GIRO conference and exhibition 2010
Paul Hewett and Steven Loyens

Reality of the Use Test
A Reality of the Use Test…
Interpreting and communicating results

Agenda

• Introduction
• Interpreting and judging model results
• Communicating the results
Introduction
The use test

Key principle

• “The undertaking’s use of the internal model shall be sufficiently material to result in pressure to improve the quality of the internal model”
For this workshop

• **Principle 1:** Senior management, including the administrative or management body, shall be able to **demonstrate understanding** of the internal model

• **Principle 6:** The internal model shall be used to **support and verify decision-making** in the undertaking

• **Principle 7:** The SCR shall be calculated at least annually from a full run of the internal model, and also when there is a significant change to the undertaking’s risk profile, assumptions underlying the model and / or the methodology arising from decisions or business model changes, **and whenever a recalculation is necessary to provide up to date information for decision-making or any other use of the model, or to fulfil supervisory reporting requirements**
Introduction
How can we use the model?

Specific strategic decisions
• Reinsurance purchasing
• Investment allocation
• Capital allocation
• M&A activity

Day-to-day updates
• Revisions to business plan
• Development of an individual risk
• Changes in wider economic or market conditions
Introduction
How do we use the model?

It is important to have:

• Quick turnaround
• Results we understand
• Clear communication
• Results which are free from mistakes

Which requires:

• Model to be designed with use in mind
• A clear, straightforward process
• Flexible, prepared team
Introduction
How do we use the model?

It is important to have:
• Quick turnaround
• Results we understand
• Clear communication
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Which requires:
• Model to be designed with use in mind
• A clear, straightforward process
• Flexible, prepared team
A Reality of the Use Test…
Interpreting and judging model results

Learn throughout the model process
• As part of the main update cycle
  – Model checks
  – Understanding the model
  – Judging the results
• For specific updates
Interpreting and judging model results
Model checks

The average
• Ensure that the average is consistent with the business plan
• Need to look wider than profit / loss ratio
• And not just the total

Helps detect
• General errors in the entering of assumptions
• Model errors or peculiarities
Interpreting and judging model results
Model checks

Key percentiles and correlations
• For key variables – what you get out is consistent with what you put in, useful in a complex model
• Key results can be communicated as part of the internal review
• Check correlations to pick up impact of causal linkages

Helps detect
• General errors in the entering of key assumptions
• Model errors or peculiarities
• Inconsistencies in the understanding of assumptions
Interpreting and judging model results

Model checks

The extreme

- Look at simulations in the extreme tails

Helps detect

- Large errors impacting only a small proportion of the simulations
- Model not responding appropriately in extreme conditions
Interpreting and judging model results
Model checks

**Gross vs net**

- Look at the implied reinsurance performance
- And the distribution of this

Helps detect

- Errors made in entering reinsurance details
- Errors made in entering claims assumptions
- Assumptions inconsistent with reinsurance pricing
Interpreting and judging model results
Model understanding

Sensitivities and scenarios
• Vary parameters in the model and record change in results
• Sensitivities should be realistic
• Also test representative scenarios
• Should not be mechanical

Useful for
• Establishing importance (or otherwise) of areas of the model
• Performing “dry runs” on possible decision areas
Interpreting and judging model results
Model understanding

Collar simulations

- Sort the simulations by capital requirement
- Select a group of simulations around the risk level
- For key indicators calculate the difference between the average over those simulations and the average over all simulations

Useful for
- Identifying the key drivers of the capital requirement

Caution
- Can create too narrow a focus
Interpreting and judging model results
Collar simulations – narrow focus

- Property
- Liability
- Market
Interpreting and judging model results
Collar simulations – narrow focus

- Property
- Liability
- Market
Interpreting and judging model results
As part of the main cycle

As part of the main cycle

• Model checks
  – Average
  – Key percentiles and correlations
  – Extremes
  – Gross vs Net

• Understanding the model
  – Collar simulations
  – Sensitivities and scenarios

• Judging the results
Interpreting and judging model results
For specific updates

Danger of concentrating on the capital

- If results do not match preconceptions
  - Mistake
  - Inappropriate model
  - Preconceptions are wrong
- If results match preconceptions?

