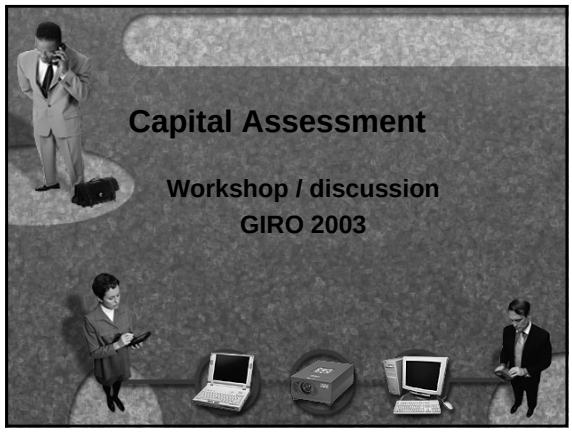
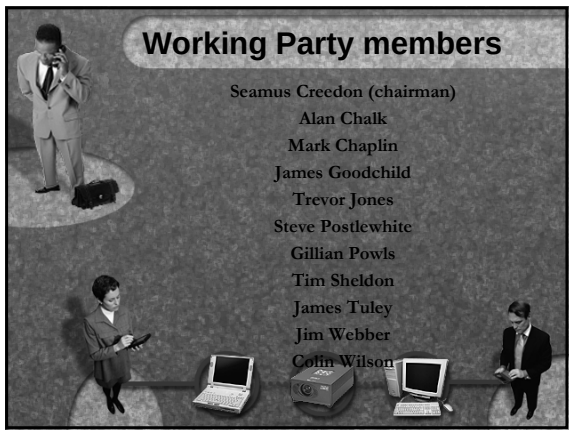
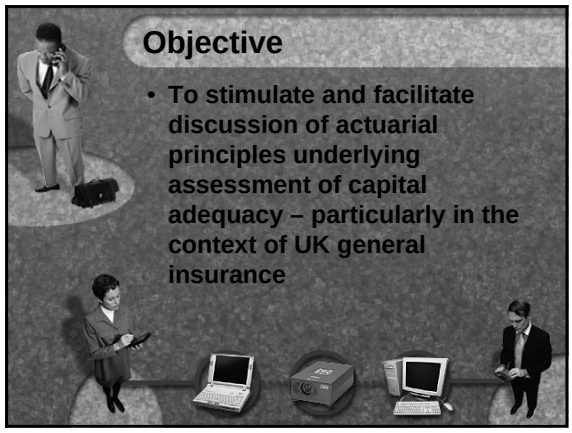
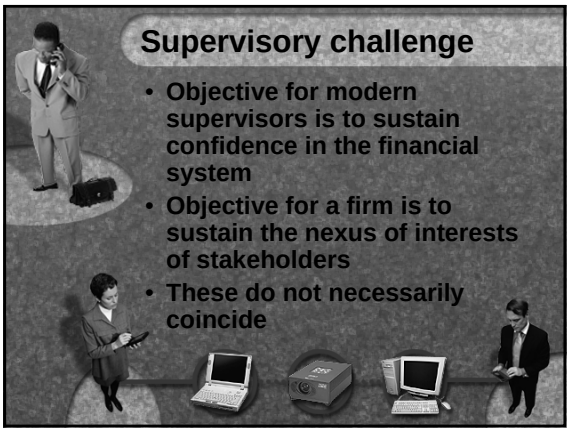

Capital Assessment
Workshop / discussion
GIRO 2003


Working Party members
Seamus Creedon (chairman)
Alan Chalk
Mark Chaplin
James Goodchild
Trevor Jones
Steve Postlewhite
Gillian Powls
Tim Sheldon
James Tuley
Jim Webber
Colin Wilson


Objective
• To stimulate and facilitate discussion of actuarial principles underlying assessment of capital adequacy – particularly in the context of UK general insurance

Supervisory challenge

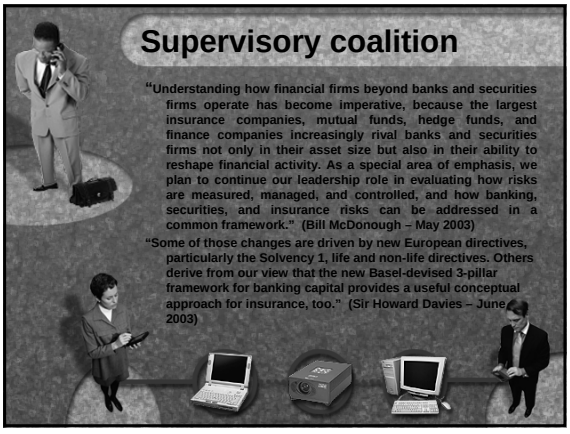
- Objective for modern supervisors is to sustain confidence in the financial system
- Objective for a firm is to sustain the nexus of interests of stakeholders
- These do not necessarily coincide



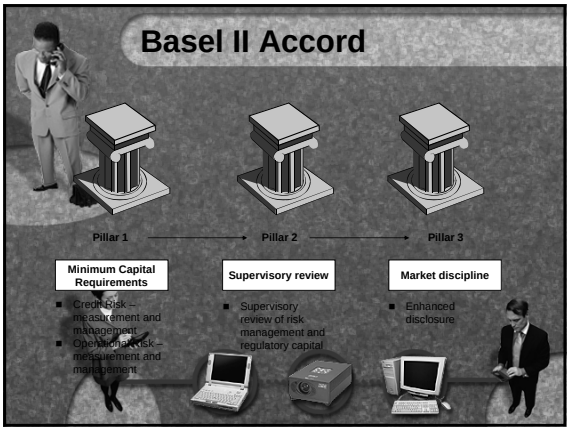
Supervisory coalition

"Understanding how financial firms beyond banks and securities firms operate has become imperative, because the largest insurance companies, mutual funds, hedge funds, and finance companies increasingly rival banks and securities firms not only in their asset size but also in their ability to reshape financial activity. As a special area of emphasis, we plan to continue our leadership role in evaluating how risks are measured, managed, and controlled, and how banking, securities, and insurance risks can be addressed in a common framework." (Bill McDonough – May 2003)

