

REPORT FROM THE ACTUARIAL PROCESSES AND CONTROLS BEST PRACTICE WORKING PARTY – LIFE INSURANCE

Members

Richard Care, Richard Budden, Matthew Cocke, David Ford,
Ian Harley, John Heenan, David Hobbs, Anthony Lee,
Mark McCarthy, Sanjeev Pujari, Dominic Veney, Nick Watkins

Contents

1	Executive Summary	2
2	Introduction	3
3	The Wider Controls Framework	7
4	Overall Process – interaction and hand-offs	10
5	Project management	12
6	System / Model Changes	15
7	Assumption Setting	26
8	Policy Data	33
9	Model Set-up and Running	41
10	Output / Consolidation of Results	45
11	Analysis and Checking of Results	52
12	Reporting	56
13	Documentation and Evidencing	61
14	End User Applications	63

1 Executive Summary

The topic of controls has been a regular area of debate in recent times. This report aims to discuss this topic within the context of life insurance actuarial work. However the principles can equally apply to other areas of actuarial work.

The report provides an initial overview of the topic of controls within the actuarial process. Following this we breakdown the typical actuarial calculation process, from assumption setting, to running the models, through to reviewing the final results. Each actuarial process is then broken down further into its smaller elements to allow the risks at each stage to be discussed and suitable controls to be identified.

The report also covers wider areas that are related to the actuarial calculation process such as project management, documentation and end user applications.

This report is written so that each section of the process is substantially self standing. Taking this approach hopefully means that readers can pick up the report and dip directly into the sections that are of particular interest to them without the need to read the whole document.

As a working group we discussed the potential downside that this approach would lead to some potential repetition in the individual sections. On balance we felt this was the lesser of two evils and hope that readers also do.

We hope that the report is useful to actuaries as both an overview to the topic of actuarial processes and controls in addition to being a reference guide on the specific risks and potential controls.

2 Introduction

2.1 Aims of the Working Party

The aim of the working party has been to take a risk based approach to the topic of life insurance actuarial processes and controls. An extract from the terms of reference of the working party is given below:

- Highlight the key risks associated with the production of actuarial reported figures.
- Consider how these key risks might vary between different life companies and lines of business. The specific issues for smaller companies will be considered.
- Consider whether best practice from other disciplines e.g. accounting, I.T can be applied to the actuarial function to further enhance the control framework.
- Capture key best practice controls which mitigate these risks
- Consider the appropriate level of documentation of controls and the ongoing monitoring and improvement that should be undertaken
- Consider the efficiency of the controls, i.e. the risk versus the cost of implementation.

There are two key points that should be highlighted from the above scope. Firstly, we are very aware of the fact that whilst one set of controls are appropriate for one company they may not be appropriate for another. Secondly, actuaries may not have all the answers. To address the first point we would recommend individuals use this report as a tool kit which can be tailored to their specific needs.

In relation to the second point the working party membership is made up of representatives from a range of different insurance companies both large and small and not exclusively actuaries. In addition, we have also sought the input and advice of individuals working in other areas such as accountancy and IT. As a result, it is hoped that the report will be an effective tool for the majority of actuarial functions.

2.2 The approach taken by the working party

As a working party the approach that has been adopted is below:

- Segment the actuarial reporting / calculation process
- Analyse each sub-process for its inherent risks

- Identify factors which impact on those risks rather than rate these risks directly as each firm will be different
- Document controls that mitigate those risks
- Classify controls as preventative or detective
- Classify controls as High / Medium / Low effectiveness

Preventative Controls are those that work towards stopping the risk event happening in the first place. Detective Controls are those that let you know that a risk event has actually happened thus allowing you to correct an error or issue as required.

As the report developed, the working party attempted to classify the inherent risks in the processes as high, medium or low. However, it became apparent that the risks would vary in their significance from one firm to another. As a result, the working party took the approach of identifying factors that impact on the significance of the risk, i.e. the characteristics of a firm or its processes which may make the risk more or less significant.

By taking this approach, we have hoped to address one of the working party's aims on considering how risks and therefore appropriate controls are different between different life companies and lines of business and particularly issues faced by smaller firms.

Another aim was to consider the efficiency of the controls against their potential cost of implementation. The first of these has been achieved by classify all controls as preventative or detective and providing a High / Medium / Low effectiveness categorisation. The second, i.e. the cost of implementation, has been discussed within the group and it was decided that the actual costs will potentially vary significantly from one firm to the next and therefore it was inappropriate to be too prescriptive on the costs (it would also be potentially skewed to the experiences of the working party members). Therefore, no detailed information has been included in this report.

In order to demonstrate the approach, below is an example of the risk and control matrix table that is used throughout the main body of the report.

<u>Step x: Sub Process 1</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
x.1	Risk 1	<ul style="list-style-type: none"> • Factor 1 affecting size of risk • Factor 2 affecting size of risk • 	<ul style="list-style-type: none"> • Preventative Control a (Effectiveness of Control H, M L) • Preventative Control b (Effectiveness of Control H, M L) • 	<ul style="list-style-type: none"> • Detective Control x (Effectiveness of Control H, M L) • Detective Control y (Effectiveness of Control H, M L) •

2.3 So why worry?

There has recently been a significant amount of focus on internal controls around financial reporting e.g. the Sarbanes Oxley Act (SOX) and FSA communications on the topic. Audit teams, both internal and external, are increasing focussing on controls to gain comfort with the underlying results they are reviewing. In addition, the draft requirements for internal model validation under Solvency II highlight the need for robust actuarial processes and controls. In summary, the actuarial functions of life insurers are being increasingly required to demonstrate sound control frameworks, both in terms of design and operation.

On a more immediate and practical level, there is an opportunity for firms to reduce the risk of errors and the associated damage this would cause. These include the cost of putting things right, incorrect or sub-optimal decisions being made by the business as a result of incorrect financial figures or analysis and the potential reputation risk, especially in relation to incorrect market disclosure. A well controlled process could potentially be used as an argument for a reduced capital requirement for Operational Risk as part of a firm's ICA. Fewer restatements will also lead to an improvement in the reputation of the actuarial function across the business and lead to an increase in influence of the profession.

Having a robust controls framework could reduce the need and costs associated with review work and potentially even reduce internal and external audit costs.

2.4 Best Practice

What are best practice controls is difficult to completely define. This is because the choice of controls will depend on many factors that vary between companies, geographical / economic / regulatory or administrative environments, for example:

- What is considered best practice in other major markets outside the UK (e.g. EU, USA, Asia) may differ in some respects. Differences may arise from different regulatory regimes, culture and historical development.
- FSA rules and regulations place the minimum standards on statutory reporting in the UK. International reporting standards place the minimum standards on other reporting requirements. Compliance with the minimum FSA rules and regulations is considered best practice.

Furthermore, over time, systems and processes evolve e.g. as new technology and new ideas emerge. Individuals and companies are constantly seeking ways to become more effective in a competitive world. Hence what may be considered best practice is dynamic and constantly evolving.

Notwithstanding these issues, we believe there are benefits in developing a report/guide on controls best practice. It provides reference for practising actuaries and encourages the achievement of high minimum standards of work.

2.5 Scope of this paper

This report covers the major processes and controls involved in the delivery of life actuarial services. The content has been developed with UK Life Insurance work in mind and specifically on the actuarial valuation process from system design, data, basis setting, production and analysis of results through to reporting and documentation. Whilst the paper has this focus, the controls are potentially applicable in a wide range of actuarial work.

2.6 and finally ...

As a Working Party we have held many stimulating discussions that have not always reached clear resolution. The views expressed in this paper are those of at least one of the authors, and usually of a majority, and should certainly not be regarded as the views of our employers!

We would like to thank colleagues who commented on drafts of this paper and Audrey Cosens of the Actuarial Profession for her assistance throughout our work. Any errors that remain are our own. We hope that this paper will stimulate a lively discussion.

3 The Wider Controls Framework

3.1 Company risk management and controls

A company should have in place a documented company-wide risk management process. It should identify its key risks and have in place controls to manage those risks. There should be key control indicators (KCIs) and there should be a way to assess whether or not the controls are working. Part of this risk management process would include controls to manage the risk that actuarial processes produce inappropriate or incorrect financial analysis and results.

KCIs surrounding actuarial processes should be monitored and reported on regularly as part of the risk management framework. Improvements should be made where the processes and controls are lacking, or where KCIs are indicating that unacceptable risks are being taken. The company should demonstrate to the reviewers (both internal and external) that the controls are working.

A gap analysis of a company's current practice against best practice set down in this paper could form part of the risk management framework monitoring process.

3.2 Actuarial Processes

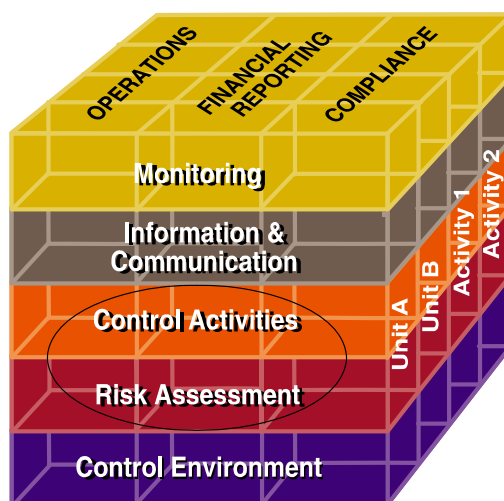
Traditionally actuaries have been seen as managing longevity, persistency and financial risks. However, in order to manage these risks appropriately the actuarial calculation processes and work itself needs to be managed correctly, i.e. the operational risks associated.

These are the risks considered in this report. The actuarial control cycle (identify, manage and feedback) could be applied to help with managing the risks and improving processes to achieve and maintain best practice.

3.3 COSO

A recognized framework was developed by the Committee of Sponsoring Organisations (COSO) of the Treadway Commission. COSO is an integrated framework for a control infrastructure. The diagram below illustrates the framework.

Figure 1. COSO Framework



Below is a summary of the key elements of the framework.

(i) Control Environment

This sets the tone of an organisation, influences the control consciousness of its people and is the foundation for all other components of internal control providing a discipline and structure. Factors include:

- Integrity, ethical values and competence of the firm's people
- Management's philosophy and operating style
- The way management assigns authority and responsibility, and organises and develops its people, and
- The attention and direction provided by the board of directors

(ii) Risk Assessment

This is the identification and analysis of relevant risks to the achievement of the firm's objectives, and the forming a basis for determining how the risks should be managed.

(iii) Control Activities

These are the policies and procedures that help ensure management directives are carried out, help ensure that necessary actions are taken to address risks to the achievement of the firm's objectives, occur throughout the organisation, at all levels and in all functions, and include activities such as approvals and authorisations.

(iv) Information and Communication

This is where the firm captures and communicates pertinent information that makes it possible to run and control the business and produces reports containing operational, financial and compliance related information. It also deals with information concerning external events, activities and conditions necessary to informed business decision-making and external reporting

(v) Monitoring

This process assesses the quality of the control system's performance over time, occurs in the course of operations, and includes regular management and supervisory activities, and other actions personnel take in performing their duties.

3.4 Controls Framework – Actuarial Work

Figure 2 shows a control framework for actuarial work which fits within the overall COSO approach. It is designed to be a continuous process rather than a one-off exercise which is then put on the shelf and forgotten about. A key challenge with ensuring this happens is making it come to life and be part of the actuarial function's normal activities.

It is also potentially valuable to use this structure to obtain clarity on the risk and control environment through documentation of the key steps in an actuarial process. The key is obtaining a balance between it being a paper exercise and making it useable.