We need a procedure to ensure the result is valid
Interpreting and judging model results
For specific updates

The process needs to be
• Be capable of identifying key issues
• Quick
• Easy to interpret
• Easy to communicate
• Transferable
• Suitable for all circumstances
Interpreting and judging model results
Component analysis

Suggested methodology

• Breakdown the profit and loss into component causes
• For each, standalone, calculate the “stress” - the difference between:
  – the expected value
  – the 99.5\textsuperscript{th} percentile (or other percentile)
• Check the correlations between the key components
• Create a standard schedule of the stresses
• Track how these change with new runs
Interpreting and judging model results
Component analysis

Simple illustration

• Company writing liability business
• Focus on claims and reserve risk only, so 4 components
  – Attritional claims
  – Large claims
  – Reserve run-off
  – Disputed claim
• Looking over a one-year time horizon
• Only Individual XOL reinsurance
Component analysis
Example

Attritional claims

£10 million
Component analysis

Example

Large claims £11 million
Component analysis
Example

Historic reserves

£18 million
Component analysis

Example

Disputed claim

£5 million
Component analysis

Example

Total claims

£28 million
Component analysis
Example

Underwriting profit

£28 million
Component analysis

Example

Key correlation – Attritional and Reserves

50% correlation
## Component analysis

### Example

**Base components**

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attritional</td>
<td>10</td>
</tr>
<tr>
<td>Large</td>
<td>11</td>
</tr>
<tr>
<td>Reserves</td>
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<tr>
<td>Dispute</td>
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<tr>
<td><strong>Total claims</strong></td>
<td><strong>28</strong></td>
</tr>
<tr>
<td>Profit</td>
<td>5</td>
</tr>
<tr>
<td>Capital</td>
<td>23</td>
</tr>
</tbody>
</table>

- **20%**
- **50% correlation**

- Total difference from mean
- Expected profit
- Total loss = capital over 1 yr
# Component analysis Example

## Scenario 1: Resolution of disputed claim

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attritional</td>
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<tr>
<td>Large</td>
<td>11</td>
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<tr>
<td>Reserves</td>
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<tr>
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<td>Total claims</td>
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<td>Profit</td>
<td>5</td>
</tr>
<tr>
<td>Capital</td>
<td>23</td>
</tr>
</tbody>
</table>

Disputed claim has now been settled, albeit for 1 million worse than expected.

But at least the risk has been removed from the book…
## Component analysis

### Example

### Resolution of disputed claim

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Value</th>
<th>Scenario</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>Profit</td>
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</tr>
<tr>
<td>Capital</td>
<td>23</td>
<td>23</td>
</tr>
</tbody>
</table>
Component analysis
Example

Scenario 2: Growth in earned exposure

<table>
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<tr>
<th>Component</th>
<th>Base Value</th>
</tr>
</thead>
<tbody>
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<td>Dispute</td>
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<td>Total claims</td>
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<td>Profit</td>
<td>5</td>
</tr>
<tr>
<td>Capital</td>
<td>23</td>
</tr>
</tbody>
</table>

Volumes of business being written has increased significantly, we now expect to earn an extra 30% in the year.

What does this mean for our capital position, do we need to act?
### Component analysis Example

#### Adding 30% earned exposure

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Value</th>
<th>Scenario</th>
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</thead>
<tbody>
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<tr>
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<td>23</td>
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</table>
## Component analysis Example

### Adding 30% earned exposure

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Value</th>
<th>Scenario</th>
<th>Or…</th>
</tr>
</thead>
<tbody>
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<td>Capital</td>
<td>23</td>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>
Interpreting and judging model results
Component analysis

Advantages of this analysis

• Quick and transferable
• Standardised
• Easy to interpret and communicate
• Easy for multiple people to review
• Can form the core of model change analysis
  – Senior management review
  – Regulatory communication
• Assist with other Model Tests
### Component analysis
**Profit and Loss Attribution**

**After the year**

<table>
<thead>
<tr>
<th>Component</th>
<th>Stress</th>
<th>Result</th>
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<tr>
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<td>(5)</td>
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<td>Reserves</td>
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<td>(3)</td>
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<tr>
<td>Dispute</td>
<td>5</td>
<td>(1)</td>
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<tr>
<td><strong>Total claims</strong></td>
<td><strong>28</strong></td>
<td><strong>(7)</strong></td>
</tr>
<tr>
<td>Profit</td>
<td>5</td>
<td>(2)</td>
</tr>
<tr>
<td>Capital</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>
Interpreting and judging model results
Component analysis

