlying the modelling of dependencies;

- take into particular consideration extreme scenarios and tail dependencies;

- test the robustness of this system on a regular basis; and

- actively take account of diversification effects in making business decisions.

Internal models must be constructed at syndicate level. No credit can be taken for diversification effects with other syndicates or with non-Lloyd's entities within a group.

Aggregation of distributions with only key points known

The aggregation and modelling of diversification effects of risks for which only some key points of the distribution are known is particularly challenging.

The aggregation mechanism will usually rely heavily on expert judgment or circumstantial evidence because the data necessary to support data driven parameterisation will not exist. Assumptions and parameters underlying the aggregation mechanism will be subject to particular scrutiny by Lloyd's, who will expect the resulting model uncertainty to be compensated by higher validation standards. These may include sensitivity analysis, stress testing and references to findings from scientific or other credible sources. Managing agents shall provide Lloyd's with a detailed description of the methodology used in these additional measures.

The scarcity of information available may make it challenging to demonstrate that the aggregation mechanism is in compliance with the requirements of Articles 120 to 126. In such cases, the managing agent may have to take additional measures to ensure that it is still equivalent to a 99.5% VaR over one year.

Risk mitigation techniques

Directive Article 121.6

Insurance and reinsurance undertakings may take full account of the effect of risk mitigation techniques in their internal model, as long as credit risk and other risks arising from the use of risk mitigation techniques are properly reflected in the internal model.

Application of proposed level 2 requirements to Lloyd's managing agents

Article 121.6/CEIOPS Doc 48/09: 5.273-5.275

A managing agent may take full account of the effects of risk mitigation techniques (e.g. reinsurance, hedging) if their inclusion in the internal model reflects the following criteria:

Economic form over legal form, i.e. they deliver a demonstrable transfer of economic risk.

They are legally effective and enforceable in the relevant jurisdictions and are adequately documented.

They are liquid and can be valued under both normal and stressed conditions. They meet documented liquidity requirements under both normal and stressed conditions. They are capable of liquidation (or retention) in the event of counterparty default. They are not double-counted;

Associated secondary risks (e.g. credit risk, concentration risk, basis risk, legal risk, operational risk), and the interactions between them, are identified, documented and included in the internal model.

They provide a direct claim on the protection provider and the extent of cover is explicitly referenced to specific exposures or a pool of exposures. To the extent that the protection is not irrevocable or unconditional, this should be reflected in the model or, if not possible, the risk mitigation technique should be excluded from the model.

Exposure is assessed at both the gross level and net of the effects of risk mitigation techniques.

Where risk mitigation techniques are used to justify a reduction in the SCR, they must demonstrably reduce risk at 99.5% VaR over one year.

Equivalent requirements apply whether or not the protection provider is independent from the syndicate or is part of the same group

Financial guarantees and contractual options

Article 121.7/CEIOPS Doc 48/09: 5.273-5.275

A managing agent must identify, collect and model the risk of all relevant financial guarantees and contract options and understand the special features they possess. It should be able to demonstrate that its internal model takes account of these features appropriately, with expert judgment appropriately corroborated.

Such analysis must take account of the impact of future changes in pertinent financial and non-financial conditions.

The assessment of risks from guarantees and options must be consistent with the methods used to calculate technical provisions in the context of Solvency II.

Non-contractual payments

Article 121.9/CEIOPS Doc 48/09: 5.305-5.306

Payments to policyholders and beneficiaries

The internal model must take account of all payments expected to be made by a syndicate, whether contractually guaranteed or not.

This must be done in a manner consistent with the calculation of best estimate technical provisions.

Future management actions

Article 121.8/CEIOPS Doc 48/09: 5.294-5.302

Definition of future management actions

Future management actions may be linked to any decision which the managing agent has the right to make. The syndicate internal model should allow for the currently anticipated exercise or implementation behaviour in respect of any such rights of decision.

Risk mitigation techniques that are currently in place are clearly not future management actions and are to be treated solely in accordance with the standards set out in Article 121(6) on risk mitigation techniques. Risk mitigation actions that are not yet in place (e.g. the following year's reinsurance programme) are classified as future management actions and their treatment in the internal model must comply with the corresponding requirements, over and above the requirements specific to risk mitigation techniques.

Reflection in the model

Modelling of future management actions in the syndicate internal model must take account of conditions beyond the managing agent's control. Examples include liquidity and the willingness of counterparties to trade.

