Insurance Risk Management in the Light of Basel II*

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*also in the light of Solvency 2.

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This talk is based on the following:

- Hans Peter Boller: Solvabilität im Wandel. Internationale Überlegungen und Umsetzung in der Schweiz. BPV Seminar, ETH Zürich, November 3, 2003

- Report of Solvency Working Party, Prepared for IAA Insurance Regulation Committee, February 2002

- Swiss Solvency Test (SST), BPV Bern, October 20, 2003

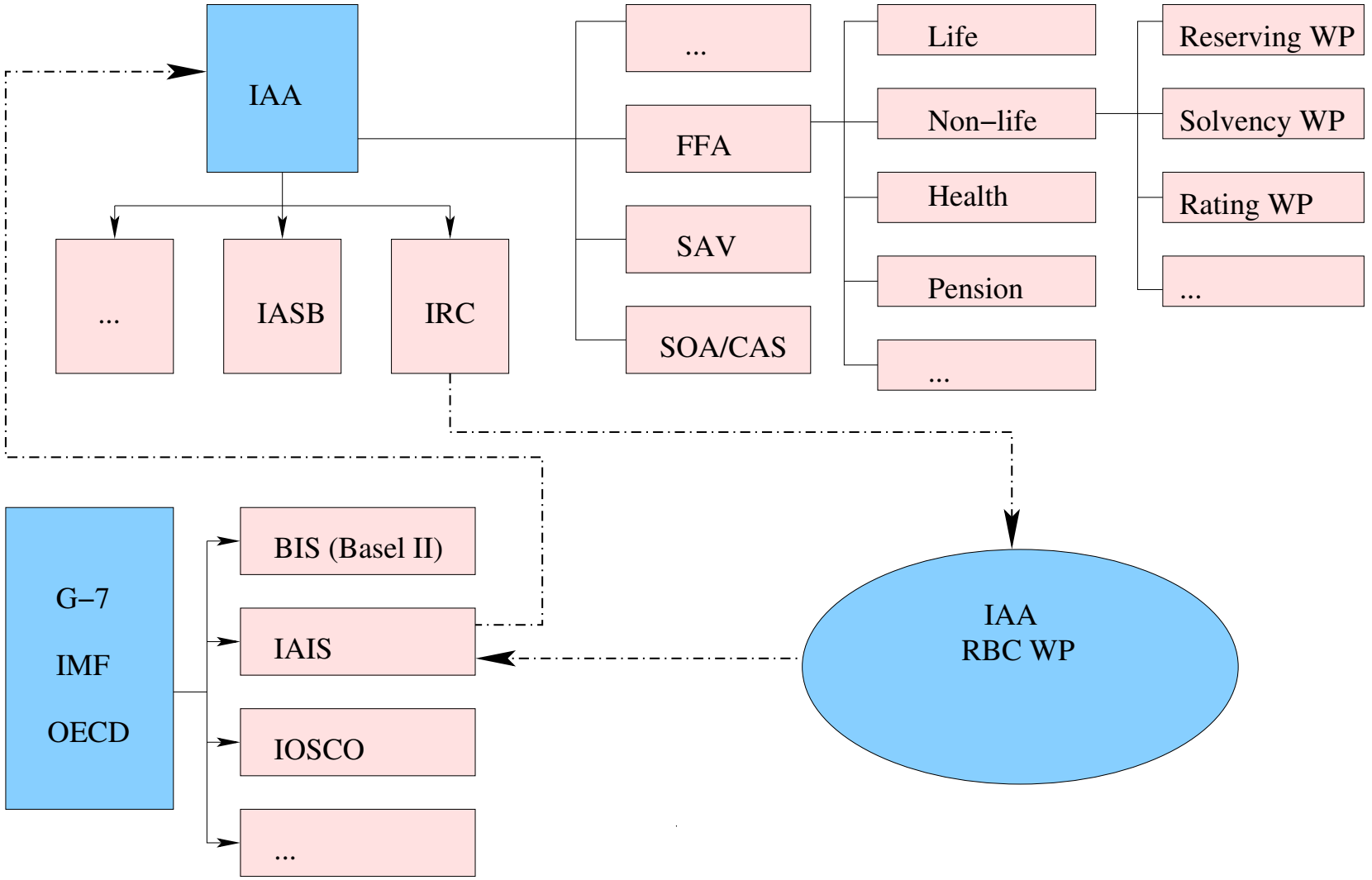
- D. Filipović and P. Keller: Szenarienbasierte Berechnung des Zielkapitals (für eine Einzelperiode), BPV Bern, October 29, 2003