By using the reporting and evidencing activities the process has a better chance of being embedded in the function as individuals will be using it on a day to day basis. This combined with the review, potential revision and improvement to controls for next time also helps bring the exercise to life.

Whilst all the steps in the process are important we have focused on the risk assessment and key controls elements of the framework within this report. We have also made comments which relate to the other areas of the COSO framework within the report but not presented detailed outputs on these areas.

Figure 2. Controls Framework – Actuarial Work



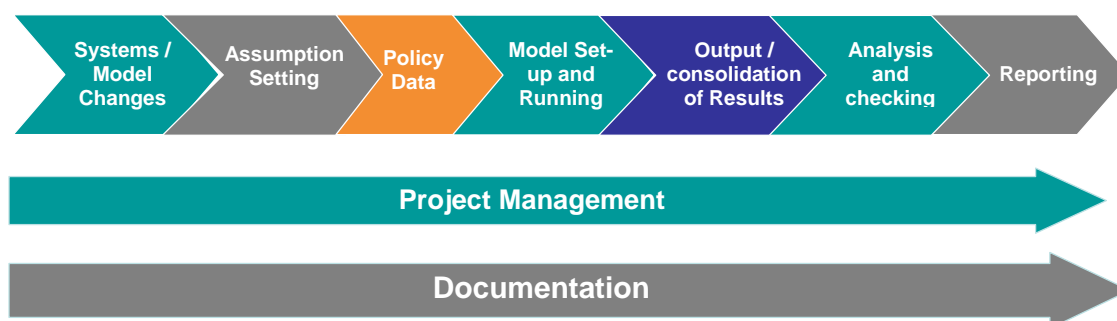
4 Overall Process – interaction and hand-offs between the sub-processes

4.1 Summary

The process of producing, say, technical provisions for the statutory accounts, can be broken down into a number of sub-processes. These sub-processes are often inter-linked. Below is a list of the main sub-processes:

- Assumptions setting
- Policy data
- Model set-up and running
- Output/consolidation of results
- Analysis and checking of results
- Reporting

In addition, before production begins, there may be changes to the actuarial systems / models and these are also covered within this paper. End User Applications/spreadsheets will most likely be developed and used with the actuarial calculation process. The report contains a separate section on this topic because we believe their use brings additional risks that are less inherent when using recognised actuarial modelling software packages. Underpinning all these processes is project management and documentation.



The report has been structured to consider each of these sub-processes. Sections 5 considers project management, Sections 6 to 12 consider the sub-processes shown above from system / models changes through to reporting at the end of the process. Section 13 covers documentation and Section 14 covers end user applications / spreadsheets as these both have risk and control issues common across all the preceding sub-processes.

The format of the paper has been designed such that each sub-process is fairly stand-alone. As some of the risks and therefore controls are the same in multiple sub-processes this does result in a degree of duplication between the sections of this paper. However, as mentioned earlier we felt that this approach was preferred as it allows the reader to read only the particular sections that are of interest to them and see a complete set of risks and controls.

4.2 Key interactions

Communication will be a key part of how the process runs between stages. Sometimes, if errors are found, some if not all stages of the core process will need to be repeated. It will be imperative to keep regular communication between “controllers” responsible for each sub-process. For larger companies where controllers may be in a different department, floor, building, another part of the country or even in another country altogether, a key control is that there is a smooth hand-off from one process to another. Best practice would require a formal sign-off. The degree of formality will clearly depend on the size of the company and the size of the process involved.

It is critical that one person, group or committee takes ownership of the delivery of the whole process from start to finish. This could be a project manager rather than specifically an actuary. This person should ensure that appropriate hand-overs are completed from sub-processes.

4.3 Inputs

Where inputs are required from external third parties, a formal sign-off is likely to form part of Service Level Agreements between the parties concerned. Examples of such third party arrangements would be Economic Scenario Generators, the use of consultants and contractors and investment management.

Another common area where external inputs are required is the policy data from third party administrators. It is particularly important to have clarity around who is responsible for the quality of the deliverable. Not obtaining policy data to the required quality standard is likely to have a critical impact on the total actuarial reporting/calculation process.

Also some firms outsource parts or all of their actuarial processes. For example some firms use external firms for the Actuarial Function Holder role and associated activities or just parts of the process such as experience analysis, model changes or even running the models. Outsourcing part of the process will potentially become more common in the future and having effective controls around these processes will be critical.

In addition to external inputs we should not forget internal inputs and hand-offs in the process between different areas within the organisation. For example, between business units actuarial and group actuarial teams or between internal investment management and the actuarial function.

5 Project management

5.1 Introduction

Project management underpins the whole process from the beginning, i.e. before the process activity starts with planning, through the actual activity via management of the deliverables right through to the very end via the post project review.

- Controls will be improved if failures within the processes are recorded and solved. This would form part of the post project review.
- Poor planning will often lead to a reduction in the quality of results. If problems occur during the process, this normally leads to a squeeze at the end of the process affecting the amount of review time available. This may also lead to some controls not being completed.
- Poor planning could lead to failure to meet delivery dates leading to fines and damage to reputation.
- A post project review will lead to an improved understanding of the process and the resource required to complete. It will also help to identify any inefficiencies in the process.
- Poor planning often leads to additional stress leading to poor staff performance, problems with staff motivation and staff retention.

5.2 The key stages and aspects of the project management are outlined below.

- Core Planning Stages
 - Buy-in on planning from all interested parties
 - Agree high level milestones
 - All plans aligned to high level milestones
 - Focus on handoffs between teams
 - Ensure sufficient contingency in plans
 - Sign-offs set up for key stages in process
 - Detailed task-list with individual sign-off for each task
- Management of Deliverables During Process
 - Communication of plan to all
 - Regular meetings to cover high level milestones
 - Offline meetings for specific problems
 - Communication of progress to key stakeholders

- Keep issues log
 - Ensure closure of issues that will affect overall delivery
 - Other issues retained for closure post-results
- Project Review
 - After an actuarial process (e.g. the year end valuation) has been performed, it is important that it is reviewed to determine what went well, what errors arose and where bottlenecks occurred. Such a review would include monitoring and reporting on how well the controls around the process operated. For the maximum benefit to be obtained from the post implementation review, it is important for outcomes of the post implementation review to be fully documented for future reference and use.

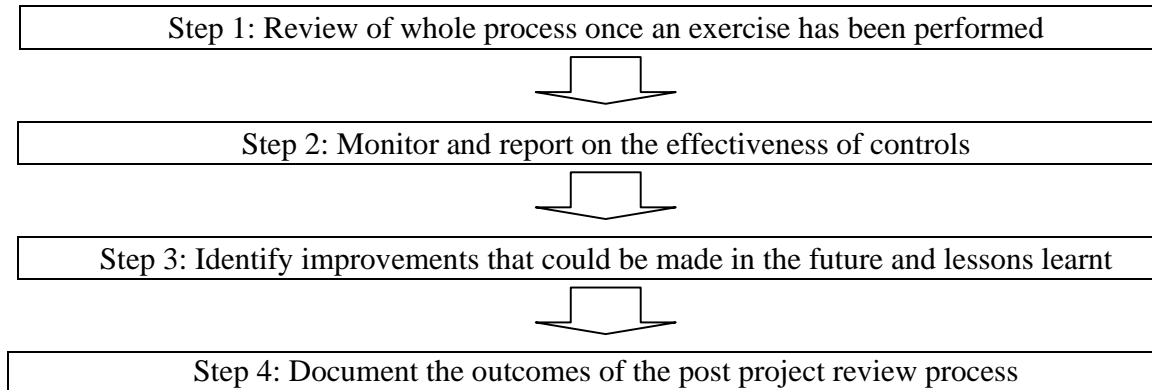
We are aware that there are countless sources of information around on good project management available to actuaries and therefore we have not sought to expand these sections further within this report. However, we felt that the project review process was an area where more information may be useful as it is an area that is often at risk of being neglected in the rush to move onto the next challenge (see Section 5.3 below).

The project manager is critical to the process. As a result the resourcing for this role should be given more consideration and not just given to someone who is already heavily involved in the detail of the process. Another key consideration is often ensuring the reporting timetable is not too detailed. After the results have been produced it is important that a post project review is not left too late so important information is captured before it is forgotten.

5.3 Flowchart

The following flowchart sets out the suggested approach to the post project review of actuarial processes within a life office.

Flow Chart - post project review



Review of whole process once an exercise has been performed – this should be an established part of the company processes rather than an optional extra. In order to ensure this happens it is often important to obtain senior management commitment. A written record would be kept of the outcome.

Monitor and report on the effectiveness of controls – this is an overview of each process and includes a specific review of the controls and their efficiency. Reviewing historic project issues logs is useful here.

Identify improvements that could be made in the future and lessons learnt – this is a suggestion list which should be reviewed before the next time the process is to be carried out. It would normally include known faults and issues carried forward. The list should be given prioritisation and estimated implementation dates before the next time the process is to be carried out. That way it is possible to schedule the improvements and chase up on their delivery. Otherwise there is a risk of starting to plan the next process and finding that none of the improvements have been implemented.

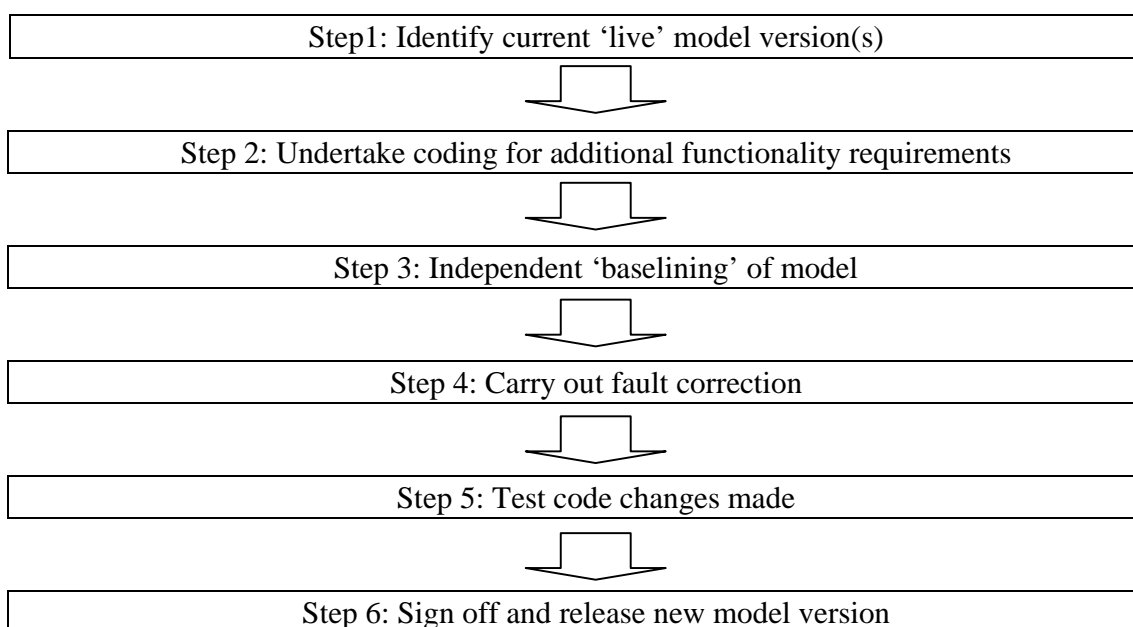
Document the outcomes of the project review process – this is ensuring that the outcomes of the previous steps are documented for future reference and implementation.

6 System / Model Changes

The following flow chart identifies the key steps that would typically be followed before using a model for financial projections. In section 6.2 we describe one of the key generic controls that should be put in place to mitigate a number of risks associated with developing actuarial models.

In section 6.3 the risks associated with each step and the additional controls that could be used to mitigate these risks are described.