Where practicable, the materiality of future management actions should be quantified by calculating their impact on the SCR.

Process and governance frameworks must be set up in respect of future management actions. Planned actions should be subject to approval by the managing agent's board, as should their implementation and any significant deviations from them.

Significant deviations from planned future management actions must be reported to Lloyd's, along with details of the reasons for the deviation and its consequences for the syndicate's SCR. Such deviations may be deemed inconsistent with the Use Test and/or may lead to the imposition of a capital add-on.

Previous deviations from planned management actions will be considered by Lloyd's in deciding whether to approve a new or changed set of future management actions.

Treatment of future management actions in the internal model must be consistent with the methods used to calculate technical provisions.

Assumptions for future management actions in the internal model must be objective, realistic and verifiable.

STATISTICAL QUALITY STANDARDS

Statistical quality standards are, by their nature, a very technical subject and managing agents will be required to document and evidence more than they may currently do to satisfy the standards expected by Article 121.

Probability distribution forecast

The Level 2 advice states that the probability distribution forecast should refer, amongst other things, to a quantity of monetary value such as profits and losses.

The SCR should be calibrated so that it corresponds to the value-at-risk of the basic own funds subject to a confidence level of 99.5% over a one-year period. The probability distribution used should allow for calculation of the SCR under this calibration requirement. As such, it requires consistency with the movement in the Solvency II balance sheet position over the next 12 months (further information on this is given in the section on calibration standards).

The advice does not state that a stochastic model must be used, and in theory a stress and scenario test approach can be applied for some risks. However, many requirements may become significantly more difficult under an internal model that does not produce a full probability distribution (such as profit & loss attribution) and agents should also be aware that the LIM is likely to require various points on the distribution. In addition the advice suggests that additional validation is required where the internal model generates fewer data points than a full probability distribution forecast.

The definition of the probability distribution forecast must also enable the profit & loss attribution test to be met.

Calculation methodology and assumptions

Sufficient information must be provided by the managing agents for Lloyds to review the calculation methodology and assumptions in detail. This should cover the calculation kernel, external models and any other material calculations which are within the scope of the internal model e.g. stress tests for operational risk events.

To ensure the model meets full Solvency II standards, managing agents must ensure that information is provided about the calculations within each of the risk categories of the internal model, as defined by the agent. These risk categories do not necessarily need to correspond to the modules of the standard SCR formula, but must cover all risks referred to in Article 101 (note that CEIOPS DOC 50/09 proposes that, for the purposes of reporting and disclosure, reported risk categories should be based, to the extent possible, on the categories defined by the level 1 text).

In addition, Lloyd's internal model is likely to require that syndicate models are able to output capital requirements by the standard formula risk types. All other elements of the calculation methodology and assumptions, even if outside the main calculation kernel, must also be sufficiently documented.

Methodological adequacy

The existing ICA guidance includes various methodological areas which should be described and this guidance is not repeated here. However, agents should provide detailed commentary on all areas including the following:

- approach for modelling losses over a 12 month horizon in line with the calibration standards of Solvency II
- granularity of risk modelling
- insurance claims, including both premium and reserve risk
- treatment of exposure and business volumes
- rating variability
- treatment of reinsurance and associated credit risk
- correlation, diversification and dependency structures
- risk margin calculation

- currency risk

- discounting

The onus is on managing agents to demonstrate the methods used are based upon current and credible information, and to this end regular methodological reviews are required. Managing agents must also demonstrate that they have a process for keeping abreast of progress in modelling techniques and approaches. This requirement could be captured by the validation exercise.

Methodological consistency and credibility

Agents must have in place a process by which the consistency of methodologies and assumptions can be verified (in particular with respect to business plans and the technical provision calculation process). This process must highlight the areas where there are inconsistencies and should ensure that these are justified and their impact detailed. This process should also review the methodology to ensure credibility is maintained.

Assumptions

Assumptions must be identified, fully documented and justified. The source of the assumptions and the process behind their derivation and justification relative to other possible alternatives should be recorded. For each assumption a full audit trail as to how it was arrived at should be available on request.

Managing agents should also clearly distinguish between a model assumption or parameter and a regular data update.

Lloyds expects the use of many assumptions to involve a degree of expert judgement. The extent to which judgement has been applied should be made clear along with the underlying rationale. Standards applying to the use of expert judgement should be followed, and the expert judgement used should be adequately documented. Further details are set out in the following section.