"Some of those changes are driven by new European directives, particularly the Solvency 1, life and non-life directives. Others derive from our view that the new Basel-devised 3-pillar framework for banking capital provides a useful conceptual approach for insurance, too." (Sir Howard Davies – June 2003)



Basel II Accord



EU Solvency II objectives

- Extend the scope of the revision to the whole prudential system (post-Solvency I)
- Create a prudential framework more appropriate to the risks facing insurance companies
- Take into account the different needs for harmonisation (European level, international level, convergence of financial sectors)
- Better consumer protection

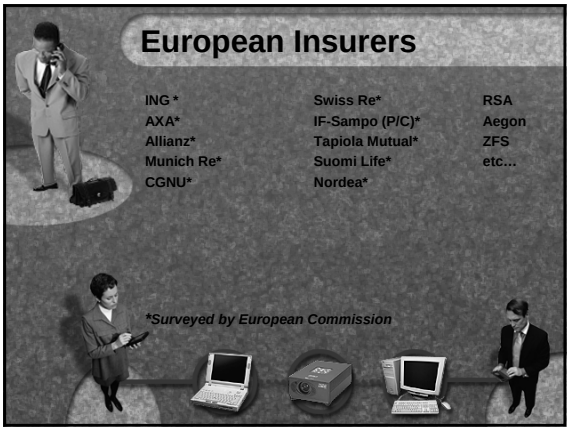
EU commission principles

- Target economic capital and lower absolute minimum
- Harmonisation of quantitative and qualitative methods
- Asset risk to be confirmed more explicitly
- Standardised or validated internal model
- Requirement for sound risk management
- Disclosure – for supervisor or public

European Insurers

ING *	Swiss Re*	RSA
AXA*	IF-Sampo (P/C)*	Aegon
Allianz*	Tapiola Mutual*	ZFS
Munich Re*	Suomi Life*	etc…
CGNU*	Nordea*	

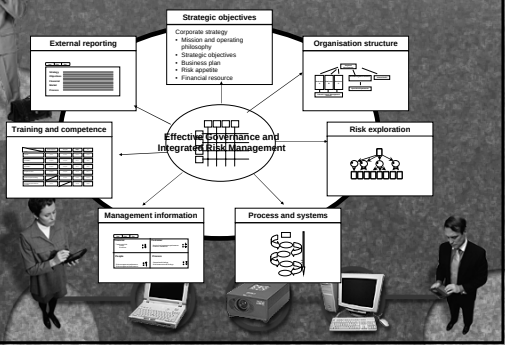
**Surveyed by European Commission*



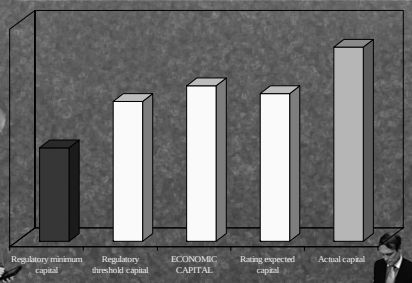
Insurer Risk Models

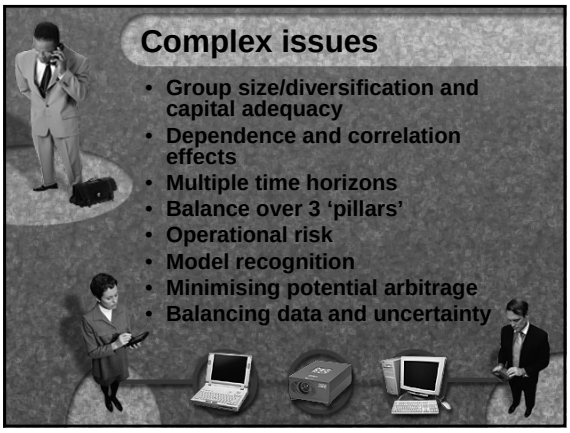
- Virtually all models are aggregate models
- Degree of completion of the models varies from draft/prototype to “operational”
- Companies are taking a continuous improvement approach to model development
- The sophistication of risk measurement varies significantly
  - Formulaic (S&P / RBC factors)
  - Statistical simulation
  - DFA
- There are as many approaches as there are companies

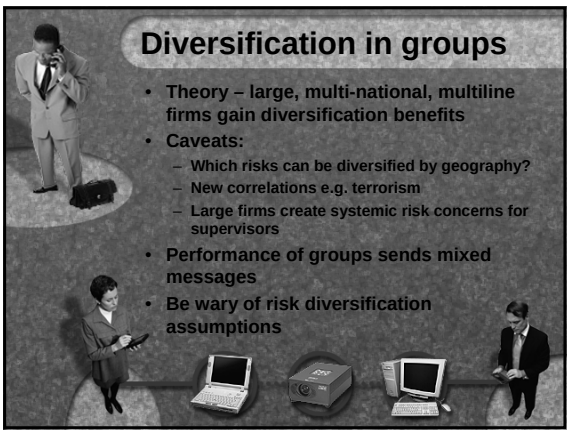
Risk, capital and governance

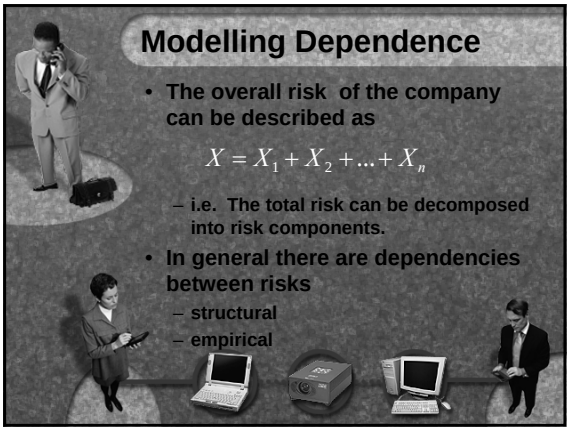


Capital assessment




Complex issues
• Group size/diversification and capital adequacy
• Dependence and correlation effects
• Multiple time horizons
• Balance over 3 'pillars'
• Operational risk
• Model recognition
• Minimising potential arbitrage
• Balancing data and uncertainty