6.1 Flow Chart



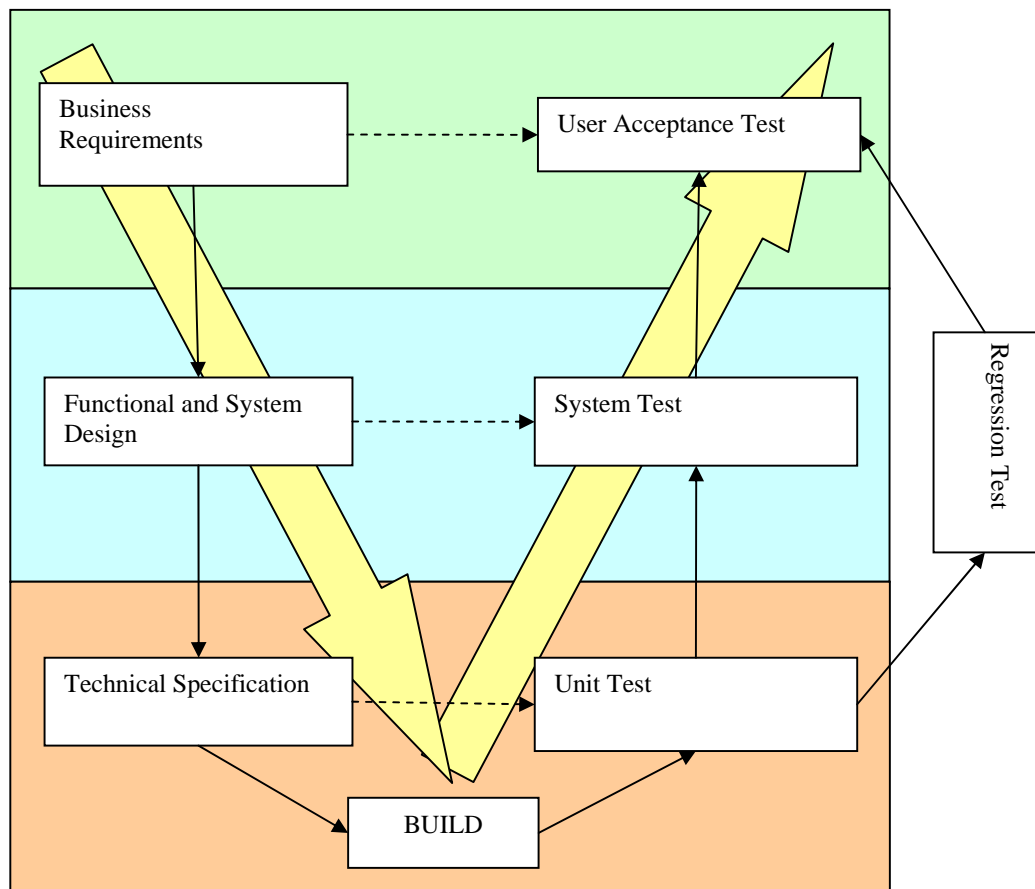
- Identify current 'live' model version – this should be a straightforward exercise provided separate development and production environments exist and there is a clear version control process in operation. Good practice dictates that the current production models are kept in a secure, read only environment with limited access.
- Undertake coding for additional functionality requirements – Any coding changes that are required should be underpinned with a robust 'development life cycle' (see section 6.2). This should include the documentation of Business Requirements, Functional & System Design prior to any actual build work. Coding should follow clearly documented coding standards.
- Independent 'baselining' of model – periodically a certain level of independent testing should be undertaken to ensure the accuracy of the main projection models

being used. The systems used to do this will depend on the main systems in use but could include excel and the use of other projection systems e.g. checking the reserves from a valuation system against those in an EV model. The approach taken could be to ensure over a period of say 2 years 75% of an agreed metric have been independently tested. The metric chosen will depend on use of the model e.g. EEV (use of PVFP), RBS (cost of options and guarantees). The baselining should also include comparison back to policy details to ensure the models capture all significant product features e.g. guarantees.

- Carry out fault correction – at any point in time it is possible that a number of known faults exist with the models and for which ‘end piece’ adjustments have been made to the results. A process should exist to correct these faults in batches based on a materiality assessment that will again depend on the end use to which the model is being put.
- Test code changes made – a key element of any change is the testing undertaken to ensure accuracy of the model. This should be split into different levels of testing (see section 6.2) and will need to reflect the nature of the model i.e. different testing will be required for stochastic models versus deterministic models.
- Sign off and release new model version – Once all testing is complete a new version of the model needs to be released for use and will replace the old version as the ‘live’ model. A formal process should exist to release models with a ‘release pack’. This will detail the key changes made, the materiality of the changes and any existing deficiencies with the model e.g. approximations made in the modelling of certain products or features. This new model should have a clear version number and could for example be set up with an internal number stamp that is output during a run to identify the model version used. The version control process should clearly identify those models that are in development (there may be more than 1), those that are in User Acceptance Testing and those that are Production models to be used for actual reporting.

6.2 Development Life Cycle

As explained earlier one of the key controls when developing and changing models is to have a clear, agreed and documented process. Within this ideally certain segregation of duties should exist i.e. greater risks exist where the same person is involved in specifying, coding and testing a change. There are a number of methodologies that can be used to achieve this. Below we describe the 'V' development methodology. This particular methodology can be adapted in its implementation to reflect the type of model being used, the number of people using it and the degree of rigour that is required e.g. Sarbanes Oxley.



Business Requirements – produced by the customer of the model to detail exactly what is required. This should include any prescribed methodologies e.g. FSA driven reserving requirements.

Functional and System Design – articulates the solution to the requirement in terms of the particular model design and structure. It can be used as source information to code directly i.e. this would require some technical actuarial as well as system knowledge.

Technical Specification – More detailed document showing the actual code to be used. This would only be needed where pure IT resource is used i.e. where the coder has no prior actuarial knowledge.

Unit testing – low level testing of individual lines of code e.g. testing of RB algorithm in isolation.

System testing – a variety of tests are performed ranging from single model point/single scenario to multiple (volume) tests. Depending on the size of the change it may also be desirable to split the tests between modular tests affecting only one element of the model and end to end tests incorporating multiple elements of the model.

Regression testing – regressions tests should be carried out periodically throughout the build and test process to ensure results that shouldn't be impacted by the change are not.

User Acceptance Testing (UAT) – designed to run the new model in 'production' mode to check the high level reasonableness of the model and any changes to inputs and outputs resulting from the change.

As a general rule the greater the number of users and complexity of the model the more segregation is desirable between the different duties. This is represented by the three layers in the diagram above. One final point to note is that the testing should be completed by reference to the equivalent task on the left hand side of the diagram e.g. during UAT the tests are designed to ensure that the requirements have been met by testing against the requirement document itself.

Section 6.3 now goes on to consider the detailed risks and controls (on top of the development life cycle) that need to be considered when developing actuarial models.

6.3 Risk & Controls

Step 1: Identify current 'live' model version(s)				
	Risks	Risk factors	Preventative Controls	Detective Controls
1.1	Incorrect model used	<ul style="list-style-type: none"> • Number of different production models in use e.g. separate models for valuation/EV or Peak 1 /Peak 2 • Number of model users • Degree of physical separation of I.T environments e.g. segregated development and production environment • Number of versions of the same model on the network 	<ul style="list-style-type: none"> • Use a write protected area of the network to store all current production versions of the model. Have a separate area for development/old versions with restricted user access (H) • Maintain and publish as part of a model release process a list of current model versions and their use (M) • Reduce the number of different users e.g. have single team running all the production models (L) • Reduce number of different model versions (of the same system) being used for different purposes e.g. have one model for all uses (M) 	<ul style="list-style-type: none"> • Add the version number as a control check when checking model output (H) • Reconciliation of results to previous versions of the model (M)

Step 2: Undertake coding for additional functionality requirements				
	Risks	Risk factors	Preventative Controls	Detective Controls
2.1	Requirements poorly understood/misstated and design incorrectly implemented	<ul style="list-style-type: none"> Complexity of the change required. This could be driven by complex Co. structures or technically complex methodologies e.g. projecting RBS or ICA Extent of the segregation of duties i.e. if the same person writes the requirement as does the design the risk is increased that these are aligned but incorrect Inadequate review and sign off 	<ul style="list-style-type: none"> Implementation of an agreed development methodology e.g. as described in section 6.2 (H) Involve technical experts from other areas to review and input e.g. when building a corporate tax model make sure the tax team have had sufficient input and review (M) Set up teams so that segregation of duties can be implemented. If this is not possible ensure that several different people are involved in the specifications and sign off (M) All documents reviewed and formally signed off by senior experienced resource (M) 	<ul style="list-style-type: none"> Back testing of the models will help identify where results do not match with reality. This can show where a particular model is either too approximate or is not modelling a real feature of the business correctly. This can help to identify when the requirement is incorrect even if the coding has been done consistently with the requirement (M)
2.2	Coding incorrectly executed	<ul style="list-style-type: none"> see step 4.1 for more detail 		

Step 3: Independent 'baselining' of model				
	Risks	Risk factors	Preventative Controls	Detective Controls
3.1	No independent testing carried out/deemed necessary	<ul style="list-style-type: none"> Complexity of the model both in terms of numbers of different products but also features e.g. where options and guarantees exist independent testing against spreadsheets may be very difficult without building another parallel model which defeats the object of the testing Legacy elements of the model e.g. old products may not be well understood and documentation poor. This makes it difficult to know that the model should actually be doing Number of different systems in use e.g. MoSes, Prophet, VIP etc. The more different systems in use the more time consuming this is and therefore more likely it isn't carried out 	<ul style="list-style-type: none"> Develop approximations to make independent testing easier e.g. spreadsheet calculation of closed form to test reasonableness of options and guarantee costs (H) Implement appropriate senior governance to ensure visibility and funding for these type of checks (M) Maintain a log of products independently tested. This ensures that over many years previous testing is not wasted as people move on (L) On a regular basis using agreed metrics assess the changing materiality of different lines of business. This ensures that if a previously untested line of business becomes important it is picked up and identified (H) 	<ul style="list-style-type: none"> Test different systems against each other e.g. if different systems are used for peak 1 valuation and calculation of EV the 2 models can be compared to provide an ongoing check on each other. Also perform check against pricing models where these are independent (H)

Step 3: Independent 'baselining' of model				
	Risks	Risk factors	Preventative Controls	Detective Controls
3.2	Product features or reinsurance treaties not identified and therefore not modelled	<ul style="list-style-type: none"> Complexity of product mix e.g. how many unusual guarantees and options exist Age of portfolio. The older this is the greater the risk that product features are not well understood Number and complexity of reinsurance treaties in existence, including addenda 	<ul style="list-style-type: none"> Carry out periodic reviews of models against product literature/documentation/reinsurance (H) Rationalisation of business where possible to reduce the number of different product types and therefore features (L) Maintain a log of products reviewed with dates and make this visible within actuarial (M) 	<ul style="list-style-type: none"> Back testing of actuarial models against accounts. This can identify unusual actual payments being made that aren't actually predicted within the model (M)
3.3	Portfolio coverage too low	<ul style="list-style-type: none"> Number of different product types making model maintenance more time consuming Number of different models and systems in use. Where multiple systems/versions exist modelling the same products, keeping the product coverage up across all models becomes more difficult 	<ul style="list-style-type: none"> Early engagement with marketing areas when new products are launched to ensure likely materiality of sales is understood and system development can be planned (L) Rationalise and reduce number of different models being used (M) 	<ul style="list-style-type: none"> Production of regular MI detailing the model coverage for each model using a number of different metrics (M) Discussion with end users of the information to understand how many off model adjustments are made to the results and why (H)