- **Remark**: Don't shoot me, I am only the piano player!

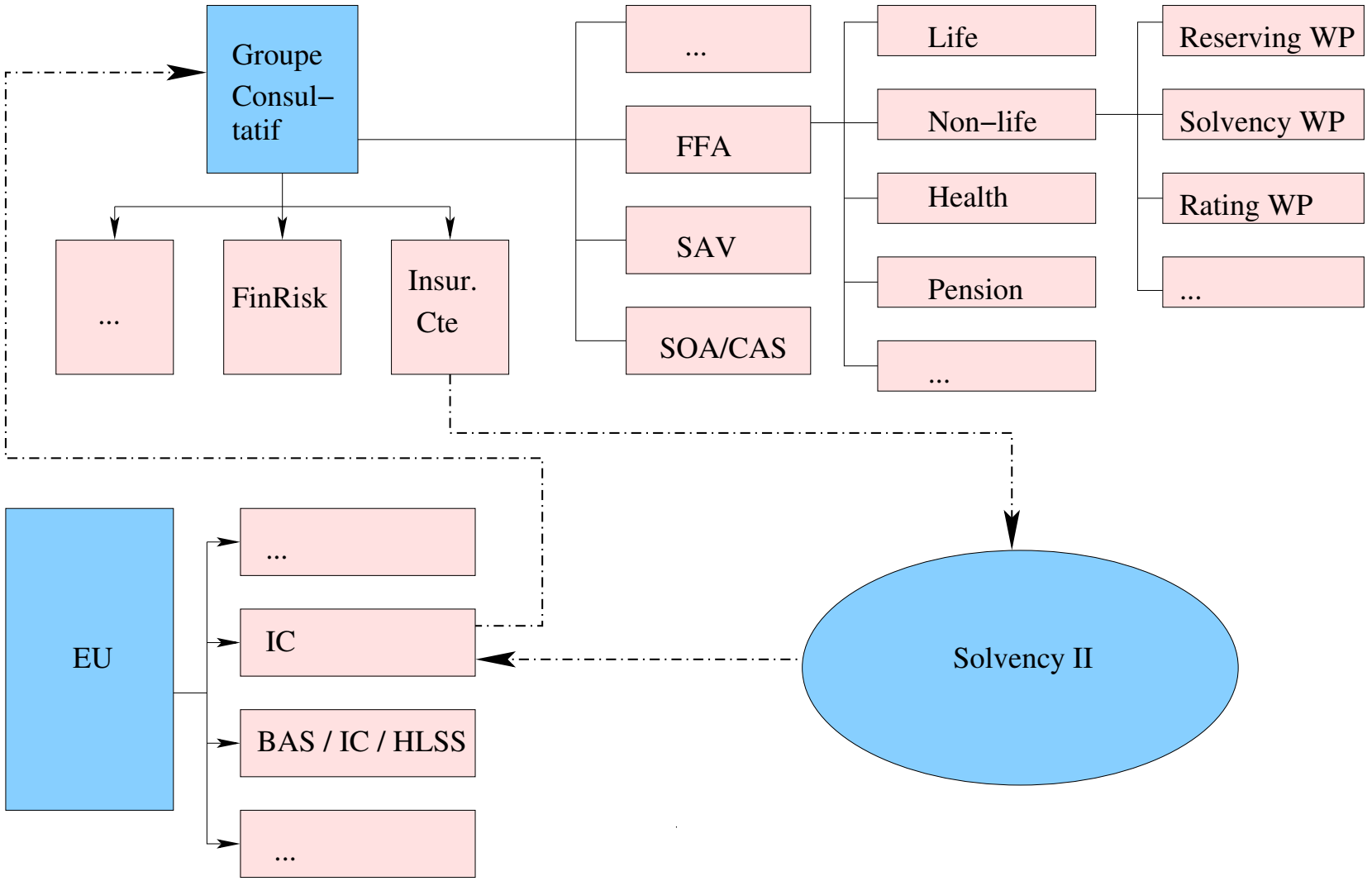
Background and Goals

- Worldwide search for the assessment of solvency for insurance companies
- Who is looking? ➜ Regulators
- Ansätze:
  - Solvency is linked to risk
  - Traditional systems/tools/rules often failed
  - Insufficient early warning from rating agencies
- **Ansatz**: Actuaries should be key players
- As a consequence, regulators look for actuarial support leading to:
  IAA Risk Based Capital Solvency Structure Working Party

Regulation on International Level



Regulation in Europe



Tasks of the IAA WP

IAA forms "Risk Based Capital Solvency Structure Working Party" in the spring of 2002, as requested by the IAIS.

- **Tasks**:
  - Design of a globally applicable risk-based solvency framework for the calculation of capital requirement for non-life, life and health
  - Formulation of methods and principles towards the quantification of solvency
  - Identification of adequate techniques towards the quantification of the risk potentials and the independence between risks
  - Focus on praxis-relevant riskmeasures and internal risk models

Proposed Framework

- Three pillar approach for insurance supervision (à la Basel II):

  ❶ Pillar 1: minimal capital requirements

  ❷ Pillar 2: a supervisory review process

  ❸ Pillar 3: measures to foster market discipline

- **Remark**: rules for capital adequacy (pillar 1) are necessary but not sufficient towards a solvency judgement

- Which risks are to analysed/included?

  - all risks relevant for an insurance company

Proposed Framework (cont'd)

- Principle -versus rules- based approach
  - principle based (CH, UK, NL, "CA",. . .): "do the right thing"-oriented, based on common thrust and risk based regulatory framework
  - rules based ("EU", USA,. . .): objective and easy but probably not capable of mapping all relevant risk factors facing an insurance company
    $\longrightarrow$ could give rise to regulatory arbitrage
- Separate the issues of accounting from the questions of solvency:
  - **accounting** determines the financial progress from period to period (going-concern principle), as such it gives greater emphasis to the annual P&L statement than does
  - prudential **regulation** which focusses on the total balance-sheet under a system that depends upon realistic rules and does not generate hidden surplus

Proposed Framework (cont'd)

- Prudential regulation measures the capacity of insurers to meet their obligations to pay the present and future claims to policy holders (wind-up, run-off, temporarily going-concern,. . .)