Managing agents should also identify those model assumptions which are particularly sensitive and critical to the overall SCR figure, and the associated documentation should be commensurate with the impact of the model parameter.

Any output from validation should be taken into account in reviewing the methodologies and assumptions used.

Data & expert judgment

Data is a key issue under Solvency II. The Directive description of the data used as part of the internal model is that it "shall be accurate, complete and appropriate".

Whilst Solvency II requirements are detailed, they are not in principle different to current requirements under the ICAS regime. For all insurance undertakings, the Solvency II directive will, however, require a new level of rigour with respect to evidencing. Within the risk management and actuarial functions, the level of audit, external review and disclosure become more akin to that of the reserving and financial reporting processes. This additional rigour will spill out to other functions closely related to and feeding into the risk management and actuarial functions. Though these requirements have always been implicit within the ICA, they have now been more explicitly stated.

Lloyd's is aware of the challenges that it faces with regards to data. London Market data is subject to the following common features:

- data scarcity due to inherently volatile business including large risk losses and catastrophe exposures

- data scarcity due to non-homogenous products and niche markets where risks are fundamentally difficult to benchmark against the past or indeed market information

- challenging data capture and reporting due to legacy underwriting systems, and difficulties associated with automating data processing for a wide range of insurance products.

Lloyd's will engage with agents over the pre-application process to ensure that the issues above are being addressed to work towards meeting Solvency II model standards and LIM approval. Consideration of proportionality is key to a number of these issues. Agents will need to satisfy themselves as to the suitability of their data standards with regards to the principles of proportionality. Lloyd's will then ensure that there is consistency between agents and proportionality is applied fairly.

Expert judgement

Lloyd's is the world's leading specialist insurance market. This necessarily means that the risks around the business written within Lloyd's are specialist and complex in nature. These inherent features of the business naturally lead to the use of and reliance on expert judgement. Expert judgement employed by all manner of professionals within the Lloyd's market has become a key feature of the way that Lloyd's manages its risk through underwriting, reserving and capital provisioning.

Whilst it is not possible for the Lloyd's market to move away from this dependence, Solvency II requires that expert judgement be better substantiated. Expert judgement relates to any decision that affects the selection of data, parameters or methodology within the internal model. That judgement may be exercised at numerous points in the journey from original data source to the final internal model input, but will nonetheless be considered within the remit of expert judgment.

Expert judgement should only be used where uncertainty exists. When expert judgement is used, if possible, it should be used with statistical techniques to minimise the risks highlighted below. In some cases, where credible statistical techniques cannot be used, expert judgement alone may drive decisions e.g. tail dependence assumption between two new lines of business. Where expert judgement alone has driven a material assumption, there will be a greater need to review and to validate the decision making process.

Managing agents will need to consider carefully the additional risks that arise when relying on expert judgement (e.g. conscious or subconscious biases in estimates). Care needs to be taken to minimise these risks when using expert judgement to calibrate or validate the internal model.

Expert judgement should be evidenced where it forms part of the internal model. Managing agents need not document each and every piece of judgement. The selection of the level and scope of documentation should consider proportionality and materiality. Examples of ways to document expert judgement could include:

- name of expert
- date of opinion
- what expert opinion is being used
- reason why expert judgement is required in this particular instance
- rationale for the opinion itself (e.g. the stress test backing a particular view of risk)
- comment on any potential conflicts of interest that may arise from the use of this expert judgement
- review by an independent third party
- back-testing of the historic expert opinion in this class and from this particular expert.
- where expert opinion is contradicted by otherwise applied standard statistical techniques, the judgement should be documented further to explain the deviation.

This list is not intended to be prescriptive; it is intended to give examples of what might be appropriate.

This process should reduce the risks around the use of expert judgement, but will never completely remove them.

Data Policy and Data Directory

The data policy and data directory are two key documents that should meet a number of the data requirements outlined within the latest Solvency II text and some guidance is included below as to what these documents may look like. This guidance is not intended to be prescriptive but instead provides an example of what could be done.

The minimum requirement for the data directory and data policy is to cover the internal model however so defined. It is the choice of the agency to define the internal model, and the degree to which data standards are applied outside the internal model.

However, managing agents should note that CP80 (paragraph 5.16) implies that the data *policy* should be extended to cover the wider flow of data that feeds the internal model, including source systems and databases. For example, a data policy could specify the requirements that data processes outside the internal model need to meet in order to feed that data into the internal model.