<u>Step 4: Carry out fault correction</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
4.1	Coding change implemented incorrectly	<ul style="list-style-type: none"> • Number of faults being corrected at the same time e.g. some may interact and produce unexpected results • Complexity of the model and functionality being changed e.g. corporate tax changes more difficult to correct than product expenses • Complexity of the organisation the model is representing • Type of model e.g. stochastic models generally more difficult to correct than deterministic ones 	<ul style="list-style-type: none"> • Involve coder in sign off of the functional & system design to ensure that they understand what the change is, how it impacts the design of the model and dependencies (M) • Use a set of coding standards to ensure consistency of approach where more than one coder is working on the model (L) • For all code changes ensure visual inspection review of change by another experienced coder (M) 	<ul style="list-style-type: none"> • Ensure rigorous testing standards are followed. See step 5 (H)
4.2	Issue or problem misunderstood	<ul style="list-style-type: none"> • Competency and skill level of the person analysing the detail of the change required 	<ul style="list-style-type: none"> • As above 	<ul style="list-style-type: none"> • As above

<u>Step 5: Test code changes made</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
5.1	Testing inadequately carried out	<ul style="list-style-type: none"> • Complexity of the change being carried out • Complexity of the model i.e. stochastic v deterministic model • Reporting time constraints • Number of changes being carried out simultaneously 	<ul style="list-style-type: none"> • Document and agree standard testing approach. This should include a 'test pack' of standard data, assumptions and metrics to compare to previous releases of the model. The metrics will depend on what the model is used for but could include: statutory reserves, PVFP, revenue accounts, NBV, cost of guarantees etc. (H) • Write & sign off test plan before commencing the testing incorporating acceptance criteria. This ensures completeness of the testing and provides a defined end to the testing (H) • Organise the testing in stages so that non interacting changes can be batched together (M) • When testing a stochastic model a range of tests need to be run from single scenario (bad, good and best estimate) all the way up full scenario set. It is also useful to use a cut down set of scenarios using fitting techniques to facilitate analysis and shorter run times during testing (M) • Review and sign off of all key results by experienced actuary (H) 	<ul style="list-style-type: none"> • Ongoing regression testing may pick up errors after initial development. (H)

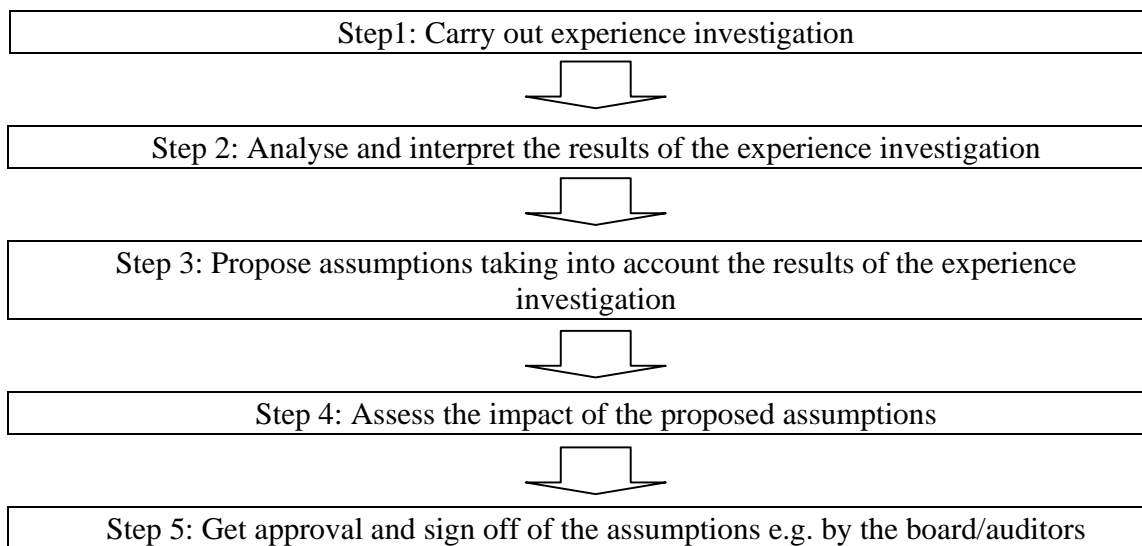
<u>Step 6: Sign off & release new model version</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
6.1	Wrong model version released	<ul style="list-style-type: none"> Number of models/versions in use 	<ul style="list-style-type: none"> Multiple levels of sign-off, i.e. more than one individual involved (H) 	<ul style="list-style-type: none"> Dry-run model prior to “live” use (H)

7 Assumption Setting

7.1 Introduction

The following flow chart identifies the key steps that would typically be followed when setting the assumptions. The assumptions can be split into economic and non-economic items. There are also standard assumptions and non standard assumptions. The non standard assumptions tend to be in the form of manual adjustments.

7.2 Assumptions setting flow chart



Step1: Carry out experience investigation – For standard non-economic items such as mortality and persistency, this involves investigation of the company experience in the recent past, assuming there is sufficient data to get credible results. For economic items, this may involve looking at the movement in the value of relevant indices. The experience investigation for non-standard items e.g. endowment mis-selling provision will also involve looking at recent experience such as pattern of claims and payouts.

Step 2: Analyse and interpret the results of the experience investigation – This involves splitting the results into subcomponents; the results may be split by e.g. cause and geographical location. Averages over the recent past may be computed

and the results may be compared with prior year values. A check may be made to see if there are trends. An attempt may be made to explain any unusual experience.

Step 3: Propose assumptions taking into account the results of the experience investigation – based on an analysis of the experience and interpretation of the results of the experience, a best estimate basis will be proposed. It is important that all areas of actuarial agree the best estimate assumptions to ensure consistency across the company when these results are used for different purposes.

Propose assumptions for each reporting purpose, e.g. regulatory reporting, pricing, internal management reporting – this will include the consideration of a margin or adjustment to the best estimate assumptions agreed above.

Step 4: Assess the impact of the proposed assumptions – Calculations are done to assess the impact of changing the assumptions. This may involve running a copy of the production model and making assumptions changes in a way similar to what would actually happen in production. The impact of changing each assumption in turn will be calculated.

Document the assumptions and the relevant experience investigations – The experience investigation and assumptions will be documented in line with the company standards and guidance.

Step 5: Get approval and sign off the assumptions – The assumptions will be brought for approval, typically by the company board. The approval should be sought and should be obtained before the assumptions are used.

Risks and controls that need to be considered when setting the assumptions are considered in Section 7.3 below.

7.3 Risk & Controls

<u>Step 1: Carry out experience investigation</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
1.1	Inconsistent methodology across groups	<ul style="list-style-type: none"> Complexity of the business 	<ul style="list-style-type: none"> Document methodology (M) 	<ul style="list-style-type: none"> Regular external reviews of methodology (M)

<u>Step 2: Analyse and interpret the results of the experience investigation</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
2.1	Results not correctly analysed / wrong interpretation of the results	<ul style="list-style-type: none"> Complexity of the assumptions is affected by company structure, type of basis (deterministic or stochastic) and item of basis. Qualification and experience of the individual Degree of review and sign off 	<ul style="list-style-type: none"> Agree and document method and approach to use for analysing the results (H) There should be independent review of all the work carried out. (H) All work reviewed and formally signed off by senior experienced resource (H) Involve the marketing department in the interpretation of the results (M) 	<ul style="list-style-type: none"> Compare the results with the work done by other departments e.g. high volume of claims will mean claims department would have been very busy. (M) Compare the results of the current year with the results of previous years. (M) Compare the results with those of peers in the market (M). Provide an explanation of the results (H).
2.2	High level or too low level analysis undertaken	<ul style="list-style-type: none"> Knowledge and experience of individual 	<ul style="list-style-type: none"> Review by a senior resource (H) 	
2.3	Materiality not properly taken into account	<ul style="list-style-type: none"> Knowledge and experience of individual 	<ul style="list-style-type: none"> Set materiality guidelines (M). 	
2.4	Seasonality of experience	<ul style="list-style-type: none"> Time period over which results analysed Class of business Decrement analysed 	<ul style="list-style-type: none"> Analyse results over a suitably long period (M) 	<ul style="list-style-type: none"> Analyse trends (M) Compare with the results of peers in the market (M)

<u>Step 3: Propose assumptions taking into account the results of the experience investigation</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.1	Assumptions do not reflect the actual experience i.e. basis not appropriate	<ul style="list-style-type: none"> • There is no methodical link between the results of the experience investigation and the assumption setting • Prudence in the assumptions • Market pressure - basis may be set to be in line with the assumptions used by other companies in the market 	<ul style="list-style-type: none"> • Assumptions should be justified in relation to actual experience (H) • Margins in the assumptions should be explicit (M) • There should be a documented basis setting process linking the basis to the results of the investigation (H). 	<ul style="list-style-type: none"> • Impact of assumptions change should be compared with the financial impact of the actual experience. (M)
3.2	Assumptions do not comply with the regulations	<ul style="list-style-type: none"> • Staff knowledge of the regulations. • Extent of formal checks that the assumptions comply with the regulations. • Degree of complexity of the assumptions and extent to which the valuation systems can cope with complex bases. 	<ul style="list-style-type: none"> • There should be a formal check that the assumptions do comply with the regulations (H) • Regular reviews of the systems to ensure that they can cope with the nature of assumptions required by the regulations. (H) 	<ul style="list-style-type: none"> • Seek external review of the assumptions (M) • Benchmark the assumptions against those used by other companies in the market (H)
3.3	Assumptions does not reflect the actual experience for sub classes of business/products	<ul style="list-style-type: none"> • Assumptions is set at a very high level 	<ul style="list-style-type: none"> • The assumptions should be set separately for each sub class of business/product where the results of the experience are credible (M). 	<ul style="list-style-type: none"> • Analyse the results by class of business/product where there is adequate data for credible results (M).

<u>Step 3: Propose assumptions taking into account the results of the experience investigation</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.4	Results of the investigation are not used for setting the assumptions	<ul style="list-style-type: none"> • Time constraints. • Existence of a well defined process linking the assumptions and the results of the investigation. 	<ul style="list-style-type: none"> • The experience investigation should be done well in time to allow the results to be used for setting the basis (M). • Set a timetable for the experience investigation with key dates and milestones (M) 	.