- Solvency capital requirement =

$$\text{(total balance sheet requirement)} - \text{(liability requirement)}$$

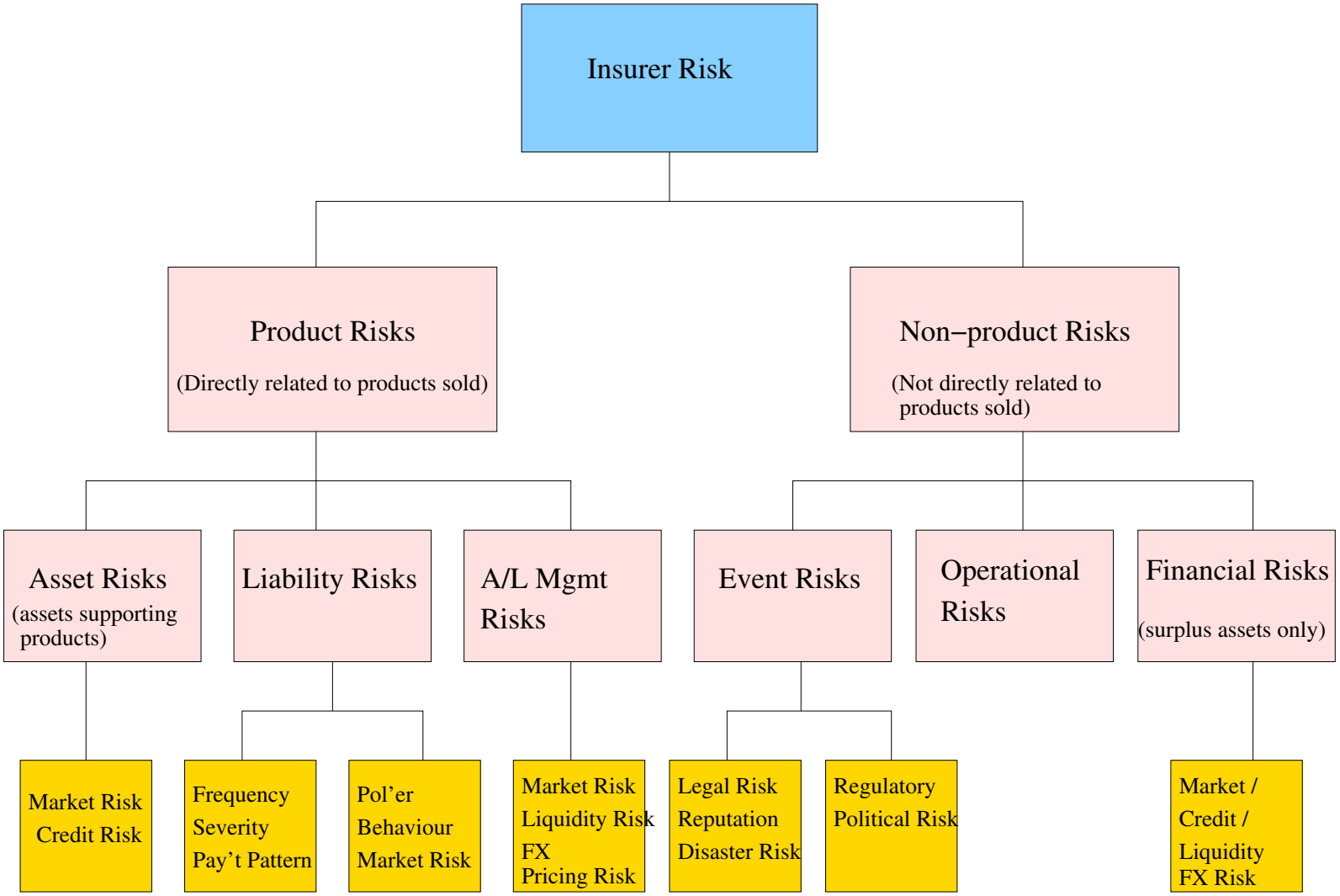
Basel II $\neq$ Solvency 2

- "The difference between the two prudential regimes goes further in that their actual objectives differ. The prudential objective of the Basel Accord is to reinforce the soundness and stability of the international banking system. To that end, the initial Basel Accord and the draft New Accord are directed primarily at banks that are internationally active. The draft New Accord attaches particular importance to the self-regulating mechanisms of a market where practitioners are dependent on one another. In the insurance sector, the purpose of prudential supervision is to protect policyholders against the risk of (isolated) bankruptcy facing every insurance company. The systematic risk, assuming that it exists in the insurance sector, has not been deemed to be of sufficient concern to warrant minimum harmonisation of prudential supervisory regimes at international level; nor has it been the driving force behind European harmonisation in this field"

  (EU Insurance Solvency Sub-Committee (2001))

- Also: continued convergence in the supervision of the financial services sector

A general view of insurer risks



WP chosen risk categories

- Underwriting
- Credit
- Market
- Operational (internal OpRisk Basel II)
- Liquidity (linked to market risk)
- Event (external OpRisk Basel II)