Considerations

• What to group?
  – Same component across correlated lines
  – Small components on the same line
  – Shared reinsurance
  – Possibly 2-teir analysis
• Incorporating exposure and rate volatility
  – Requires standardisation
• Expanding over multiple years
Interpreting and judging model results

Conclusion

What we need to consider

• Preparation is key
  – Design the required outputs into the model
  – Learn and understand throughout the process
  – Important to document this knowledge

• Develop the process
  – Train multiple people
  – Develop standardised structures
Communicating the results
Overview

• MI requirements are ever-changing
• Current Management Requirements
• Use Test Foundation Principle
• Impact on Decisions
• Showing Results
• Quick Validation & Audit Trail
• Parameter update: Automated check and log
• Model update: Automated check and log
• Reporting example
MI requirements are ever-changing
Current Management Requirements

1. Result is valid
2. Show different options
3. Help with important decisions
4. Explain result in understandable terms
5. Explain limitations of analysis
Use Test Foundation Principle

- “The undertaking’s use of the internal model shall be sufficiently material to result in **pressure to improve** the **quality** of the internal model”

- **Source**: Level 2 Implementing Measures on Solvency II: Articles 120 to 126 – Tests and Standards for Internal Model Approval (former CP 56), 3.14 p19

- Highlighting **limitations** is key
- But, need to prove model quality to management
  - ⇒ **Quick Validation & Audit Trail**
Impact on Decisions

Parameters
- Completeness
- Accuracy
- Relevance

Model
- Reliability
- Limitations

Result

Actuarial Team
- Technical skills
- Communication skills

Governance

Impact on Decision

Explanation
Showing Results

- Risk – return relationship
- Define risk
  - VaR
  - TVaR
  - Downsize Risk
  - Standard Deviation
- Define Return
- Return on Capital
  - SCR
  - Economic Capital (ORSA)
  - Rating Agencies Capital
## Capital Measure

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Base</th>
<th>Strategy</th>
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<td>99.9</td>
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</tbody>
</table>

#### Capital Requirements

A graph showing the capital requirements for different percentiles, with two lines representing 'Base' and 'Strategy'. The graph illustrates the trend and comparison between the two strategies across various percentiles.
Quick Validation & Audit Trail

- **Model**
  - Confirm model name & seed
  - Show base capital (before update)
  - Show model structure updated correctly
- **Parameters**
  - Show that what should have changed has changed
  - Show that what shouldn’t have changed hasn’t
  - List key assumptions and sensitivity
- **Governance**
  - Regular Validation Reports increase reliability
Parameter update: Automated check and log

- Automated comparison of values in 2 ranges in Excel.
- Automated text format report showing:
  - Audit trail (model, range, date etc)
  - Changes (which cell has changed from what into what)
  - All the comparisons made (for completeness)
- Helps with audit
  - Ranges can be of different size – allows for additions and deletions between 2 versions
  - Changes are documented automatically
## Example for Reinsurance Input Template

**Microsoft Excel - CompareRangesviaVBA.xls**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<th>J</th>
<th>K</th>
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<td>Date:</td>
<td>20Sep10</td>
<td>Include in report:</td>
<td>Updated values only</td>
<td>Compare all Ranges &amp; Create Report</td>
<td>File old version</td>
<td>Path: S:\Risk Officer\Capital Modelling 2009\Input Templates\Name: InputTemplate_Reinsurance.xlsm</td>
<td>File new version</td>
<td>Path: S:\Risk Officer\Capital Modelling 2009\Input Templates\Name: InputTemplate_Reinsurance.xlsm</td>
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</tbody>
</table>
Parameter Update: Change Report