Diversification in groups
• Theory – large, multi-national, multiline firms gain diversification benefits
• Caveats:
– Which risks can be diversified by geography?
– New correlations e.g. terrorism
– Large firms create systemic risk concerns for supervisors
• Performance of groups sends mixed messages
• Be wary of risk diversification assumptions


Modelling Dependence
• The overall risk of the company can be described as
$X = X_1 + X_2 + ... + X_n$
– i.e. The total risk can be decomposed into risk components.
• In general there are dependencies between risks
– structural
– empirical

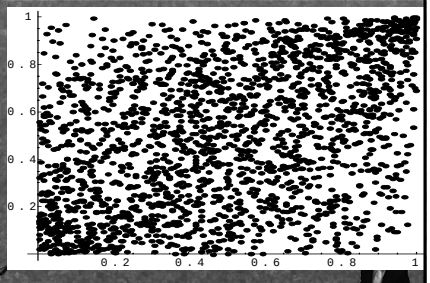
Structural Dependencies

- Loss variables are driven by common variables:
  - Economic factors: inflation drives costs in various lines of insurance
  - Common shocks: a motor accident can trigger several related claims (BI, damage)
  - Uncertain risk variables: long term mortality changes affect all mortality-related insurance/annuities
  - Catastrophes: 9/11 ripple effect over many lines (life, business interruption, health, property, etc)
- Known relationships can be built into internal models

Empirical Dependencies

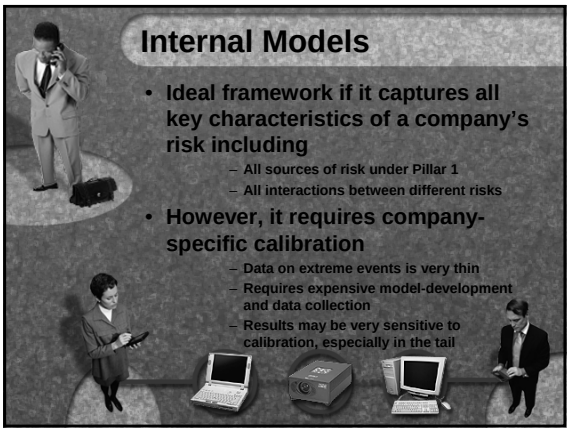
- Observed relationships between lines (usually) without necessarily well-defined cause-effect relationships.
  - Relationships may not be simple.
  - Relationships may not be over entire range of losses.
- In practice, observed relationships are at a macro level
  - Detailed data on relationships is often not available.
  - Detailed data on marginal distributions is available.

Dependence?



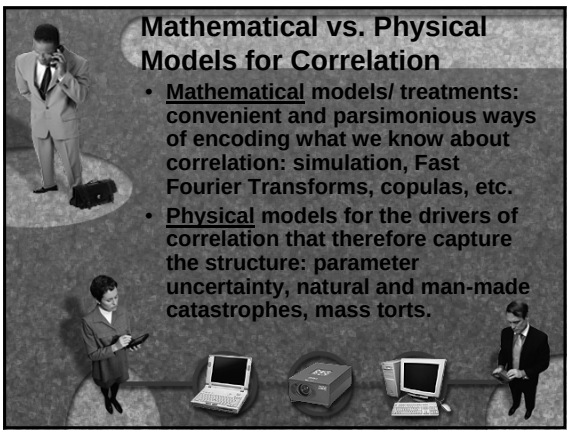
Internal Models

- Ideal framework if it captures all key characteristics of a company's risk including
  - All sources of risk under Pillar 1
  - All interactions between different risks
- However, it requires company-specific calibration
  - Data on extreme events is very thin
  - Requires expensive model-development and data collection
  - Results may be very sensitive to calibration, especially in the tail



Mathematical vs. Physical Models for Correlation

- Mathematical models/ treatments: convenient and parsimonious ways of encoding what we know about correlation: simulation, Fast Fourier Transforms, copulas, etc.
- Physical models for the drivers of correlation that therefore capture the structure: parameter uncertainty, natural and man-made catastrophes, mass torts.



Development of formulas

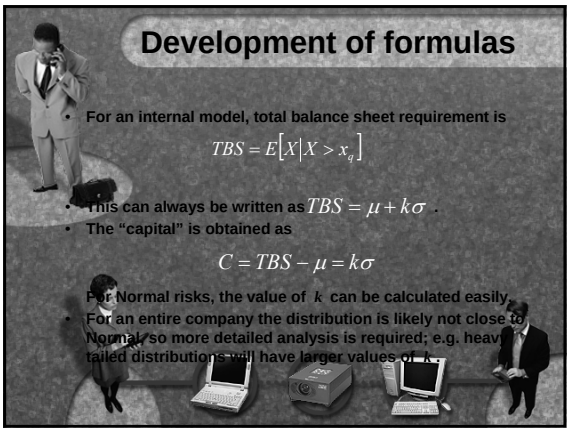
- For an internal model, total balance sheet requirement is

$$TBS = E\left[X \middle| X > x_q\right]$$

- This can always be written as $TBS = \mu + k\sigma$.
- The "capital" is obtained as

$$C = TBS - \mu = k\sigma$$

- For Normal risks, the value of k can be calculated easily.
- For an entire company the distribution is likely not close to Normal, so more detailed analysis is required; e.g. heavy-tailed distributions will have larger values of k.