Step 4: Assess the impact of the proposed assumptions				
	Risks	Risk factors	Preventative Controls	Detective Controls
4.1	The estimated impacts are incorrect.	<ul style="list-style-type: none"> • Many model used • Data errors • Any approximations that are used to estimate the impact of the basis change • Complexity of the change being carried out • Complexity of the model • The number of changes being carried out simultaneously 	<ul style="list-style-type: none"> • A signed off model should be used to assess the impact of the assumption change (M) • An independent check should be made of the impact of the assumption change. This could be by way of approximate manual calculations (M). • Any issues identified should be documented and management should be involved in making sure that the issues are resolved (H). 	<ul style="list-style-type: none"> • The actual impact of the assumption change should be compared to, and reconciled with the estimated impacts (H).
4.2	Impacts misunderstood	<ul style="list-style-type: none"> • Competency and skill level of the person analysing the results • Miss-interpretation of the results 	<ul style="list-style-type: none"> • Work should be done by an individual who is suitably qualified and has the relevant experience (M) 	<ul style="list-style-type: none"> • The impacts should be subject to review (H). • The actual impact of the assumption change should be compared to, and reconciled with the estimated impacts (M)

<u>Step 5: Get approval and sign off of the assumptions e.g. board/auditors</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
5.1	Assumptions are not approved	<ul style="list-style-type: none"> • Number of models/versions in use • Poor/inadequate documentation • Degree of compliance with the regulations • Extent to which assumptions are justified. • Degree of potential market pressure or internal conflicts 	<ul style="list-style-type: none"> • Assumptions should not be used before approval (M) • The assumptions should be documented and presented in a manner that is readily understood by the management (M). • The assumptions should be fully justified e.g. by reference to company experience and FSA regulations (M) 	<ul style="list-style-type: none"> • The assumptions should be benchmarked against the basis used by other companies in the market (M) • There should be an assumption document signed off by suitable senior management of the company (M).
5.2	Sign off – Board does not understand the results	<ul style="list-style-type: none"> • Complexity of the basis e.g. stochastic more complex than deterministic • Knowledge and experience of board members 	<ul style="list-style-type: none"> • Provide training (M) 	<ul style="list-style-type: none"> • Review communication material to see if appropriate for the audience (M)

8 Policy Data

8.1 Introduction

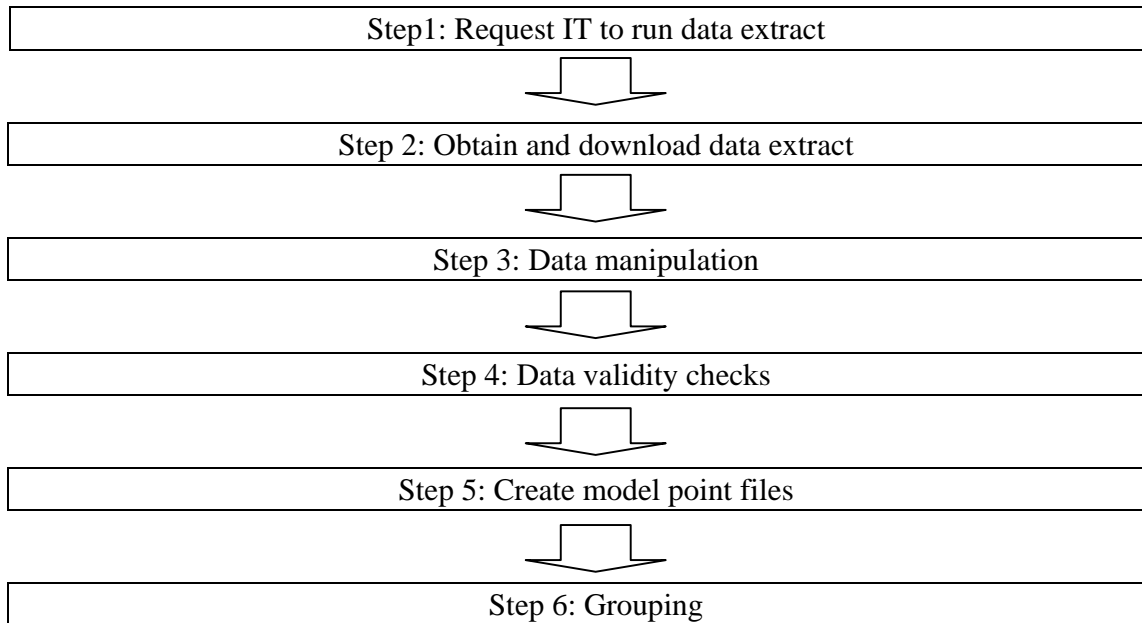
The data manipulation phase involves a number of sub-processes, most of which are likely to be performed exclusively within the Actuarial department. The first stage in process, the running of the data extract, requires close working with the IT department.

For clarity, throughout this section the term “model point” is used to describe any input of policy data to an actuarial model whether this be at individual policy level or a representative policy based on grouping rules.

8.2 Sub-Processes

The key sub-processes identified for this paper are detailed below together with a brief description of the associated tasks:

Flow Chart



- Request IT to run data extract – this assumes that IT own the data extraction process. Data extracts will be requested for each key administration system. These should be clearly specified in a standard format. The actual extraction of data is likely to be performed by an IT team.
- Obtain and download data extract – there will possibly be a download process of the extract from an IT storage area where the extract is created onto a network space accessible by members of the Actuarial team.
- Data manipulation – the data will probably need to be manipulated to allow it to be input to a tool or database for use by Actuarial. This may be done within the same process as downloading the extract.
- Data validity checks – though primary responsibility for data integrity / validity should ideally rest with the Administration area as ‘owners’ of the admin systems, it may be prudent for some checks to be performed within Actuarial given that competing priorities in the administration areas may result in lack of quality in data. An alternative would be to implement service level agreements which define the requirements on both parties as would be the case if a third party was used.
- Create model point files – the data will then be reformatted into a structure compatible for use by an Actuarial calculations platform. Some simplistic calculations may be done as part of this process, e.g. convert date of birth to age next birthday.
- Grouping – actuarial calculations may dictate that representative model points be used to approximate individual policy data. ‘Grouping rules’ are used to merge homogeneous policies together. The purpose of the calculation and the reason for grouping, such as run-times, will determine how severe the grouping needs to be, and what definition of homogeneousness should be applied.

8.3 Risks and Associated Controls

Each sub-process has risks associated with it. In order to ensure that the data being used for the valuation is correct it is important to ensure that risks at this early stage in the process are well managed. The tables below show the risks associated with each sub-process and a list of controls that can be used to mitigate them.

Step 1. Request IT (if owned by IT) to run data extract				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
1.1	Extract is not run	<ul style="list-style-type: none"> Strength of relationship and communication between Actuarial and IT team Number of competing demands on IT team's time 	<ul style="list-style-type: none"> Close liaison with IT team around extract date (H) System of formal logging of IT job requests (M) 	
1.2	Extract incorrectly / inadequately specified e.g. in expressing which data should be included in which sub-fund	<ul style="list-style-type: none"> Complexity of systems and funds structure 	<ul style="list-style-type: none"> Close liaison with Admin and IT teams when specifications drafted (H) Clear specification passed to IT team (H) 	<ul style="list-style-type: none"> Regular checks of key data fields against other sources of MI, for example from the Administration area
1.3	Extract is run incorrectly e.g. covering incorrect period	<ul style="list-style-type: none"> Complexity of extract specification Frequency with which extract specifications are altered 	<ul style="list-style-type: none"> Close liaison with IT team around extract date (H) Extracts stored generationally (and not over-written) (M) 	<ul style="list-style-type: none"> Checks over extract data, for example: <ul style="list-style-type: none"> - period covered - total records (M)
1.4	Not all data is downloaded e.g. due to admin system changes since previous valuation, incorrect specification etc.	<ul style="list-style-type: none"> Frequency with which extract specifications are altered Number of systems alterations made e.g. for new products Completeness of system-based data for example could be separate reinsurance element 	<ul style="list-style-type: none"> Clear specification passed to IT team (M) 	<ul style="list-style-type: none"> Reconciliation between extract and source admin system (control totals) (H)

Step 1. Request IT (if owned by IT) to run data extract				
	Risks	Risk Factors	Preventative Controls	Detective Controls
1.5	Data becomes corrupted during extraction process	<ul style="list-style-type: none"> Complexity of extract 'Stability' of source systems Change of valuation date 	<ul style="list-style-type: none"> Dry run on earlier period (M) No changes to admin systems or Extraction programs (M) 	<ul style="list-style-type: none"> Reconciliation between extract and source admin system or independent extraction program (control totals) such as sum assured, policy count etc. (H) Comparison to prior period extract (H) Reconciliation and analysis of policy movements between previous and current extract information, and investigation of unusual features (H) Comparison with data from other sources, such as sales/marketing data for New Business policies, information on number of units from unit pricing calculations (M)

Step 2. Obtain and download data extract				
	Risks	Risk Factors	Preventative Controls	Detective Controls
2.1	Wrong extract downloaded	<ul style="list-style-type: none"> Number of extracts in existence / being used by team 	<ul style="list-style-type: none"> Clear and logical naming and storage of extracts (M) 	<ul style="list-style-type: none"> Comparison with extract from previous period (M)
2.2	Data is corrupted during loading on to manipulation tool / database (including being only partially loaded)	<ul style="list-style-type: none"> Complexity of loading process 	<ul style="list-style-type: none"> Back up prior to loading (M) Sign off by IT area (M) 	<ul style="list-style-type: none"> Reconciliation of database to extract (H)

Step 3. Data manipulation				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.1	Actuarial manipulation of data is performed incorrectly (particularly if on block)	<ul style="list-style-type: none"> Frequency / number of changes to manipulations requirements Number of systems where data is merged, e.g. separate asset share calculation system where policy data is merged with calculated data 	<ul style="list-style-type: none"> Testing and sign-off of new tools / databases (H) One calculation engine that has all calculations contained within it – although this may be difficult to achieve in practice. (M) 	<ul style="list-style-type: none"> Summaries of all extracts compared before and after manipulation work (M) Peer review of manipulation work performed (M)
3.2	Data is changed unintentionally	<ul style="list-style-type: none"> Number of manual amendments to programs required 	<ul style="list-style-type: none"> Data manipulation programs are run automatically via macro or with few if any amendments before running (H) 	<ul style="list-style-type: none"> Summaries of inputs and outputs to make sure field totals / counts are the same (H) Reasonableness checks with last years data summaries (M)
3.3	Data is changed intentionally by another team, for example the Data team, but not communicated.	<ul style="list-style-type: none"> Number of different departments involved in valuation process 	<ul style="list-style-type: none"> Communication between teams need to be dynamic and change control procedures of shared processes needs to be robust (H) 	<ul style="list-style-type: none"> Sign-off process of dataflows between teams (M)

Step 4. Data validity checks				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
4.1	Underlying policy data is of poor quality / contains material errors for example still policies in-force that have had claims on them	<ul style="list-style-type: none"> • Size of book of business / data • Age of data • Complexity of formulae / calculations 	<ul style="list-style-type: none"> • Regular meeting with Admin to discuss known data issues / problems (L) • On-going programme of data integrity checking and remediation performed by Admin team (M) 	<ul style="list-style-type: none"> • Data integrity checks performed (and results reported) at time of extract e.g. highlighting 'outliers' for investigation (M)
4.2	The process for keying data on to the mainframe has changed for administration purposes, such as a separate record for each premium, leading to inappropriate results	<ul style="list-style-type: none"> • Frequency of changes to administration processes 	<ul style="list-style-type: none"> • Close liaison between Data team and Administration/IT during product development process as to what the exact definition of a record or variable is (L) • Close liaison between Data team and Admin as to current practices for inputting data (M) 	<ul style="list-style-type: none"> • Monitor probability distribution of key variables (L)

