

Developing and maintaining Swiss Re's Internal Risk Model ICAM in MATLAB

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Key Takeaways

1. Swiss Re has developed a professional enterprise application with MATLAB
2. MATLAB and Swiss Re's internal risk model ICAM have been growing over the last decade
3. Measurable outcome: transparency, flexibility, maintainability

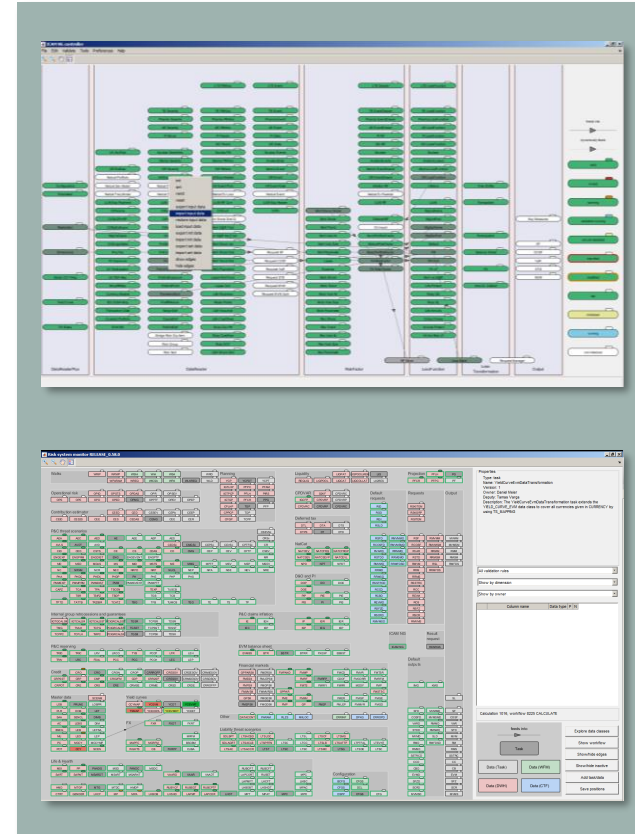


Swiss Re

- Swiss Re is the world's second largest reinsurer
- Founded in 1863, head quarters based in Zurich with offices in 25+ countries and 14'000+ employees
- Shareholders' equity 2016: USD 35.6bn
- Net premiums/fees earned 2016: USD 33.2bn
- CO₂ programme (2013-2020 Greenhouse Neutral Programme)
- Launch of Swiss Re Institute in 2017 (<http://institute.swissre.com>)

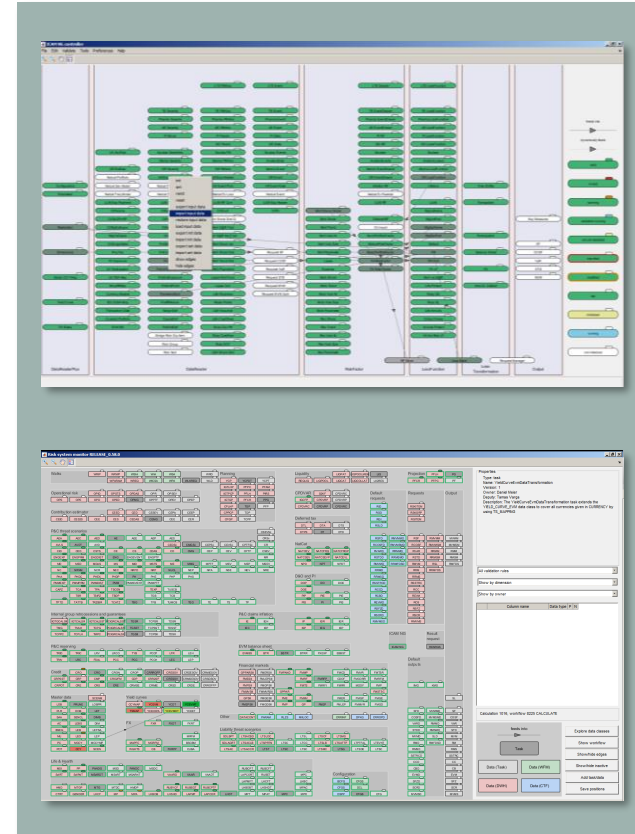
Swiss Re's Internal Risk Model ICAM (internal capital adequacy model)