Ranges Compared: 19Sep10.txt - Notepad

<table>
<thead>
<tr>
<th>Date</th>
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<tr>
<td>19/09/2010</td>
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</tr>
<tr>
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<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell d5 was changed from 1645450 to 2568512 to 0</td>
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<tr>
<td>19/09/2010</td>
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<td>Tab XOL, cell f6 was changed from USD to GBP</td>
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<td>19/09/2010</td>
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<td>Tab XOL, cell g21 was changed from 200000 to 5000</td>
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<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell j26 was changed from 0.5 to 0.20</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell k19 was changed from 2000000 to 200000000</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell l20 was changed from 0.20 to 0.20</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell m26 was changed from 1 to 1.5</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell n26 was changed from 1 to 0.9</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL, cell o52 was changed from 0.20 to 1</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>of new file InputTemplate_Reinsurance_TestCopy.xls vs InputTemplate_Reinsurance.xls</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Comparison of ranges = XOL Coverage'!$S4:$BA$103 and =XOL Coverage'!$S4:$BA$103</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Ranges in files: s:\Risk Officer\Capital Modelling 2009\Input Templates\InputTemplate_Reinsurance.xls</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Overview of the changes</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL Coverage, cell b3 was changed from 0 to LL_S_PLEUR</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>Tab XOL Coverage, cell c9 was changed from LL_S_Terrorism EUR to</td>
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<td>19/09/2010</td>
<td>18:28:08</td>
<td>End of comparison of ranges = XOL Coverage'!$S4:$BA$103 and =XOL Coverage'!$S4:$BA$103</td>
</tr>
<tr>
<td>19/09/2010</td>
<td>18:28:08</td>
<td>of new file InputTemplate_Reinsurance_TestCopy.xls vs InputTemplate_Reinsurance.xls</td>
</tr>
</tbody>
</table>
Model update: Automated check and log

Text format report is created while model is being updated:
- Audit trail (model, date, VBA process etc)
- Helps with audit & documentation
  - Update process documented in detail
  - Error checks built in and logged
Model Update: Change Report
Reporting example

Applying a new Reinsurance structure

Strategy Description

New XOL treaty was added placed with a single BB rated reinsurer
This treaty is shared between the Company and the Syndicate

Limitations

Model risks
Parameter risk
Proxy: shared reinsurance was modelled by adjusting the company and syndicate large loss FREQUENCY based on estimated exposure (GNEP)

Result section

<table>
<thead>
<tr>
<th>SCR</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td>n/a</td>
</tr>
<tr>
<td>ROC</td>
<td>n/a</td>
</tr>
<tr>
<td>Econ Capital</td>
<td>130</td>
</tr>
</tbody>
</table>

Notes

Preference based on Economic Capital differs from preference based on SCR
Credit risk in tail to be reduced by choosing a better-rated reinsurer
Strategy results in extra cost. Therefore ROC measure is not applicable

Validation section

<table>
<thead>
<tr>
<th>Validation section</th>
</tr>
</thead>
<tbody>
<tr>
<td>base Model</td>
</tr>
<tr>
<td>Seed</td>
</tr>
<tr>
<td>base SCR</td>
</tr>
<tr>
<td>base Economic Capital</td>
</tr>
</tbody>
</table>

Prove unchanged

<table>
<thead>
<tr>
<th>Prove unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP 105</td>
</tr>
<tr>
<td>GOL 75</td>
</tr>
<tr>
<td>(others)</td>
</tr>
</tbody>
</table>

Prove model update

<table>
<thead>
<tr>
<th>Prove model update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link to log: RangesCompared_18Sep10.txt</td>
</tr>
</tbody>
</table>

Explanation

SCR decreases: the new treaty gives better protection at the 1/200 year level without significant credit risk
Economic capital increases: in extremis the BB reinsurer defaults on the recoveries increasing capital requirements

Sensitivity section

| Key Assumptions | SCR levels | Change in key assumption | |
|-----------------|------------|--------------------------|
| Large loss frequency | 87        | -10%                     |
| Frequency correlation | 84       | -5%                      |
| Large loss severity | 89       | 5%                       |

| Economic Capital levels | Key Assumptions | Change in key assumption | |
|-------------------------|-----------------|--------------------------|
| Large loss frequency    | 125             | -10%                     |
| Frequency correlation   | 120             | -5%                      |
| Large loss severity     | 129             | 5%                       |

| Key Assumptions | S&P Capital levels | Change in key assumption | |
|-----------------|--------------------|--------------------------|
| Large loss frequency | n/a         | -10%                     |
| Frequency correlation | n/a       | -5%                      |
| Large loss severity | n/a        | 5%                       |
Conclusion

• For management to make informed decisions
  – Highlight limitations
  – Quick Validation & Audit Trail
• Requirements will change regularly
Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.
The views expressed in this presentation are those of the presenter.