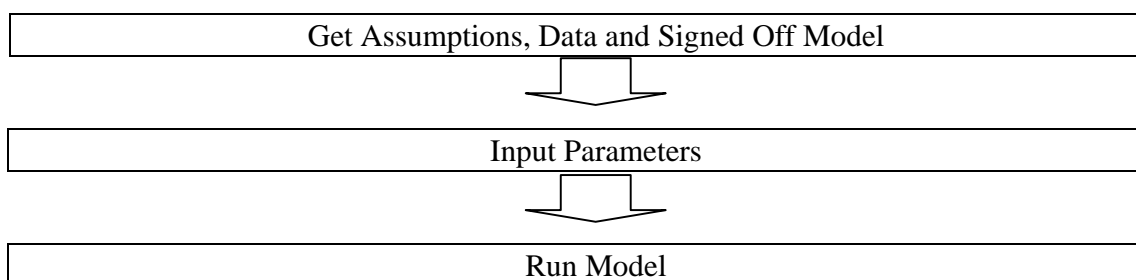
Step 5. Create “model point” files				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
5.1	Wrong model point program used	<ul style="list-style-type: none"> Number of different model point programs used 	<ul style="list-style-type: none"> Clear, documented procedure notes (H) 	
5.2	Model point program has not used the correct data extract, e.g. it uses the extract from a different administration system, or it uses the extract from a previous valuation	<ul style="list-style-type: none"> Number of similar extracts from different administration sources Number of extracts from different valuations all stored in the same network directory or storage area 	<ul style="list-style-type: none"> Extracts are clearly labelled (H) File logs of model point programs are printed so that model point program settings (e.g. file location of extract) are checked (H) Clear directory structure where extracts are stored (H) 	<ul style="list-style-type: none"> Compare number of model points (L)
5.3	Incorrect format of model point file produced	<ul style="list-style-type: none"> Number of different actuarial modelling systems used to produce results 	<ul style="list-style-type: none"> One actuarial model produces results on all reporting bases required (H) 	<ul style="list-style-type: none"> Run specifications clearly documented and checked (M)
5.4	Parameters within model point file programs not updated (e.g. valuation date)	<ul style="list-style-type: none"> Number of parameter updates required as part of model point file production process 	<ul style="list-style-type: none"> Appropriate sign-off of parameters/tables (H) Summary checks on model point output <ul style="list-style-type: none"> - variable names output - policy counts (M) minimum/maximum/averages of key variables <ul style="list-style-type: none"> - movement in totals/averages from valuation to valuation (for example minimum duration in-force has increased by 12 months for a closed book) (H) 	

Step 6. Grouping				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
6.1	Incorrect grouping rules used for the purpose	<ul style="list-style-type: none"> Number of different reporting bases 	<ul style="list-style-type: none"> Clear, documented procedure notes for grouped model point production (H) Signed-off run settings (M) 	
6.2	Data lost/overwritten during group stage	<ul style="list-style-type: none"> Amount of manual intervention in model point file production 		<ul style="list-style-type: none"> Checks on key variables that totals pre/post grouping stage are the same (H) Checks on model point file output, such as variable names (H)
6.3	Grouping rules are inappropriate, for example because of changes to data	<ul style="list-style-type: none"> Potential sudden change in key characteristics of underlying business, such as good equity returns mean that traditional policy guarantee is now out of the money but guaranteed annuity option is now biting Phased change in the make-up of the portfolio of business in the fund due to new business sales and/or maturing business 	<ul style="list-style-type: none"> Tests on reported variables on ungrouped and grouped policy data, for example cashflows are similar, key results are within a tolerance (H) 	<ul style="list-style-type: none"> Grouping rules are assessed between valuations to see if the rules remain appropriate given changes in portfolio since they were last analysed (M) Calculations using closed form solutions could be to test the appropriateness of grouped policy data as a proxy for their impact under monte-carlo stochastic simulations (H)

9 Model Set-up and Running

A high proportion of the key results are produced using models. There are a variety of models using different software that can be used to produce results, either on deterministic or stochastic bases, and the purpose of this section is to look at the controls around the process of updating data and assumptions into, and running these modes.

9.1 Model set-up and running flow chart



The most important controls are around ensuring that the correct parameters are updated into the models. More controls are required where there is more manual intervention, for example parameters typed into models, and where there are many steps between the production of the assumptions document and the generation of model parameters. It is also key that the correct data is picked up – depending on the purpose of the model run.

The extraction process of getting results out of the models is covered in Section 10.

9.2 Risks & Controls

Step 1. Get Basis, Data and Signed Off Model				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
1.1	Model changed since previous version and incorrect version used	<p>Note: same as section 6.3 Step 1.1</p> <ul style="list-style-type: none"> • Number of different production models in use e.g. separate models for valuation/EV or Peak 1 /Peak 2 • Number of model users • Degree of physical separation of I.T environments e.g. segregated development and production environment • Number of versions of the same model on the network 	<p>Note: same as section 6.3 Step 1.1</p> <ul style="list-style-type: none"> • Use a write protected area of the network to store all current production versions of the model. Have a separate area for development/old versions with restricted user access (H) • Maintain and publish as part of a model release process a list of current model versions and their use (M) • Reduce the number of different users e.g. have single team running all the production models (L) • Reduce number of different model versions (of the same system) being used for different purposes e.g. have one model for all uses (M) 	<ul style="list-style-type: none"> • Reproduce historic results as first step in Analysis of Change (AOC), and any discrepancies are in line with model development expectations (H)
1.2	Data inconsistent with sign-off from data team	<ul style="list-style-type: none"> • Number of intermediate steps between receipt of data and running model. • Complexity of file structure • Requirement to manually change location of source data in model settings 	<ul style="list-style-type: none"> • Clear documentation and understanding of procedures including full details of all files to be produced (H) • Clarity over ownership of data and SLA with data producers (M) • Regular review of models and processes to consolidate models (M) • Clear documentation and understanding of procedures for setting data location references (H) 	<ul style="list-style-type: none"> • Maintain control checks on number of policies, premiums etc (L-H depending on level of detail) • Spot checks on policy data loaded to model against admin systems (H) • Printout / review of locations from model once set up (M)

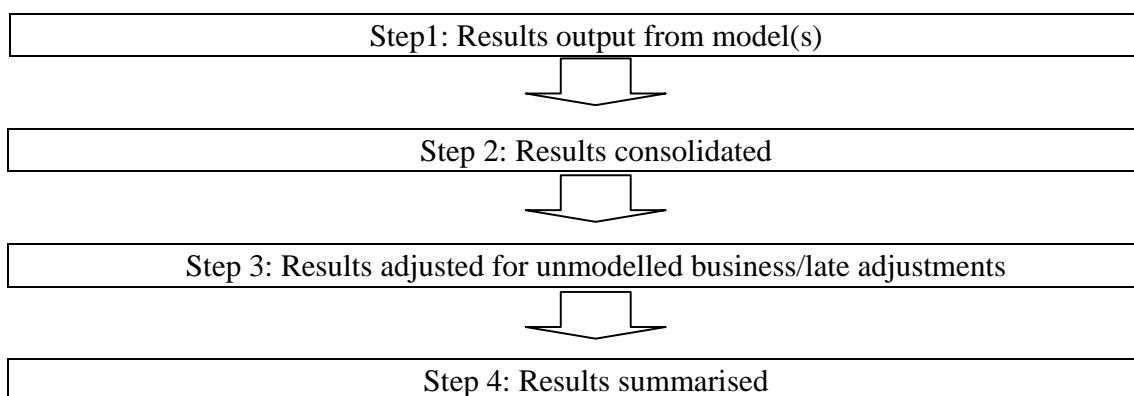
Step 2. Input Parameters				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
2.1	<p>Parameter input incorrect:</p> <ul style="list-style-type: none"> - Assumptions not consistent with Basis Document - Factual Parameters (e.g. policy fees) incorrect or out of date - Other/Fixed Parameters (e.g. indicators) incorrect 	<ul style="list-style-type: none"> • Complexity of process from assumptions document to model parameters • Extent of manual processing • How often the assumptions are changed? Are the assumptions stable or dynamic? • Number/complexity of the tables used and level of understanding of the parameters within them • Proportion of active parameters • Number of runs • Experience of model user 	<ul style="list-style-type: none"> • Version controls on assumption document and audit trail of changes (M) • Assumptions held in central location with restricted access (M) • Changes in assumptions communicated to interested parties (with interested parties clearly identified) (M) • Formal, documented signoff procedures (M) • Clarity of ownership of assumptions and responsibility for updates (M) • Regular modelling training for staff (M/H) • Regular communication of assumption and modelling changes (L) • Consistency of table layouts and variable naming conventions across separate models (M) • Regular model reviews to rationalise inputs and remove redundant variables (M) • Formal documentation of table structure (M) • Automate parameter updates from signed off spreadsheets into models (H) • Split tables between active and passive parameters (M) 	<ul style="list-style-type: none"> • Sample check of assumptions items (M) • Automated reconciliation of changes in assumption tables with differences investigated and formally signed off (H) • Independent check of parameters in model (M) • Spot check model input tables (L)

Step 2. Input Parameters				
	<u>Risks</u>	• <u>Risk Factors</u>	• <u>Preventative Controls</u>	• <u>Detective Controls</u>
2.2	Incorrect tables picked up	<ul style="list-style-type: none"> Complexity structure of models/workspaces 	<ul style="list-style-type: none"> Keep schedule of runs to ensure that runs can be reproduced (M) Formalised procedures for updating table references (M) Standardised live environment to reduce updates required (M) 	<ul style="list-style-type: none"> Check Run Logs for correct tables, data etc (M) Output assumptions used and check back to assumption document (H) Material errors may be highlighted by Analysis of Change (H)

Step 3. Run Model				
	<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.1	Run falling over – two aspects – one is time wasted, other is results of specific runs not being picked up	<ul style="list-style-type: none"> Complexity and size of models 	<ul style="list-style-type: none"> Check no other IT plans (L) Check sufficient capacity on network/servers etc (L) Regular review of hardware (M) Use (more) powerful hardware (H) User testing of model changes (L) Ensure that historic runs are not copied into new run locations (M) 	<ul style="list-style-type: none"> Check date and time stamps of runs to ensure that runs have been updated (L)

10 Output / Consolidation of Results

10.1 Output/Consolidation of results flow chart



The above flow chart identifies the key steps that would typically be followed in outputting and consolidating results from financial models in a valuation. In section 10.2 the risks associated with each step and the controls that could be used to mitigate these risks are described.

- Results output from model(s) – The model(s) will typically be financial projections such as Prophet, Moses or VIP. This stage of the process takes the results from the models and feeds these into another system, such as Excel, for further manipulation.
- Results consolidated – The results from the previous step may need more manipulation to get them into a suitable format for the valuation. The nature and the extent of this manipulation will depend on the nature of the valuation being performed and the number of models.
- Results adjusted for unmodelled business/late adjustments – The main model(s) may exclude certain classes of business, or specific reserves. Similarly, the model(s) may have known approximations. In addition it may not be possible to include late changes to the assumptions in the model(s) so the results may need manual adjustments.
- Results summarised – This stage combines the consolidated results of the model(s) and the late adjustments/unmodelled business. It summarises the results, usually at a higher level than previous stages, so they are in a suitable format for the valuation being performed (e.g. FSA Returns, IFRS Accounts) or the report/paper being produced.