- Long history of using an internal risk model to steer the company and for regulatory purposes: Swiss Solvency Test (SST) and Solvency II
- For a decade, Swiss Re has used **MATLAB** to implement its internal risk model **ICAM**
- ICAM is developed/maintained by **Risk Modelling**, a team of 13 people with a broad range of educational backgrounds



Swiss Re's Internal Risk Model ICAM (internal capital adequacy model)

- In 2017, Swiss Re concluded a major project called **IRAMP** (integrated risk analytics & modelling platform) to overhaul ICAM with key goals
 - transparency
 - flexibility for future developments, maintainability
 - speed
 - precision of risk measures (expected shortfall, value at risk, etc.)



Many different approaches to present ICAM...



Mathematical/actuarial/algorithmic approach



IT/technical approach

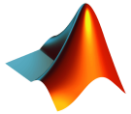


Economic/risk management approach



Educational/training approach

Many different approaches to present ICAM...

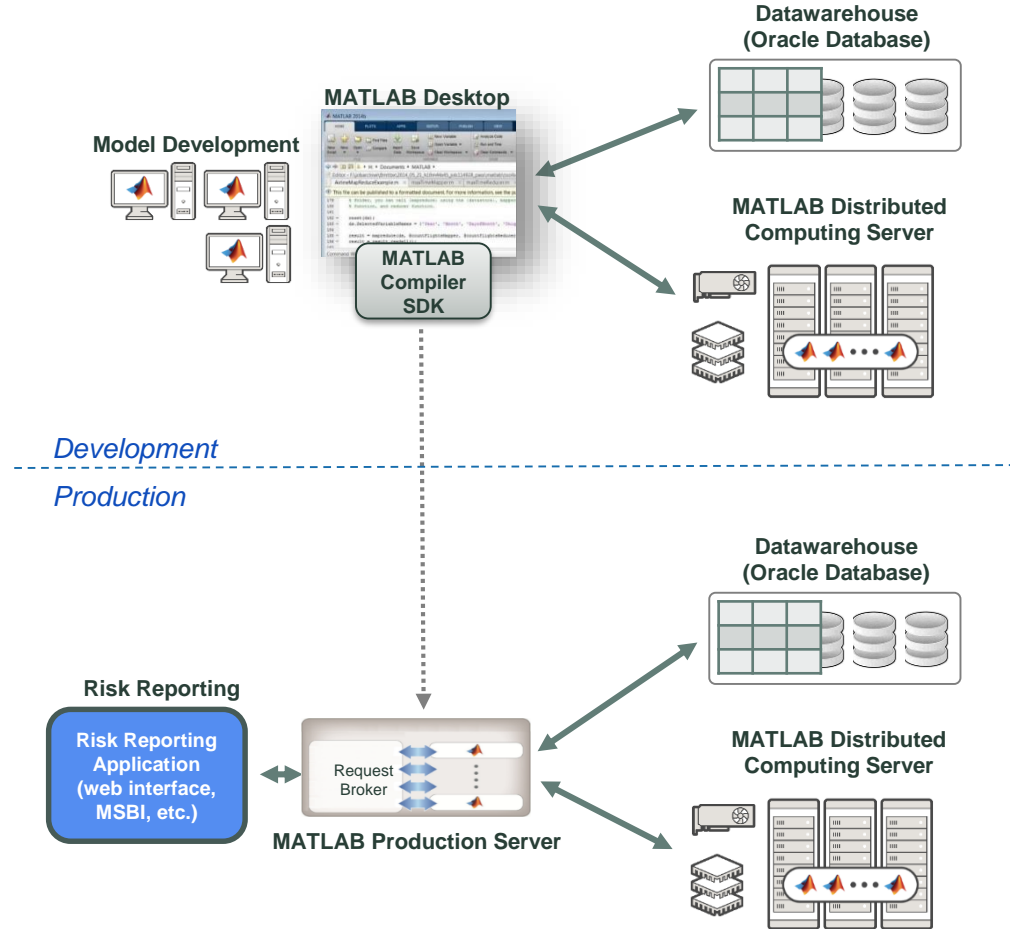


“MATLAB approach” – why and how are we using MATLAB?

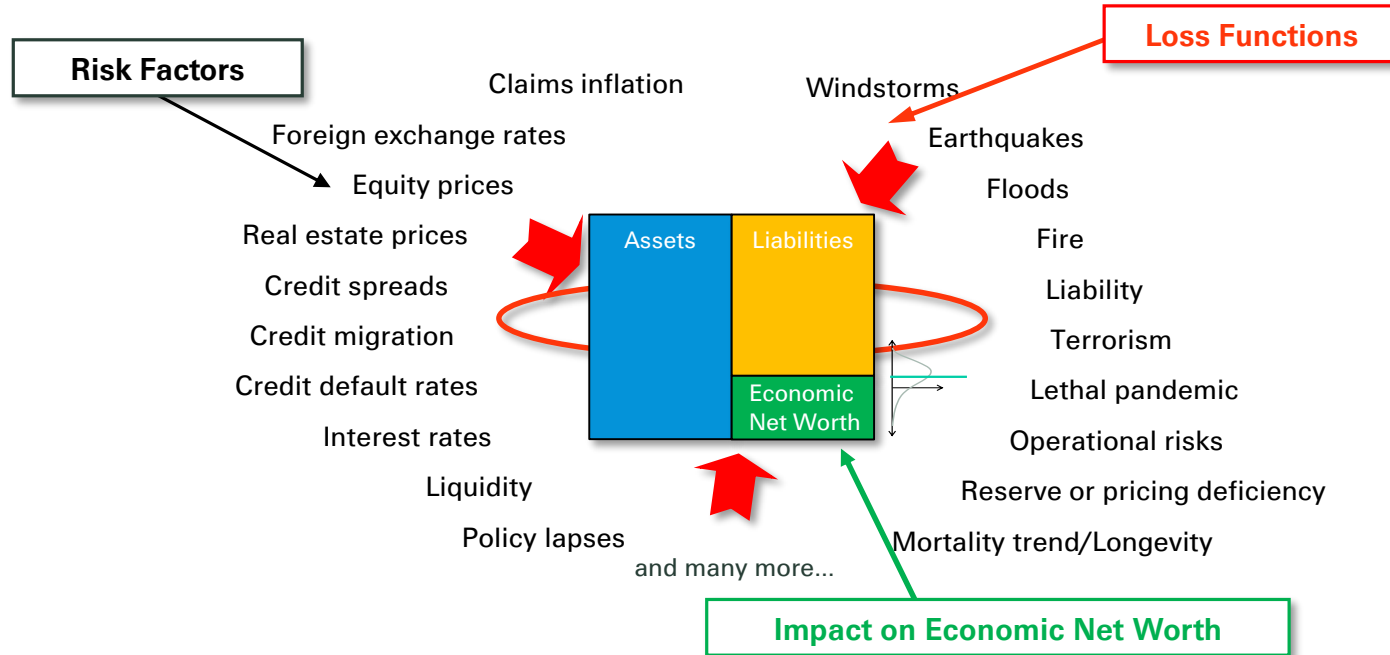
- All-in-one solution: parallel computing, data import/export, profiler, debugger, unit testing framework, GUIs, algorithm collection, speed, etc.
- Flexibility for Risk Modellers
- KISS principle (keep it safe, simple, smart, etc.)
- MathWorks is a strong partner to avoid FOMO (fear of missing out) while current tools landscape is growing too fast to follow

System Architecture

- Model development in development (and training) environment, 160 workers on MDCS, use of Parallel Computing Toolbox, 30+ users working directly with MATLAB
- Generation of risk reports in production environment, 224 workers on MDCS, risk reports essentially are consumed by the whole company as well as external stakeholders, e.g. regulators, auditors, rating agencies, etc.