Where the internal model does not include technical provisions, a separate document on data policy for technical provisions would in principle also be required. Lloyds expects agents to consider whether it may be appropriate to prepare a separate policy for different applications of the data or to create an overarching data policy.

Data Policy

A data policy document should outline at a high level the overall intent of the data within the managing agent. The policy itself does not need to include too much low level detail provided that the processes which the agent has in place for checking and validating data quality are documented elsewhere in detail.

It would, for example, be reasonable for a managing agent to have one data policy over a number of syndicates so long as the features and issues pertaining to that data were relatively similar.

Example Data Policy Format

Proposed section header	Example fields
Title page	With Managing Agent / Syndicate name
Approval record & document history	Document owner, author, date, version number
	Person(s) approving the Policy, date, version
	Version history, changes made, date, author
Table of contents	Summary of all headings and sub headings with applicable page number
Purpose and scope of the Policy	Why the Policy is needed and its desired outcome
	What is in scope of the data policy
Executive summary	Background (explain the need for the Policy)
	Business objectives for the Policy
	Policy ownership
	Key stakeholders, signatories and period for Policy review
	Communicating key uncertainty
Terminology	Interpretation of the following terms to managing agent:
	Materiality
	Consistency
	Proportionality
	Accurate, complete, appropriate
Ownership & controls	Data ownership
	Data controls / checks
Policy maintenance	Policy update process & frequency
Expert judgement	Definition of expert judgement
	Overall view on reliance on expert judgement
	Details of who has authority to act in the capacity of an expert, and where the expert judgement can be applied
	Details of independent review process
Data quality and deficiency	Data quality management
	o Data quality criteria to be applied (including accuracy, completeness

	and appropriateness)
	o Details of data limitations
	o Data thresholds
	o Roles and responsibilities
	o Details of data audit processes
	Detailed processes for monitoring and validating data quality
	o Data deficiency process
	o Roles and responsibilities
	Detailed process for application to external data
Data update processes	Data update frequency standards
	o For regular data updates
	o For unscheduled data updates
	Details of process for recording and auditing data updates and adjustments
Evidencing	Methodology for the validation of data
	Guidance on appropriateness of validation test
Appendices	Appendix 1
	Appendix 2 etc

Data Owners

It is unlikely that managing agents will be able to achieve and sustain acceptable levels of data quality without formal accountability for data quality. To this end one solution is that responsibility for the quality of specific data items and data sets should be assigned to specific "Data Owners". A Data Owner should be someone who understands the meaning and daily uses of the data, and should be someone with sufficient authority to be able to ensure adequate quality procedures and processes are implemented and followed.

Data Directory

A complete data directory must be compiled, specifying source, characteristics and usage. It is a specific requirement of Solvency II.

The "Undertaking shall compile a directory of any data used to **operate**, **validate** and **develop** their internal model. The undertaking shall compile a **directory of any data used**, specifying its **source**, **characteristics** and **usage**"

The directory should be used to help demonstrate other Solvency II requirements, including but not limited to:

- the consistency of data through clear definitions of data sets (no internal contradictions)
- Identifying data sets for focussed demonstration of complete, accurate and appropriate data
- data transparency

Using and producing the data directory should help agents understand the uses and hence the materiality of each data item to the final modelling process and result. This should help ensure that efforts in relation to data cleansing are focussed on areas where the most material benefits can be gained. Such a directory should also help agents to understand where data is updated or adjusted using judgement.

The lineage of data is an important concept in demonstrating an understanding of data within the agency. Data directories may include details of this lineage to explain fully the journey that data goes through from the original data entry through to use in the internal model. Each managing agent will decide the most appropriate format for the data directory depending on its specific requirements. The following are all possibilities: relational database, flowcharts, spreadsheets, word-processed documents.

With regards to the data journey, it would be reasonable to draw a dividing line between data up to and including a data warehouse, and data used after that point through to use in the internal model. The distinction between the two is the former should be factual with little by way of judgement or interpretation. The latter is subject to these adjustments. Major system / data flows from source databases into the internal model should be understood and documented as part of the overall internal model documentation.

Managing agents may or may not choose to include the former piece in the data directory itself. Notwithstanding this, the data warehouse would however still be subject to Solvency II data requirements on documentation and it cannot be assumed that data within the data warehouse is exempt from data validation.