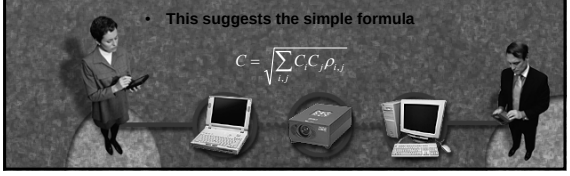
More realism

- Models are developed for specific risks within lines of business (LOB) and combined, resulting in

$$C_j = TBS_j - \mu_j = k_j \sigma_j$$

- LOBs are combined recognizing the dependence between them. So some kind of "correlation" is needed, say, $\rho_{i,j}$
- This suggests the simple formula

$$C = \sqrt{\sum_{i,j} C_i C_j \rho_{i,j}}$$



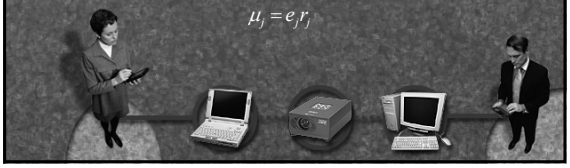
Another representation

$$C_j = k_j \sigma_j = k_j \mu_j \underset{v_j}{\nu_j}$$

where represents the "coefficient of variation".

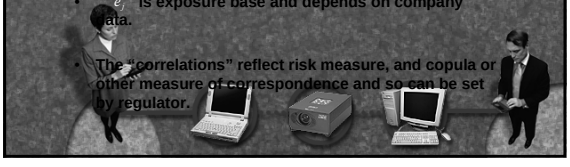
- The expected loss can be written as the product of an exposure amount and a standard "risk per unit".

$$\mu_j = e_j r_j$$



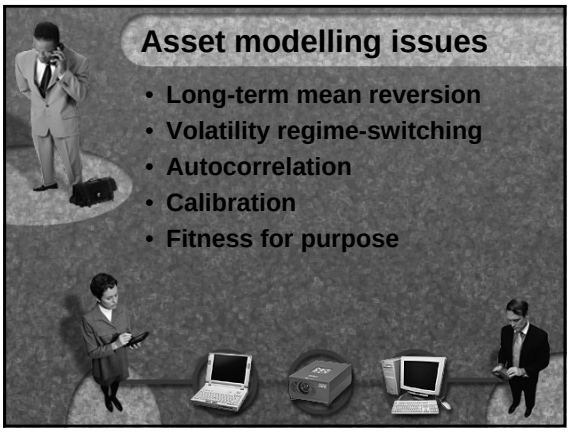
Sources of data

- v_j depend on shape of distribution, and is similar for similar risks for all companies, so this could be based on industry data.
- k_j depends on shape and risk appetite of regulator. It is also then similar for all companies.
- r_j is expected loss per unit of risk and so depends on industry data.
- e_j is exposure base and depends on company data.
- The "correlations" reflect risk measure, and copula or other measure of correspondence and so can be set by regulator.



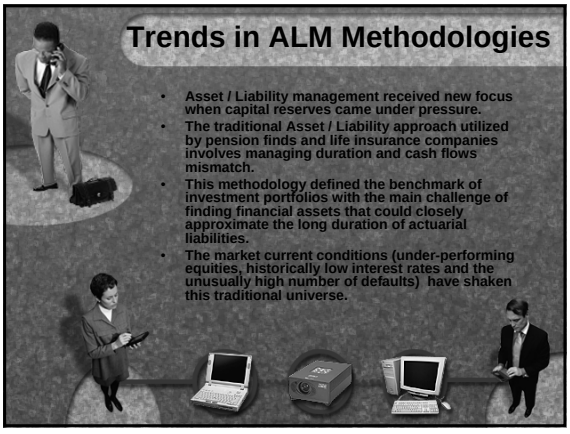
Asset modelling issues

- Long-term mean reversion
- Volatility regime-switching
- Autocorrelation
- Calibration
- Fitness for purpose



Trends in ALM Methodologies

- Asset / Liability management received new focus when capital reserves came under pressure.
- The traditional Asset / Liability approach utilized by pension finds and life insurance companies involves managing duration and cash flows mismatch.
- This methodology defined the benchmark of investment portfolios with the main challenge of finding financial assets that could closely approximate the long duration of actuarial liabilities.
- The market current conditions (under-performing equities, historically low interest rates and the unusually high number of defaults) have shaken this traditional universe.

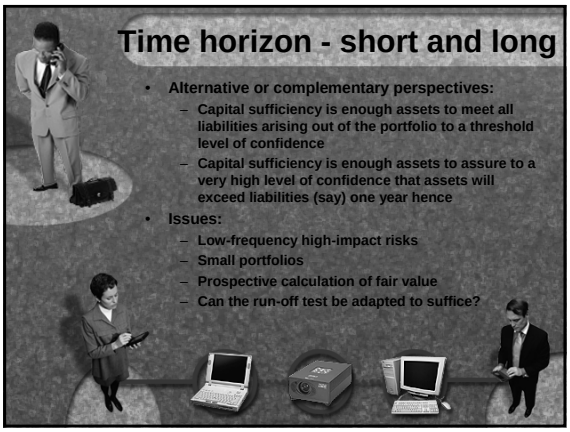


New ALM Approach

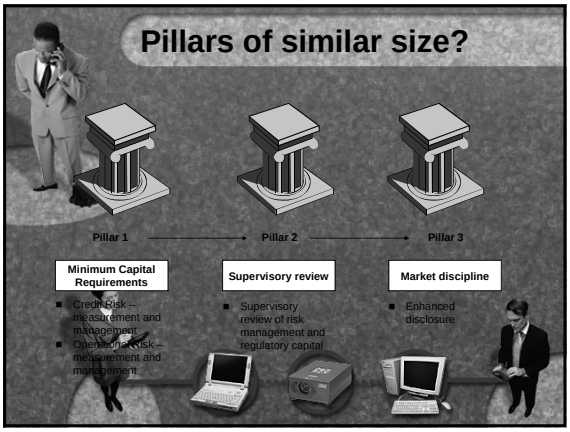
- ALM approach should simultaneously model uncertainties in projected cash flows on both asset and liability sides.
- It should combine market (interest rate, foreign exchange and equity) and credit risk on a consistent modeling platform.
- Assessing market and credit risk should be compatible with pricing and hedging models and methodologies.
- It should take into account the existing benchmark and investment guidelines.
- The suggested approach can serve as an overlay to existing risk management models, while consistently integrating different types of risk and providing practical solutions for risk reduction.