10.2 Risks & Controls

Step 1: Results output from model(s)				
	Risks	Risk factors	Preventative Controls	Detective Controls
1.1	Retrieve the wrong results	<ul style="list-style-type: none"> • Number of runs performed • Frequency of results production in a calendar year • Number of models 	<ul style="list-style-type: none"> • Clear run log index that is kept up to date (H) • Same run numbers used for each valuation (H) • Efficient management of the number of runs required e.g. remove any unnecessary runs (M) • Results consolidation process should be developed as part of model development (M) • Minimise the number of models required (L) • Run descriptions on printouts (L) • Key parameters from model on results sheet (L) • Documentation of the result upload process to reporting tools (H) 	<ul style="list-style-type: none"> • Reconcile with results on a different basis (e.g. FSA to IFRS) (M) • High level reasonableness check (M) • Reconciliation of change in results with previous valuation (L)
1.2	Not all products picked up (e.g. new products modelled but not included on results spreadsheet)	<ul style="list-style-type: none"> • Frequency of new products development • Number of distinct products • Number of policy systems 	<ul style="list-style-type: none"> • Check with Marketing for new product launches (H) 	<ul style="list-style-type: none"> • Reconcile unit linked reserves with unit pricing data (H) • High level reasonableness check (M) • Compare inputs to the models and output from the models e.g. for Sum Assured, Asset Shares, Regular Bonus etc (i.e. check totals) (H)

<u>Step 1: Results output from model(s)</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
1.3	Interpret the results incorrectly (e.g. think we are looking at central results when in fact we are looking at post-Risk Capital Margin results)	<ul style="list-style-type: none"> • Number of runs performed • Number of bases used 	<ul style="list-style-type: none"> • Clear run log index that is kept up to date (H) • Efficient management of the number of runs required e.g. remove any unnecessary runs (M) • Run descriptions on printouts (L) • Key parameters from model on results sheet (L) 	<ul style="list-style-type: none"> • High level reasonableness check (M) • Reconciliation of change in results with previous valuation. (L)

<u>Step 2: Results consolidated</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
2.1	Wrong version of consolidation process used	<ul style="list-style-type: none"> • Frequency of revision to process 	<ul style="list-style-type: none"> • Maintain an inventory showing latest versions (H) • Use of development library (M) • Documented change control process (M) • Include a formal sign-off of version control (M) 	<ul style="list-style-type: none"> • High level reasonableness check (M) • Use Check Totals on all versions / runs, for example number of polices (M)

Step 2: Results consolidated				
	Risks	Risk factors	Preventative Controls	Detective Controls
2.2	Inputs are updated incorrectly or not updated at all	<ul style="list-style-type: none"> • Number of inputs required • Time available for updating results • Complexity of process e.g. better to have more input sheets within a spreadsheet than to have multiple spreadsheets requiring inputs. However, size of spreadsheets also needs to be considered as spreadsheets that are too large can become difficult to manage. 	<ul style="list-style-type: none"> • Checklist of tasks, which are done and independently checked or other process documentation setting out clearly what has to be updated (H) • Consolidation process has clear inputs. Ideally have separate input sheets if for example using spreadsheets. Alternatively, have one spreadsheet that houses all inputs, although this will depend on complexity of the process. (H) • If there are separate input sheets, have colour coding of input sheet tabs (e.g. red indicates not been updated yet, yellow indicates updated but still to be checked, green indicates updated and checked) (H) • Use check cells next to inputs to indicate when an input has been updated and then when an input has been checked. (H) • Use colour coding of each input, a separate colour for each source and have a file reference next to each colour (H) • Use links to bring in figures rather than manual inputs (this helps if there is more than one figure being taken from the same source). (M) • Have an automated process of updating links. An example is to enter the pathname of the underlying spreadsheets that feed into this spreadsheet into a sheet and have a macro that reads this sheet and updates the links. (M) • Make inputs simple in particular let the results consolidation process do the calculation rather than the person inputting. (M) 	<ul style="list-style-type: none"> • Reconcile with results on a different basis (e.g. FSA to IFRS) (M) • High level reasonableness check (M) • Control totals/checktotals to check all inputs have been updated. Particularly useful if using links to update inputs (M) • Reconciliation of change in results with previous valuation (L)

Step 2: Results consolidated				
	Risks	Risk factors	Preventative Controls	Detective Controls
2.3	Someone accidentally changes an input	<ul style="list-style-type: none"> Number of people with access to the drive/folder 	<ul style="list-style-type: none"> Protect input cells/sheets so that person firstly has to remove protection before entering. (H) Have an automated process of updating links (see example above) (M) Password protect consolidation process (H) Restricted access to drives/folders (M) Maintain a log of when spreadsheets were last saved that way if someone has changed a spreadsheet and saved by accident this would be flagged up as it would be different to the log. 	<ul style="list-style-type: none"> High level reasonableness check (M) Print off check sheets and sign-off (M) Reconciliation of change in results with previous valuation (L)
2.4	Consolidation calculations or outputs corrupted	<ul style="list-style-type: none"> Number of people with access to the drive/folder 	<ul style="list-style-type: none"> Protect calculation and output sheets (H) Consolidation process has separate input, calculation and output sheets (M) 	<ul style="list-style-type: none"> Control totals/checktotals at each stage of the consolidation process (H) High level reasonableness check (M) Reconciliation of change in results with previous valuation (L)
2.5	Poor design of the consolidation process	<ul style="list-style-type: none"> Frequency of revision to process 	<ul style="list-style-type: none"> Development or changes to the consolidation process follows agreed procedures, such as: <ul style="list-style-type: none"> Business requirement document Functional and system design Testing Sign-off (H) There should be a formal documented change control process (H) 	

<u>Step 3: Results adjusted for unmodelled business/late adjustments</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.1	Make adjustment to results but unknowingly alter other results or forget to alter other results	<ul style="list-style-type: none"> • Number of late adjustments made • Time available to make late adjustments 	<ul style="list-style-type: none"> • Have an adjustment process setup so that adjustments are input and liabilities are automatically changed. This avoids someone having to change the calculation routine/formulae during a reporting period when there is added pressure and little time. (M) • Have separate processes for results extraction from the model, manual adjustments, and consolidating the model results and manual adjustments. This makes tracing the reason for changes easier. (M) 	<ul style="list-style-type: none"> • Control totals/checktotals at each stage of the consolidation process (H) • Comparison of pre/post adjusted results (M)
3.2	Make adjustment to some results but forget to make consistent adjustments elsewhere (e.g. adjustment made to one reporting basis but not others)	<ul style="list-style-type: none"> • Number of different bases used • Number of separate teams involved 	<ul style="list-style-type: none"> • Have a communication process across teams where such changes are mentioned e.g. regular meetings during the reporting production period. (M) 	<ul style="list-style-type: none"> • Reconciliation of different types of results (L)

Step 4: Results summarised				
	Risks	Risk factors	Preventative Controls	Detective Controls
4.1	In a pyramid consolidation of results structure where one level feeds into another level the summarised results in a particular level are not consistent with the results from the underlying level(s). An example of this is where an input in a level is updated and levels sitting above have not been updated accordingly.	<ul style="list-style-type: none"> Complexity of process Time available for revising results 	<ul style="list-style-type: none"> Process map showing how the reporting levels link to each other. If spreadsheets are used this map should show the links between the spreadsheets, whether these be manual or automatic. (H) Simple pyramid process e.g. avoid circular routes where level A feeds into level B but needs something from level B in order to finalise results in level A. This then feeds back up into level B before feeding into level C etc. (H) If using links, update links each time a level is open. Not automatically updating links is itself a control. For example someone accidentally changes a figure in an underlying spreadsheet. If we don't automatically update links then when we follow the detective control for 4.1 above, we can spot this change. We would not be able to do this if we automatically updated links. (M) As typically the stages of the consolidation process have to be updated in a specific order use date/time stamps to ensure this has been done correctly. (M) Make sure consolidation process has version control and dates to make checking against earlier versions easier. (L) 	<ul style="list-style-type: none"> Before results are finalised, check that the output from each level equals the input from the level sitting above it. This is made easier if we have separate output and input sheets. One step further may be to make sure the output sheet is identical in format to the input sheet of the level sitting above it. (H) High level reasonableness check (M) Printout of spreadsheet links (M) One folder of spreadsheets for each basis (M) Reconciliation of change in results with previous valuation (L) If the modelled results are not adjusted in the consolidation process (e.g. for late adjustments, or for unmodelled business) then could compare the final results from the consolidation process with summary output from the model. This can be useful if the results feeding into the start of the consolidation process are at a more detailed level e.g. product level. (M)
4.2	Change in structure of a level makes it inconsistent with level sitting above it	<ul style="list-style-type: none"> Complexity of process Time available for revising results 	<ul style="list-style-type: none"> Process map showing how the reporting levels link to each other so that levels either linking into or from this level are reviewed at the development stage. (H) 	

11 Analysis and Checking of Results

11.1 Overview

The previous sections of this report have focussed on the risks and controls over the individual components of actuarial processes. While implementing all of these controls is likely to mitigate the risk of error to an acceptable level it is still appropriate to perform overall sense checks on the results produced.

In this section we outline a variety of checks on the final results, ranging from simple ratio testing to full analyses of change. In each case, these controls set out to mitigate the risk that results are incorrect or are not fit for purpose. We also outline (at a high level) potential processes for completing an analysis of change. Such analyses are extremely useful tools in ensuring results of valuations are appropriate, as well as improving management, and other users' understanding of the key drivers of surplus or profit.

For the most significant items (for example statutory reserves or published embedded value results) peer review, either by independent actuaries, or auditors may be appropriate/required.

11.2 Types of overall checking

These checking controls are by their nature detective controls. We have not presented these in the same table format used in other sections to allow more description to be given.

Depending on the process being completed, and the level of comfort required from the testing, one or more of the following methods may be appropriate:

(a) Trend analysis

Comparing changes in the results with prior periods can be used to identify outliers which may indicate errors in the results. This can also incorporate benchmarking against competitor and industry information which may identify a divergence in key assumptions over time. When completing a trend analysis it is generally more informative to consider results at a less aggregate level – e.g. by product group rather than fund level.

(b) Ratio analysis

For many actuarial calculations there may be a relatively linear relationship between reserves or Value of In Force and (for example) premiums and sums assured. Testing changes in these relationships may assist in identifying errors.

(c) Scanning analytics

Where a number of calculations are being performed (for example where individual values are being calculated for a large number of model points), it may be possible to identify outliers “by eye” by looking through the list of results, or by looking for values above or below a certain value. This may assist in identifying problems with a model in extreme scenarios.

(d) Sample testing

Where the same calculation has been performed for a large number of policies it may be appropriate to perform detailed testing on a sample of cases to give comfort that the results in aggregate are appropriate. The sample size should be chosen carefully to ensure that the results of the testing are statistically credible. It is also important to ensure that the range of policies selected cover all of the required features of the population.

(e) Independent model testing

For significant model developments it would generally be considered appropriate to produce an independent model to test the results of the calculation. This may be an independent spreadsheet model, or an existing model for a product with similar features. As for sample testing, care should be taken to ensure that any policies tested are representative of the portfolio as a whole.

(f) Analysis of change

For statutory valuations or embedded value calculations a full analysis of change may be produced. The analysis is in itself a very important control over the accuracy of the results.

Historically there have been a number of different ways to complete such analyses, however with increases in IT processing capabilities most companies now favour rerunning the actuarial models to step through the relevant changes in assumptions and experience. While assumptions changes can be made at the start or the end of the period considered, pressures on life insurers to report results as soon as possible can lead to all model and basis changes (other than economic assumptions changes) being made at the start of the period to enable these runs to be completed prior to the period end.

The most difficult impacts to explain generally relate to the actual versus expected non-economic performance over the year. It is important that the method for analysing these impacts remains stable from year to year, as well as the order in which the steps are completed to ensure a meaningful comparison. It is also important that the analysis defined is complete – i.e. new steps should not be required each year to explain the result – other than for new “one-off” items arising each year.

(g) Reconciliation of results between reporting bases

Some life insurance companies report results on two or more bases. In most cases, there will be some correspondence between the impact of each of the items under the differing bases. Understanding the relationship between the results on the various bases is helpful in detecting errors and is useful analysis to enable the board to sign off the final results

(h) Comparison to management information and forecasts

Most organisations will prepare regular management information and forecast results over the year. While these forecasts are unlikely to be 100% accurate, it can be a useful control to explain divergence from the forecasts as part of the overall results checking stage.

A particularly powerful check is the comparison of revenue account information with the revenue account actuarial model outputs in the final stage of the analysis of surplus.

11.3 Risks and Controls

As noted above, the key risk at this stage is that results are incorrect, and for published results that they are materially incorrect potentially leading to misleading the users of the published information. Publishing materially incorrect results can lead to fines from the regulator, and, perhaps more importantly, damage to the brand.

Where analysis is produced, other risks exist over the quality and credibility of the analysis.