Below summarises the possible template column headings for a managing agent's Data Directory divided into the required elements outlined below.

Source	Data Origin: Where the data originated from e.g. broker, assured.
	Data Storage: Where is the data stored e.g. data warehouse.
	Data Owner: The Owner of the Data (this may change at varying stages of data use/transformation).
Characteristics	Granularity of the data e.g. line of business level, by year of account, currency
	Data Type: what form the data is in e.g. frequency, severity.
	Currency of data: what currency to store data in, and relevant exchange rates to apply.
	Data Quality Standard
	Data Quality Judgement / Comment: Commentary on quality of the data set i.e. completeness, accuracy, appropriateness.
	Materiality: A comment of how material is that data set in relation to the total model output e.g. significant driver of the SCR.
Usage	Risk Type: What risk type is this data used to quantify / validate / develop e.g. Insurance Risk.
	Model Area: More granular use of data e.g. Gross Underwriting Losses.
	Data Usage: What is the data used for in relation to the internal model i.e. operate, validate or develop

Further Evidencing

Once a Data Policy and Data Directory are in place, there should be further documentation working through the detail of how data has been adjusted, parameters selected and methodologies chosen.

Data quality criteria

The table below highlights some potential issues that might arise when assessing the adherence of data to the data quality requirements as laid out in the data policy. This would be aided by a review of data quality within the business as a point of comparison. It also highlights the ways to redress any deficiency.

Data quality measures	Materiality / Proportionality
	Do data checks / reconciliations work
	All reconciling items need to be understood
	Number of data points available and assessment of statistical credibility
	Are data quality issues due to internal or external factors? What can be done about it?
	How appropriate is the data for a specific purpose and to what level is expert

	judgement required to support its use in the model development, parameterisation or validation process?
	Where else within a group might data be used, and how appropriate is it for these uses?
Data quality adherence	Whether shortcomings still make it acceptable to use the data and why
	Quality of the data in question needs to be outlined with regard to its accuracy, completeness and appropriateness.
	Comparison of this quality against quality required in data policy.
	Consideration of whether the difference is material with regard to proportionality.
Redress	Details of remedial action required e.g. time frame, testing, owner
	What is the issue and can it be addressed?
	Improvement of front end user systems with data validation, peer review
	Application of proportionality and materiality
	Use of alternative data e.g. Benchmark data or external data

Data validation

The table below highlights some potential methods that might be used to validate data inputs whether internal or external, and validation outputs, including parameters and distributions.

Reasonableness checks	Comparison to benchmark data or market data
	Comparison to alternative model results
	Comparison to expectation given expert judgment
	Reference to any academic research done
	Output reviewed by experienced user
	Consistency with related information (e.g. for large loss assumptions, what are the expected losses to the reinsurance program and how do these compare with ceded premium)
Back testing results	Compare Actual versus Expected
	Compare historical results to as-if actual
Change analysis	Compare and explain differences between the two outputs in question
Stress and scenario testing	Illustrations of different scenarios give comfort as to the potential range of the results and the materiality of the assumptions
Independent expert judgement	An independent expert opinion could be used to provide insight into the issue.
Statistical tests	QQ Plots of percentiles of distribution of actual data and fitted points
	Sensitivity analysis of parameters or model results
	Goodness of Fit tests – Simulated vs Actual
	Confidence Intervals

It is not anticipated that all or even any of the above will be appropriate in every circumstance. The list is intended to give examples of validation methods that may be used in different circumstances.

Adjustments to data

In considering the appropriate use of data there are instances where data needs to be adjusted. Where data is adjusted, this should be documented. In particular, data is likely to be adjusted as part of the internal modelling process by way of making historical data appropriate for prospective use.

Some possible reasons for this are:

- past or future management action affecting the portfolio
- allowance for past and expected future trends
- changes in terms and conditions of business written
- changes in the legal environment
- changes in inuring reinsurances

Where data is adjusted for use in model development, parameterisation or validation the documentation should include the details of the adjustments made and the reasoning behind them. For example:

- what data has been included / excluded and why?
- what adjustments have been made for trend, line size etc. and the reasoning behind these.

The extent of the application of the proportionality and materiality principles should be covered.

Risk ranking

The Directive requires firms to use their internal model to 'rank risk'. This comprises the qualitative and particularly, quantitative assessments of the relative importance of different risk drivers within or across risk categories. Guidance around the level 2 text states that this should enable undertakings to distinguish "good risks" from "bad risks". It is the comparability that is important, not absolute amounts assigned to risks.