Time horizon - short and long

- **Alternative or complementary perspectives:**
  - **Capital sufficiency is enough assets to meet all liabilities arising out of the portfolio to a threshold level of confidence**
  - **Capital sufficiency is enough assets to assure to a very high level of confidence that assets will exceed liabilities (say) one year hence**
- **Issues:**
  - **Low-frequency high-impact risks**
  - **Small portfolios**
  - **Prospective calculation of fair value**
  - **Can the run-off test be adapted to suffice?**

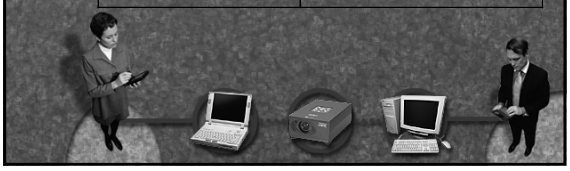


Pillars of similar size?



Op Risk - Challenges

Credit, market, actuarial risks	Operational risks
• Developed over 10-30 years • Highly quantitative • Transactional risk • Data-rich • Extensive metrics • Known variables • Few functions involved • Few risk types	• Emerging discipline • Mainly qualitative, starting to quantify • Process- and people risk • Lack of data • Limited metrics • Multiple causal & contributing factors • All functions involved • Variety of event types



How 7 Banks Have Solved These Issues

All are based on the same foundations, however there is variation in emphasis of the components

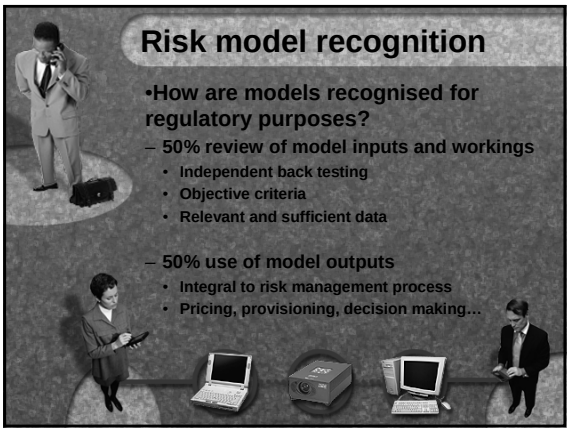
- an internal loss driven variation -> Credit Lyonnais-
- an actuarial driven variation ->Citigroup-
- an actuarial rating driven variation ->BMO-
- An external loss and Scorecard driven variation -> ING-
- A scenario driven variation -> Intesa
- A Methodology For Incorporating Bank-Specific Business Environment and Internal Control Factors-> ABNAMRO
- A Bootstrapped Methodology -> Sumitomo Mitsui-BC

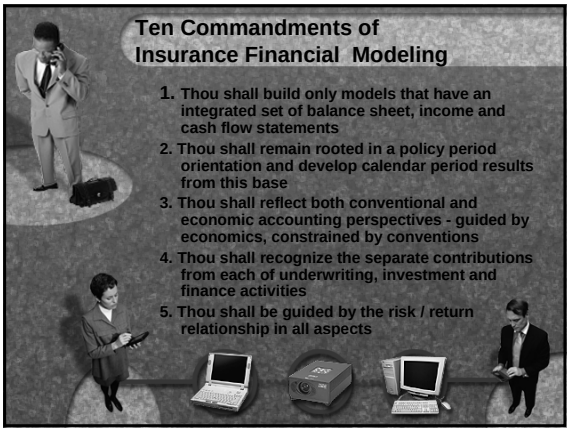
ITWG Banks

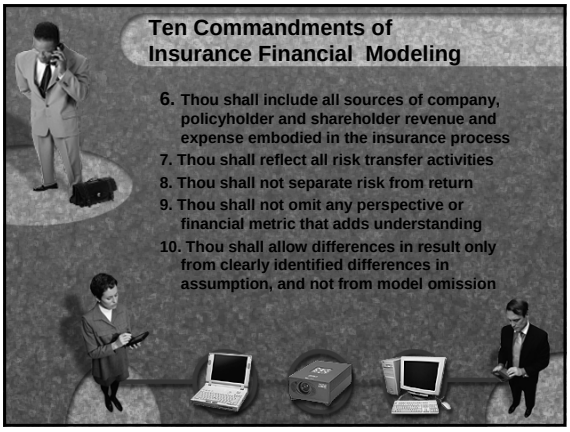
1. ITWG banks are using a variety of methods for determining operational risk capital
   - The variety is in emphasis of various components not in fundamentals
2. ITWG banks use historical losses as the foundation for their AMA
3. A variety of methods have been developed for incorporating the change in the business and control environment ie a forward looking element
4. How confident are we in the results? Sufficiently because they meet the ultimate test of credibility: The results are used by management in running the bank
5. Much progress has been made in the last year and although much more needs to be developed, it is more in the nature of improving rather than invention.

Operational risk

- Framework definition
- Qualitative, quantitative or both?
- Data issues:
  - Lack of credibility
  - High and low frequencies
  - Drawing on others
- Is change of political / regulatory context an operational risk?


Risk model recognition
•How are models recognised for regulatory purposes?
– 50% review of model inputs and workings
• Independent back testing
• Objective criteria
• Relevant and sufficient data
– 50% use of model outputs
• Integral to risk management process
• Pricing, provisioning, decision making…

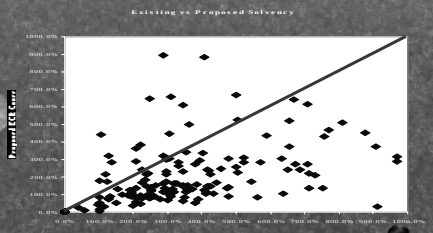

Ten Commandments of Insurance Financial Modeling
1. Thou shall build only models that have an integrated set of balance sheet, income and cash flow statements
2. Thou shall remain rooted in a policy period orientation and develop calendar period results from this base
3. Thou shall reflect both conventional and economic accounting perspectives - guided by economics, constrained by conventions
4. Thou shall recognize the separate contributions from each of underwriting, investment and finance activities
5. Thou shall be guided by the risk / return relationship in all aspects