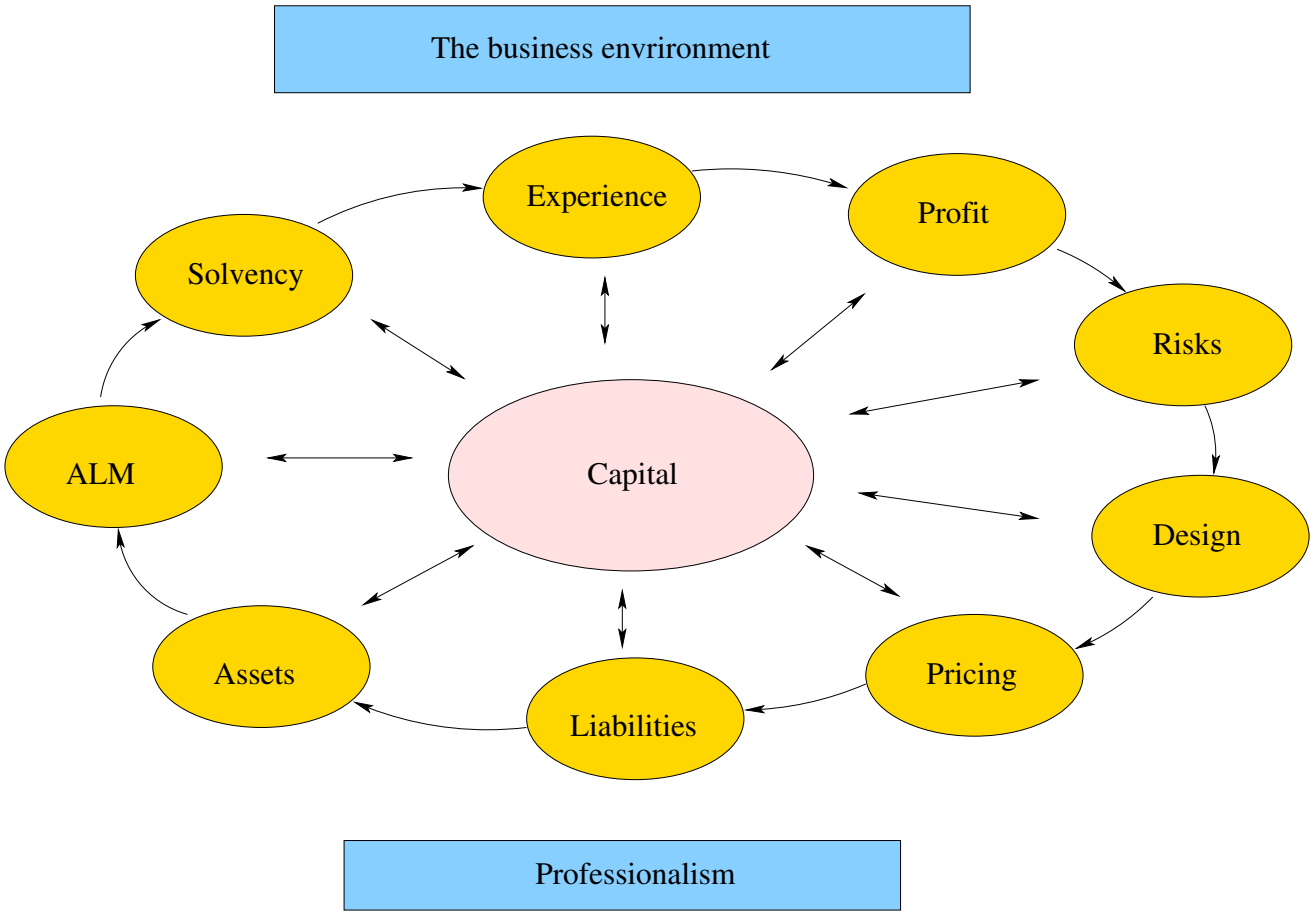
Also note that there are clear interdependencies which need modeling

Overall management of risk by an insurer

- **Ingredients**:
  - design, pricing and underwriting of its insurance policies
  - selection of assets backing the policies
  - estimation of the size and volatility of the liabilities associated with those policies
  - determination of the insurer's capital needs
  - claims management
  - updating of all these elements over time as more data and other information become available or because the underlying risk processes change
  - adequate/sound disclosure/communication process to key stakeholders, e.g. management, investors, policyholders and regulators
  - periodic financial condition analysis, providing a prospective view of the company as a whole