The exact approach for risk ranking is not made clear and it is up to firms to form their own view as to how this requirement should be met. However, Lloyds would expect risk ranking to be performed at various levels, for example:

- major risk category (e.g. premium risk, reserve risk, market risk, credit risk etc)
- business unit
- class of business or product (and possibly at a currency level)
- operational risk events

One option is to start from the major risk category and consider the underlying core risk drivers. For example, for underwriting it should be possible to rank by class of business, for market risk rank by asset type and credit risk rank by reinsurer or perhaps reinsurance programme.

A number of approaches could be employed to rank risk, and Lloyds recommends that more than one method is applied. This could include:

- capital allocation approach (a wide variety of methods can be applied)
- rank according to standard deviation / variance
- rank according to the stand-alone 99.5th percentile VaR or TVaR position (or other percentile)

Agents may find it helpful to consider risk in terms of quantum of total exposure, but also in terms of the risk per unit of exposure.

For risk ranking to have real benefit and act as a model 'use', the results should be advised to management and be incorporated within the syndicate's wider risk assessment process. The results of risk ranking should be used to influence management decisions and/or generate discussions around the model output along with possible refinement to the model parameters.

Recognition of diversification effects and dependencies

The minimum requirements in the level 2 advice for justification of diversification effects are particularly stretching and managing agents should ensure they provide comprehensive documentation in this area.

Agents should be prepared to provide detailed and explicit information on the impact of diversification within the model if Lloyds requests this level of evidence. It is likely that agents may be required to provide explanation why diversification credit within their internal model is materially different from that implied by the standard formula, possibly including a discussion around correlation parameters and dependency structures.

Agents will need to evidence the process they have in place to identify, quantify and review the dependencies within their business and those assumed within their internal model. This may take the form of periodic calculations of dependencies seen in historic data, assessment of possible dependencies by persons with relevant experience and use of market data or expert judgement.

The dependencies within the internal model, and the reasons for the selections made, must be documented. These, together with the resulting diversification effects (both within and between risk categories) should be validated carefully against the results of the processes in place to identify, quantify and review dependences.

Use of benchmark portfolios is likely to be particularly helpful for Lloyd's to understand the diversification effects of the dependencies built into the internal model.

Recognition of risk mitigation

The primary source of risk mitigation is likely to be reinsurance although other mitigation activities such as derivative hedging are also included.

With regard to reinsurance, managing agents should demonstrate that the reinsurance contracts fully provide the protection that the internal model assumes. Areas to consider should include:

- reinsurance dispute and default
- policy deductibles and excess points
- reinsurance coverage (e.g. exclusions and geographical coverage)
- willingness to pay
- loose policy wording
- basis risk (e.g. for Industry Loss Warranties)
- matching of coverage (e.g. risks attaching versus losses occurring terms)
- currency mismatch between reinsurance terms and the underlying risk
- horizontal and vertical exhaustion; reinstatement provisions

Agents should consider modifying their internal models to reflect potential shortcomings of reinsurance protection and/or including an allowance within their operational risk assessment.

Financial guarantees and contractual options

Managing agents are unlikely to have extensive use of financial guarantees and contractual options but portfolios should be examined to understand and document the findings.

Assessment of the risks of financial guarantees must be consistent with the treatment applied in the calculation of technical provisions. In particular, reinstatement premiums are specifically mentioned as non-financial guarantees. Non-financial guarantees should be treated like financial guarantees, where relevant.

Future management actions

Future management actions might include:

- withdrawal of cover or changes in policy conditions (e.g. for war business)
- future purchase of reinsurance

The materiality of future management actions should be assessed and the impact on the SCR calculated.

The future purchase of reinsurance may pose a particular problem for agents who assume that reinsurance will be bought in line with the business plan. The managing agent needs to evidence that the Board is involved in the review and approval of the anticipated reinsurance programme for the next year. The anticipated reinsurance programme is likely to have inception dates at various times of the year (for example 1st of January, 1st of April) and there is the risk that in the event of a catastrophe the planned reinsurance programme may not be placed or placed at a higher cost.

Payments to policyholders and beneficiaries

Lloyds believes this requirement is largely in relation to life assurance business but managing agents should review all expected payments to policyholders and ensure the treatment of them in the internal model is consistent with that in the technical provisions.