Ten Commandments of Insurance Financial Modeling
6. Thou shall include all sources of company, policyholder and shareholder revenue and expense embodied in the insurance process
7. Thou shall reflect all risk transfer activities
8. Thou shall not separate risk from return
9. Thou shall not omit any perspective or financial metric that adds understanding
10. Thou shall allow differences in result only from clearly identified differences in assumption, and not from model omission

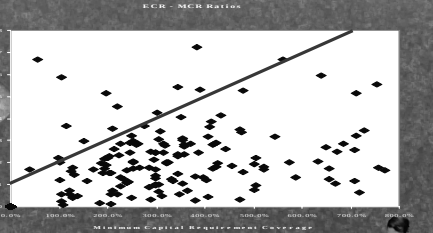
Model Requirements for Effective ERM

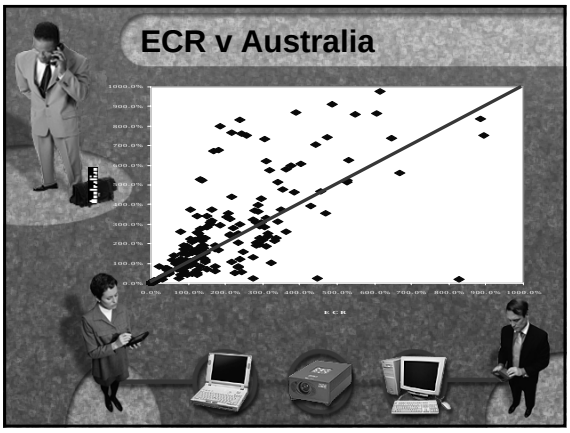
- What you should have
  - Fully Integrated Model (Assets & Liabilities)
  - Risk Adjusted Assets
  - Sophisticated Economic Scenario Generation
  - Risk Adjusted Liabilities
  - True Decision Support Communication