The actuarial control cycle

(Australian Institute of Actuaries)



- A multitude of actuarial tools enter
  - collective risk model
  - aggregate risk models
  - diffusion models and other stochastic processes
  - multi-state models
  - cashflow models
- Specific concerns are:
  - time horizon (long-term RM*)
  - combining risks (copulae*)
  - appropriate risk measures (coherence*)
  - extreme event risk (EVT*)
  - and other . . .
- But at the end of the day, the proof of the pudding is in the eating!

*RiskLab projects/contributions: `www.risklab.ch`

Key components of the new regulatory framework

- Summary:
  - principle-based solvency requirement
  - risk-based
  - expected shortfall as risk measure (beyond VaR!)
  - modeling of dependencies through "increased correlations" or copula based approach, stress scenarios (EVT)
  - transition from conservative standard-factor-model to a full internal model Ansatz (allowing for intermediate levels)
  - potential issues:
    - time-horizon (life versus non-life)
    - confidence level (per risk category, overall level)

Introduction of such a regulatory framework: when?

- EU evaluates the applicability of the framework for
  - solvency 2 (200x?)
  - reinsurance-guidelines (now: 2004)
- new Swiss supervisory body (2004/5)
- consequences for Australia or Canada?
- revision of the US-RBC model in USA?

A concrete set-up: The Swiss Solvency Test (SST)

- Task force (BPV): basic considerations concerning changes to the VAG $\longrightarrow$ March 2003
- BPV initiated the following working parties:
  - Methodology
  - Life & ALM
  - Non-life & reinsurance
  - Assets and capital
  - Operational risks
- Each group consists of representatives from the BPV, industry individual, industry global, consulting firms, banks and academia

SST: time schedule

- **1/10/2003**: Methodology
- **3/2004**:
  - full text available (Verordnungstext)
  - discussed and adjusted (Vernehmlassung)
- **2005**:
  - calibration, parameter
  - start of transition period towards new rules

SST: basic principles

- all relevant risks are taken into account, either quantitatively or qualitatively.
  - the use of internal models is supported
- aim at level playing field
  - consistence with Basel II where relevant
- internationally oriented
  - in agreement with EU solvency rules
  - SST should aim at international "best practice"

SST: capital adequacy

- **Minimal solvency**:
  - as in the EU
  - the last hurdle before insolvency

- **Risk based capital** (RC) =

$$\text{(Market value of assets)} - \text{(Expected discounted liabilities)}$$

- **Target capital** (TC)
  - larger than minimal solvency
  - all relevant risks are mapped
  - If RC $<$ TC, then regulators could/should react appropriately

SST: how to calculate TC

(TC1) Standard approach, mainly using adverse scenarios

- a scenario is a given state of the world
  - 40% equity drop over a given period
  - specific natural catastrophe leading to insolvency of several re-insurers
- order with respect to risk type
- use extra scenarios coming from the regulator and the chief actuary (RM)
- company has to "survive" all scenarios
- the pro-risk calculated capitals are aggregated appropriately

SST: how to calculate TC

- Recall: $RC(t)$: risk based capital at time t

$$RC(t) = A(t) - L(t)$$

  - At time $t = 0$: $RC(0) = A(0) - L(0)$
  - At time $t = 1$: $RC(1) = A(1) - L(1)$ should be positive with a certain high probability

- **Target capital TC**:

$$\boxed{TC := RC(0) + \varrho\big(\widetilde{RC}(1)\big)}$$

where

  - ϱ: coherent risk measure, e.g. worst conditional expectation
  - $\widetilde{RC}$: discounted risk based capital

- **Assumption**:

$$\boxed{\widetilde{RC}(1) = g\big(\boldsymbol{X}(1)\big)}$$

  where

  - $\boldsymbol{X}(1) = (X_1(1), \ldots, X_d(1))$: state vector
  - $\widetilde{RC}$: discounted risk based capital