<u>Risks</u>	<u>Risk Factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
Steps in analysis of change are not identified	Large amount of business / economic change occurring in intra-valuation period	<ul style="list-style-type: none"> • Consultation with all areas of the business, e.g. Admin, Product Development etc., prior to valuation to identify material impacts (M) • Consistent stages in each analysis of change (H) 	<ul style="list-style-type: none"> • Low level of untraced in the analysis of change(H) • Review average hours worked during the reporting period (M)
Results are materially incorrect	<p>Inadequate checking process due to staffing levels/insufficient time to complete checking process</p> <p>Complexity of calculations/lack of understanding of the results</p>	<ul style="list-style-type: none"> • Where possible build automated checks into the process – e.g. automated reconciliations (H) • Schedule appropriate senior review time into timetables (H) • Move processes outside of critical path i.e. do some of the work before year end (M) 	<ul style="list-style-type: none"> • Regular external review (H) • Benchmark practices to the market (H) • Complete full analysis of change (H) • Review average hours worked during the reporting period as potential for errors will increase if individuals are too stretched (M)
Results are not understood	<p>Analysis is not completed or not completed at an appropriate level (either too high or too low) for the users of the information</p> <p>Significant items are not included in the analysis</p> <p>Significant positives and negatives offset each other</p>	<ul style="list-style-type: none"> • The time and cost of analysis should be in the budget (H) • All key data items required for analysis of surplus should be identified in advance and data delivery formally agreed and monitored (H) • Process should be specified in advance and reviewed by senior staff to ensure that all significant items are considered (H) • Process should be appropriately documented and staff appropriately trained (H) • Process should be planned and scheduled in the timetable (M) • Commentary should be provided with analysis to explain key results (M) 	<ul style="list-style-type: none"> • Benchmarking practices against market (H) • Process should be subject to external peer review/audit (H) • Unexplained items should be investigated until reduced to an acceptably low level (M)

12 Reporting

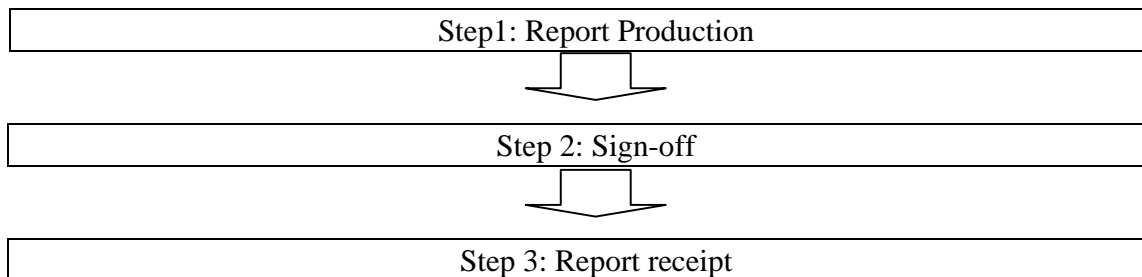
12.1 Introduction

This section considers the reporting of results to their intended audience. The reports produced would generally include

- a) regular internal reports explaining results and how they have changed e.g. valuation report. These reports will be of a relatively stable format but not prescribed so that the author can vary from the norm should circumstances warrant
- b) production of reports for external purposes, e.g. Appendix 9.4 and 9.4a within the FSA Returns. These reports will tend to be of a prescribed format where there is little flexibility in what figures are produced and what can be said

The readers of these reports will potentially vary widely in technical expertise depending on its circulation.

12.2 Sub-Processes



- Report production – the process of transferring aggregated balances in to a reporting format. The format is likely to be determined by regulation and professional standards.
- Sign-off – the process by which the reporting is authorised as ‘fit for purpose’.
- Report receipt – including the risks that the contents are not understood

12.3 Risks and Associated Controls

Each sub-process has risks associated with it. In order to ensure that the reporting is an accurate reflection of underlying business / data it is important to ensure that controls operate effectively at this, the final stage, where errors are likely to be detected. The

following shows the risks associated with each sub-process and a list of controls that can be used to mitigate them.

An important element of this section relates to the project management of the actuarial process and ensuring the specification of the required outputs is undertaken at the beginning of the process.

Step 1: Report Production				
	Risks	Risk factors	Preventative Controls	Detective Controls
1.1	Wrong data used for report preparation	<ul style="list-style-type: none"> • Number of data sources • Level of automation used for data feeds from final aggregation • Number of late adjustments to figures 	<ul style="list-style-type: none"> • Procedures detailing data sources to be used (M) • Automatic data links e.g. macros to populate Word documents from Excel spreadsheets (H) • Appropriate file structure and naming convention to enable reports to be linked to versions of results (H) • Sign-off procedure for report by owner of the numbers (see detective control opposite) and the author of the report, e.g. Head of Actuarial Function (H) 	<ul style="list-style-type: none"> • Agreement and documentation of responsibility for the accuracy of each number in the report and who uses the numbers and for what purpose (H) • Peer review of draft reports by subject matter expert (H)
1.2	Aggregation process introduces errors e.g. due to incorrect links or manual transposition error	<ul style="list-style-type: none"> • Level of automation used for data feeds from final aggregation 	<ul style="list-style-type: none"> • Checking of data links prior to use (H) 	<ul style="list-style-type: none"> • Peer review of draft reports (H)
1.3	Not all data included in report	<ul style="list-style-type: none"> • Changes in personnel • Changes in reporting requirements 	<ul style="list-style-type: none"> • Retain experienced personnel / continuity e.g. via appropriate cross-skilling (M) 	<ul style="list-style-type: none"> • Reconciliation between report and final aggregation spreadsheets (H)
1.4	Report inconsistent with other reports	<ul style="list-style-type: none"> • Number of different actuarial reports produced • Number of personnel involved in report writing and overall sign-off 	<ul style="list-style-type: none"> • Review of reports by subject matter experts (M) 	<ul style="list-style-type: none"> • Experienced actuary, e.g. AFH, responsible for signoff of all actuarial reports – this may be possible in small firms but not in larger firms. For larger firms, more reliance often placed on preventative control opposite (M)
1.5	Report structure / content inconsistent with regulatory requirements	<ul style="list-style-type: none"> • Level of regulatory change 	<ul style="list-style-type: none"> • Review of report structure against current requirements prior to population of report e.g. by a specialist post holder – the “Statutory Reporting Actuary” (M) • External review either by Compliance function, internal or external audits or external consultants. (M) 	

<u>Step 2: Sign-Off</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
2.1	Sign-off inadequate as final test to detect errors / anomalies e.g. sign-off undertaken at inappropriate level i.e. too senior (without lower level sign-off) or too little experience	<ul style="list-style-type: none"> • Availability of knowledgeable / experienced actuarial staff • Too little time for thorough sign-off process • Actuarial structure e.g. very wide spans of responsibility • Organisation size e.g. the larger the organisation the more 'distant' the final signatory may be from the detail • level of review to be undertaken (risk based) • style of review to be undertaken e.g. face to face or desktop • information to be provided to reviewer (and by when) 	<ul style="list-style-type: none"> • Documented procedures for late adjustments to reported numbers (M) • Detailed and rigorous planning and monitoring against plan (M) • Training and education needs to have been provided well in advance of the review meeting in order for the reviewer to have the required level of understanding to be able to perform a meaningful review and sign-off. (M) 	<ul style="list-style-type: none"> • Documented staged sign-off process detailing, under which sign-off is undertaken by levels of management up to Head of Actuarial Function for example (H)

<u>Step 3: Report Receipt</u>				
	<u>Risks</u>	<u>Risk factors</u>	<u>Preventative Controls</u>	<u>Detective Controls</u>
3.1	The report is mis-understood or read by a different audience than that originally intended	<ul style="list-style-type: none"> Knowledge and understanding diversification of target audience 	<ul style="list-style-type: none"> The audience of the report should be considered when designing the report structure in terms of style, length and content, e.g. formal word report or presentation (M) Make the content as simple and clear as possible Include appropriate caveats within the document to ensure its intended use. 	

13 Documentation and Evidencing

13.1 Introduction

Although documentation is not a specific stage in the reporting process, we deemed it was an important enough control to warrant a separate section. This section includes a review of different types of documentation, what makes good documentation and how it should be used. We have expanded the definition of documentation to include not only process documentation but also methodology documentation and documentation that evidences control processes have been followed.

13.2 Process and Methodology Documentation

If written correctly, process and methodology documentation is useful for the following reasons:

- It provides a good overview of a particular process or methodology
- It can be used as a preventative control for reducing errors
- It is a useful training tool
- Provides a good platform for evidencing (see section below)
- It can be used to reduce key man dependencies, for example not relying on information inside an experienced colleague's head

There are debates over what makes good documentation. It is common sense that all documentation should be clearly written, well structured and concise but there are other considerations that will improve the quality of documentation used. In particular:

- There should be clear ownership in terms of methodology, where the direction and standards should be set by senior management (e.g. Actuarial Function Holder) and by the user.
- Documentation should be regularly reviewed and process documentation regularly tested to ensure that it is still appropriate. There should also be an overall review to ensure methodology and process documentation is consistent. Methodology documentation should give an understanding of why the process is being performed as well as instructions on how to complete it.
- Effective documentation should be structured so that it is dynamic and can be updated as methodology and processes are updated
- Documentation should be stored in a central location with appropriate access rights and under a sensible level of version control.

It should also be stressed that documentation, particularly process documentation, should not be adhered to rigidly in the absence of understanding of the process and should be used as part of a training procedure and as part of a wide range of controls.

13.3 Evidencing

Documentation in this context means electronic or paper records that demonstrate that procedures have been followed appropriately and checks have been made. It is an essential part of a control environment in providing management and auditors with assurances that controls have been followed and can also help by ruling out possible areas of investigation when analysing results.

Examples of good evidence include:

- Process checklists signed off
- Inputs/calculations with “doer” and “review” signoffs
- Commentary on unusual results
- Signatures for process handovers
- References of compliance with regulatory requirements

14 End User Applications

There has been a significant amount of literature devoted to the issue of End User Applications. This has been as a result of an increasing focus on spreadsheets in the last few years from legislation such as Sarbanes-Oxley and as the profession increasingly recognises the risks involved in using spreadsheets, either through experience of particular problems or from ‘war stories’ circulated across the industry.

We have not attempted to re-invent the wheel in this area, but simply highlight some of the documents that are currently available on this issue.

The key themes from these documents are

1. The use of spreadsheets within actuarial processes is a key risk which should have as much control around development and running as specialist actuarial models; see earlier sections in this report.
2. Spreadsheets should have quality documentation supporting their workings; see earlier sections in this report.

A number of references to papers on spreadsheet controls are included below. These have been selected on the basis of a brief amount of research by members of the working party and are not intended to be an exhaustive list.

(i) *Spreadsheet Modelling Best Practice* by Nick Read and Jonathan Batson.

This guide is of interest to anyone who relies on decisions from spreadsheet models. The techniques described include areas such as ensuring that the objectives of the model are clear, defining the calculations, good design practice, testing and understanding and presenting the results from spreadsheet models.

(ii) *What can you afford in a 1% world?* Louise Pryor asks whether we are testing our spreadsheets. Actuary article in July 2003.

Louise Pryor asks whether we are testing our spreadsheets.

(iii) *Actuaries excel: but what about their software?* : Paper presented at the 33rd Annual GIRO conference, September 2006. Louise Pryor, Richard Evans, Brian Foley, Michael Garner, Neil Hilary, Justin Skinner, Mark Shapland, Kathryn Staff, James Tanser

The report from the software use working party presented at GIRO 2006, containing the results of a survey of over 700 non-life actuaries.

(iv) *When, why and how to test spreadsheets* by Louise Pryor. Appears in the *Proceedings of Eusprig*. 2004.

(v) *Managing spreadsheet risk* by Louise Pryor. November 2005

(vi) *SpACE-Methodology for the Audit of Spreadsheet Models* developed by the HMR Revenue & Customs Audit Service.