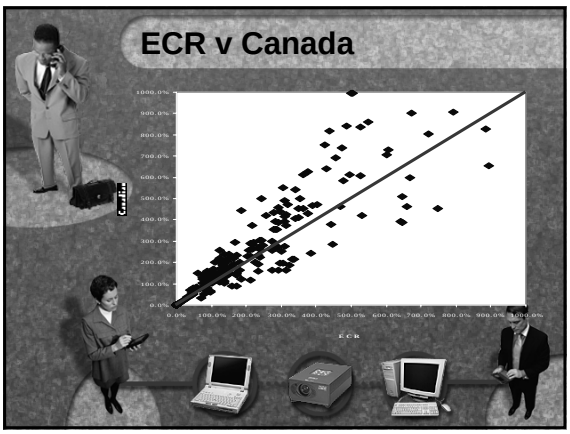
ECR v Current cover

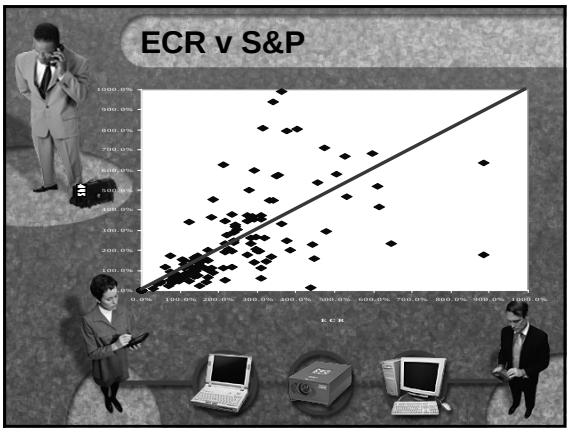


ECR-MCR Ratios

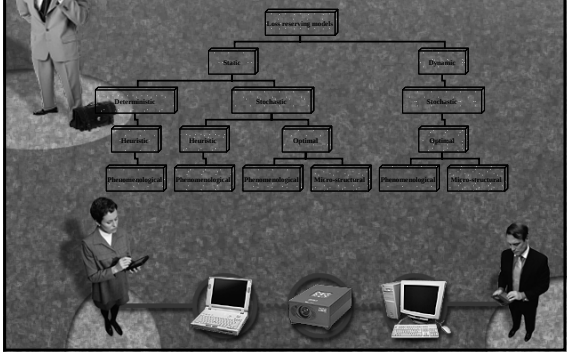



ECR v Australia
ECR

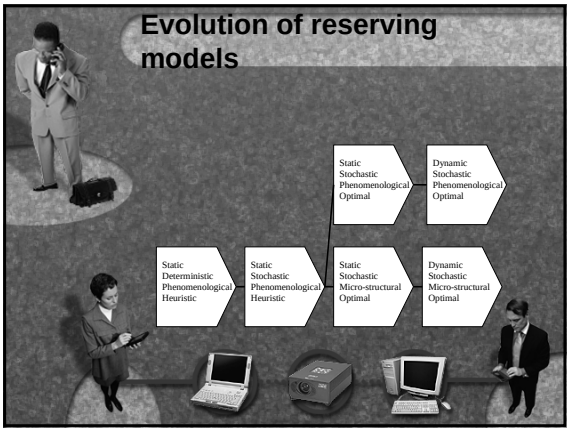

ECR v Canada
ECR


ECR v S&P
ECR

Reserving model taxonomy

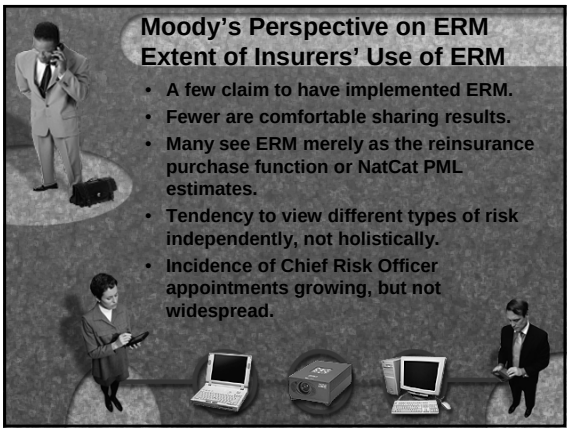


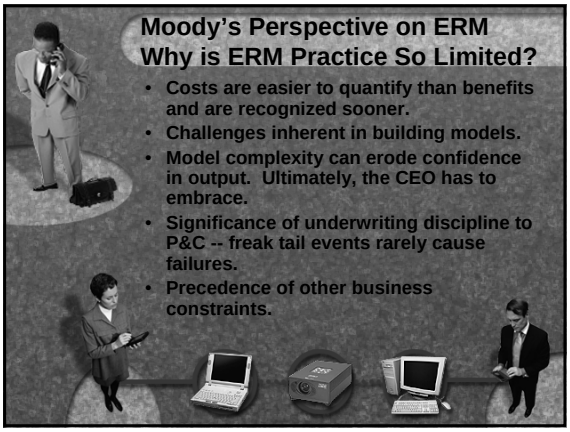
Evolution of reserving models

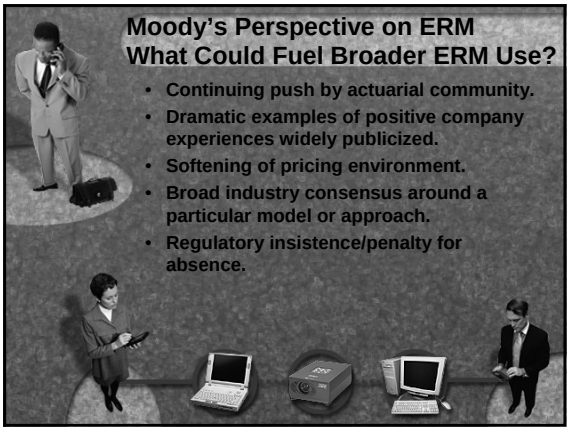


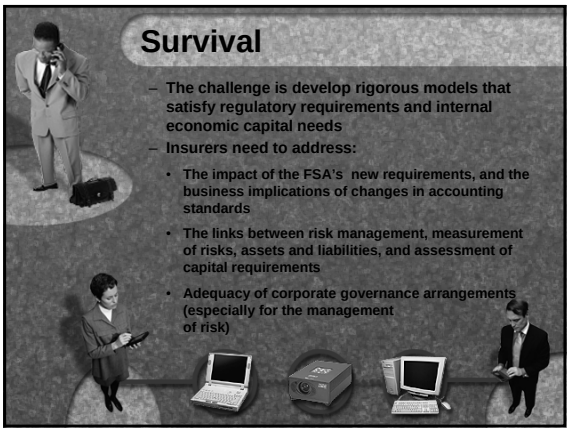
Moody's Perspective on ERM Can ERM Help Ratings?

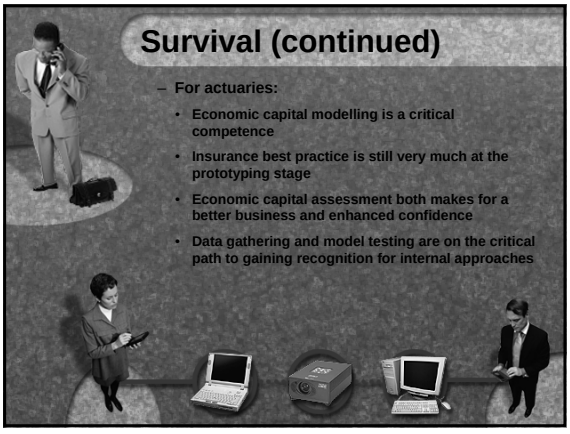
- **Use of ERM is a credit-positive.**
- **ERM can help demonstrate that insurer really knows the key drivers of risk, and has developed a strategy for managing them that follows from a coherent process.**
- **Moody's takes great comfort in cases where the insurer clearly manages its business according to a sensible and comprehensive risk management discipline. This is rare.**

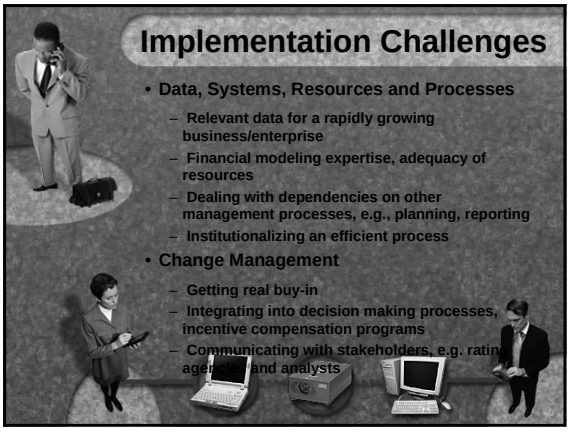

Moody's Perspective on ERM
Extent of Insurers' Use of ERM
• A few claim to have implemented ERM.
• Fewer are comfortable sharing results.
• Many see ERM merely as the reinsurance purchase function or NatCat PML estimates.
• Tendency to view different types of risk independently, not holistically.
• Incidence of Chief Risk Officer appointments growing, but not widespread.


Moody's Perspective on ERM
Why is ERM Practice So Limited?
• Costs are easier to quantify than benefits and are recognized sooner.
• Challenges inherent in building models.
• Model complexity can erode confidence in output. Ultimately, the CEO has to embrace.
• Significance of underwriting discipline to P&C -- freak tail events rarely cause failures.
• Precedence of other business constraints.


Moody's Perspective on ERM
What Could Fuel Broader ERM Use?
• Continuing push by actuarial community.
• Dramatic examples of positive company experiences widely publicized.
• Softening of pricing environment.
• Broad industry consensus around a particular model or approach.
• Regulatory insistence/penalty for absence.