- **Firm-specific tasks**:

  - Determination of g and the (empirical) distribution of $\boldsymbol{X}(1)$
  - Calculation of $\varrho\big(\widetilde{RC}(1)\big)$ for different scenarios, where $\varrho = \mathsf{WCE}_\alpha$

- **WCE**: Worst conditional expectation (a coherent, scenario-based risk measure)

$$\mathsf{WCE}_\alpha(X) = \sup\Big\{\mathbb{E}[-X|A] \;\Big|\; A \in \mathcal{F},\ \mathbb{P}(A) > \alpha\Big\}$$

(TC2) Internal model

- **aim**: calculation of TC, at least in part

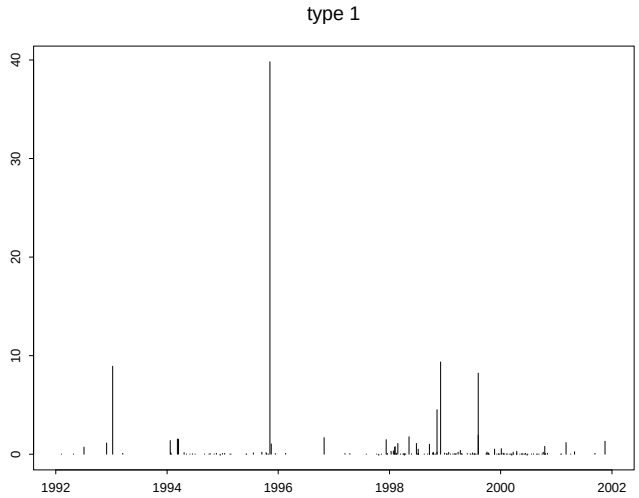
  - add effects from predetermined scenarios

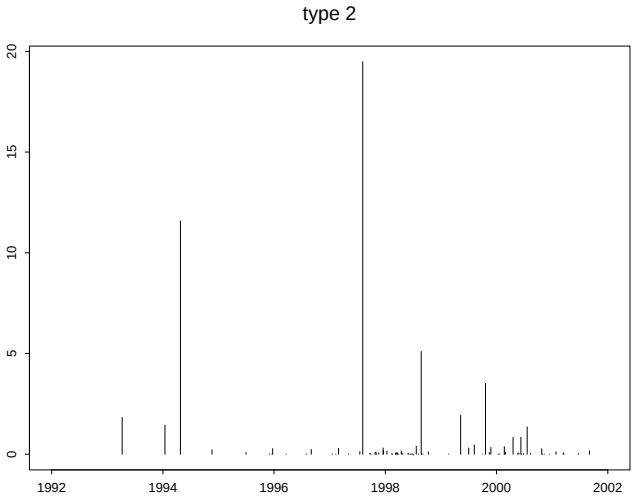
- internal models have to be verified and accepted

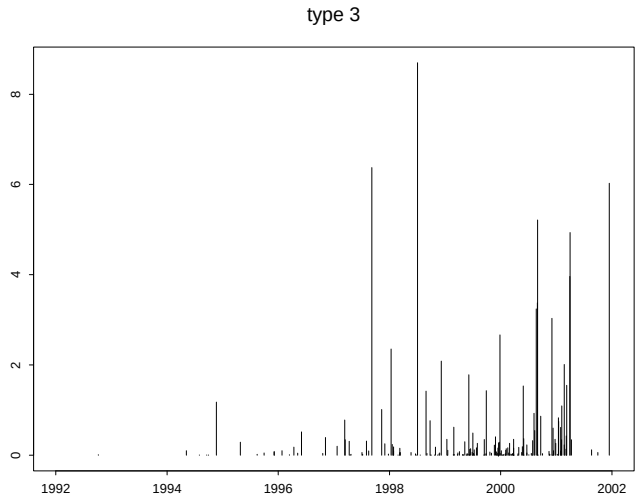
- they have to be integrated in the insurers' processes