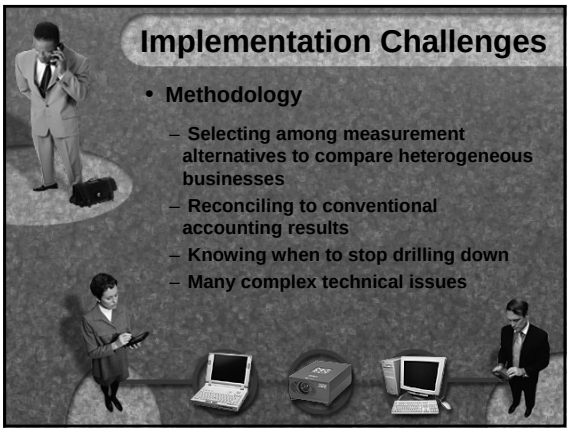

Survival
– The challenge is develop rigorous models that satisfy regulatory requirements and internal economic capital needs
– Insurers need to address:
• The impact of the FSA's new requirements, and the business implications of changes in accounting standards
• The links between risk management, measurement of risks, assets and liabilities, and assessment of capital requirements
• Adequacy of corporate governance arrangements (especially for the management of risk)


Survival (continued)
– For actuaries:
• Economic capital modelling is a critical competence
• Insurance best practice is still very much at the prototyping stage
• Economic capital assessment both makes for a better business and enhanced confidence
• Data gathering and model testing are on the critical path to gaining recognition for internal approaches

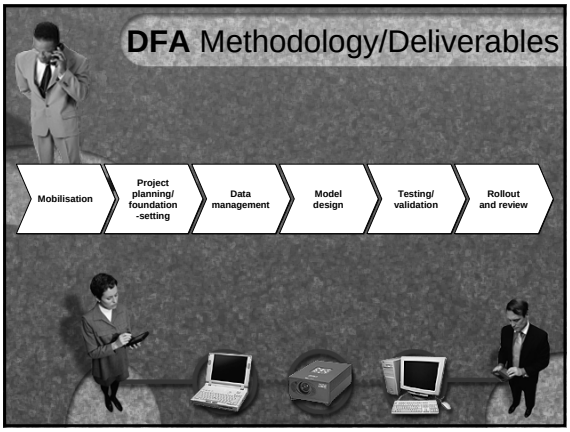

Implementation Challenges
• Data, Systems, Resources and Processes
– Relevant data for a rapidly growing business/enterprise
– Financial modeling expertise, adequacy of resources
– Dealing with dependencies on other management processes, e.g., planning, reporting
– Institutionalizing an efficient process
• Change Management
– Getting real buy-in
– Integrating into decision making processes, incentive compensation programs
– Communicating with stakeholders, e.g. rating agencies and analysts

Implementation Challenges

- **Methodology**
  - **Selecting among measurement alternatives to compare heterogeneous businesses**
  - **Reconciling to conventional accounting results**
  - **Knowing when to stop drilling down**
  - **Many complex technical issues**

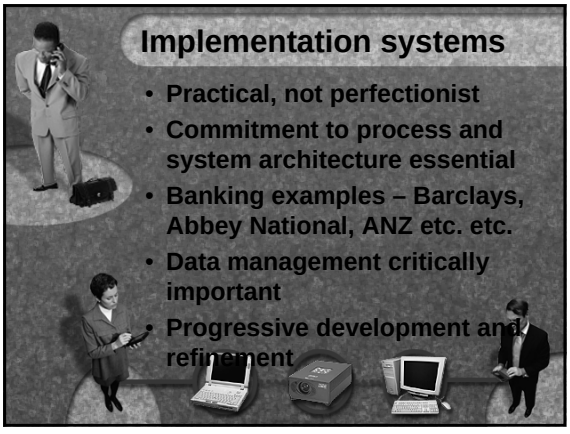


DFA Methodology/Deliverables

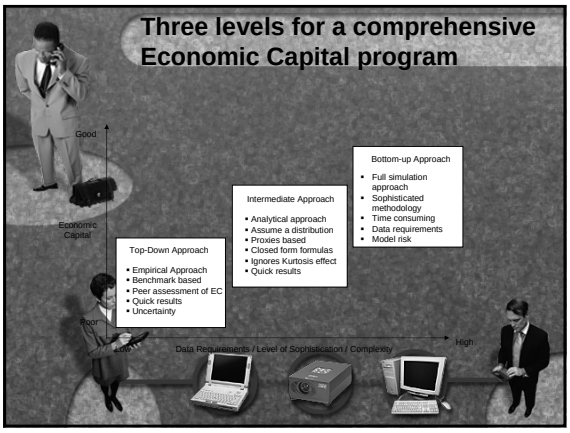


Implementation systems

- **Practical, not perfectionist**
- **Commitment to process and system architecture essential**
- **Banking examples – Barclays, Abbey National, ANZ etc. etc.**
- **Data management critically important**
- **Progressive development and refinement**

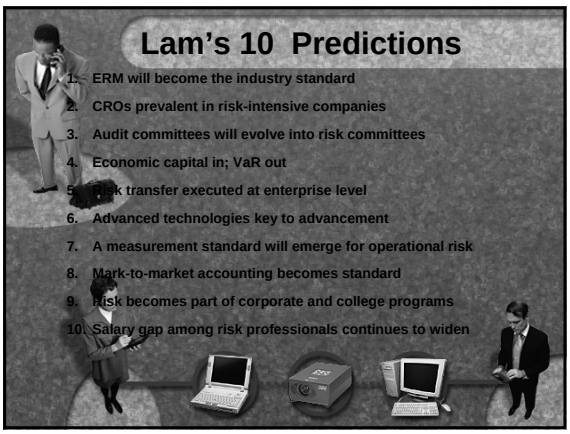


Three levels for a comprehensive Economic Capital program



Lam's 10 Predictions

1. ERM will become the industry standard
2. CROs prevalent in risk-intensive companies
3. Audit committees will evolve into risk committees
4. Economic capital in; VaR out
5. Risk transfer executed at enterprise level
6. Advanced technologies key to advancement
7. A measurement standard will emerge for operational risk
8. Mark-to-market accounting becomes standard
9. Risk becomes part of corporate and college programs
10. Salary gap among risk professionals continues to widen



Meanwhile…….