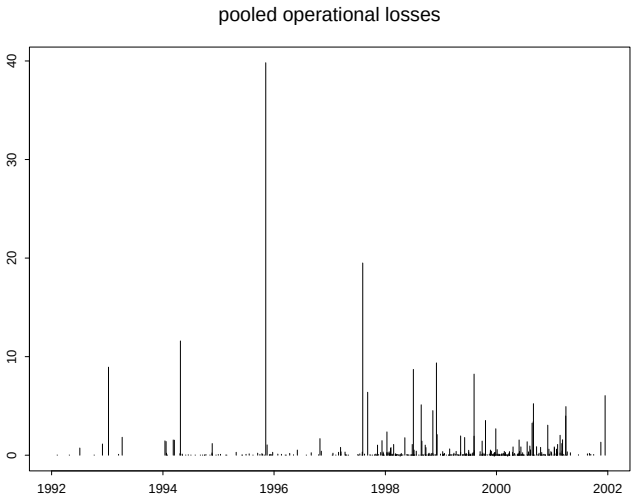
- have to be based on a stochastic approach and have to be able to produce a distribution function

Some aspects on OpRisk: data









Some aspects on OpRisk: modelling issues

- Stylized facts about OP risk losses:
  - Loss occurrence times are irregularly spaced in time (selection bias, economic cycles, regulation, management interactions,. . .)
  - Loss amounts show extremes
- Large losses are of main concern!
- Repetitive vs non-repetitive losses
- **Red flag**: Are observations in line with modeling assumptions?
- Example: "iid" assumption implies
  - NO structural changes in the data as time evolves
  - Irrelevance of which loss is denoted X_1, which one X_2,. . .

Some aspects on OpRisk: the problem

- In-sample estimation of $\text{VaR}_\alpha(L^{t+1})$ (α large) impossible!
- Estimation of the (far-) tail of L_t via subcategories:

$$L = \sum_{\ell=1}^{N} Y_\ell \,, \qquad 1 - F_Y(x) \sim x^{-\alpha} h(x) \;, \qquad x \to \infty$$

$$\rightarrow \quad 1 - F_L(x) \sim \mathbb{E}[N]\, x^{-\alpha} h(x) \;, \qquad x \to \infty$$

- Standard actuarial techniques:
  - Approximation (translated gamma/lognormal)
  - Simulation
  - Inversion methods (FFT)
  - Recursive methods (Panjer)

How accurate are VaR-estimates?

- **Assumptions**:
  - (L_m) iid $\sim F$
  - For some ξ, β and u large ($G_{\xi,\beta}$: GPD):

$$F_u(x) := \mathbb{P}(L - u \leq x | L > u) = G_{\xi,\beta(u)}(x)$$

- Tail- and quantile estimate (based on EVT):

$$1 - \hat{F}_L(x) = \frac{N_u}{n}\left(1 + \hat{\xi}\frac{x-u}{\hat{\beta}}\right)^{-1/\hat{\xi}}, \quad x > u.$$

$$\widehat{\mathrm{VaR}}_\alpha = \hat{q}_\alpha = u - \frac{\hat{\beta}}{\hat{\xi}}\left(1 - \left(\frac{N_u}{n(1-\alpha)}\right)^{\hat{\xi}}\right)$$

How accurate are VaR-estimates? (cont'd)

- **Idea**: Comparison of estimated quantiles with the corresponding theoretical ones by means of a simulation study (McNeil and Saladin 1997)

- **Results**: in order the quantile estimate be accurate (in terms of bias and standard error), a large number of observations is required. "Large": $\approx$ 1,000 claims p.a.

- The number of observations has to increase in the same way as the tails of the underlying distributions become thicker

- **Remember**: The simulation study was done under idealistic assumptions. OpRisk losses, however, typically do **NOT** fulfil these assumptions.

Conclusions

- Concretization of minimal solvency rules
- Principle-based thinking
- Driven by Solvency 2 and in line with Basel II
- From collaboration to joint supervision
- Many technical an organisatorial problems remain
- Insurance analytics