ICAM Overview



An integrated risk model is needed to understand the aggregate **joint** impact of all risk factors on the total economic balance sheet

ICAM Demo (running on modified/artificial data)

ICAM NG controller

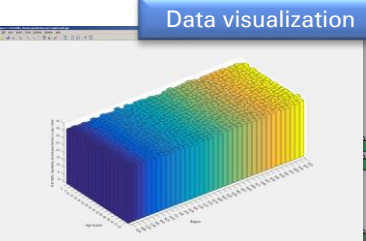
File Edit Validate Tools Preferences Help

ICAM main user interface

The interface displays a grid of controls for various risk factors and data readers. The controls are organized into columns and rows, with labels such as 'LTS PFAloc', 'LTS Event', 'LTS Drawer', and 'LTS LossFunction'. A central menu is open, showing options like 'import input data', 'restore input data', and 'export init data'.



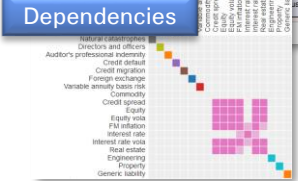
Legal entity network



Data visualization

Export/modify/import functionality for all objects

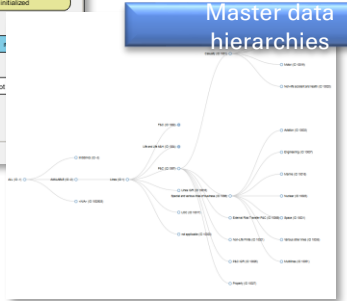
Well-defined objects (risk factors, loss functions, loss transformations, etc.) keeping track of all dependencies



Dependencies



Contributions to shortfall



Master data hierarchies

ICAM Demo (running on modified/artificial data)

Risk System monitor

Validation rules run on data classes

All data classes and tasks have an owner/deputy, description, version

Keeping track of all data flows

Data classes (simple tables)

Tasks (transformations, filters, models, pre-processing, etc.)

Properties

- Type: task
- Name: YieldCurveEvmDataTransformation
- Version: 1
- Owner: Daniel Meier
- Deputy: Tamas Varga
- Description: The YieldCurveEvmDataTransformation task extends the YIELD_CURVE_EVM data class to cover all currencies given in CURRENCY by using TS_MAPPING

All validation rules

Show by dimension

Show by owner

Column name	Data type	P	N

Calculation 1016, workflow 8225 CALCULATE

feeds into

Task

Data (Task) Data (WFM)

Data (DWH) Data (CTF)

Explore data classes

- Show workflow
- Show/hide edges
- Show/hide inactive
- Add task/data
- Save positions

ICAM Demo (running on modified/artificial data)

The screenshot displays the ICAM IIG controller software interface. The main window is titled "Portfolio manager" and features a hierarchical node selection tree on the left. The tree includes nodes such as "ALL", "AVAILABLE", "All Values of Potential", "Operational", "Insurance", "Man-made", "Financial market and credit", "Life & health", "Natural catastrophes", "Costing and reserving", and "Claims inflation".

At the top of the interface, there are several buttons for "Engineering PTF All", "Engineering Prop", "Engineering", "Engineering", "Property MM PTF All", "Property MM Prop", "Property Maintenance", "Property Maintenance", "LTP PTF All", "LTP Prop", "LTP", and "LTP".

Below the node selection tree, there are two "Selection" tabs (Selection 1 and Selection 2) and a "Node selection" section with "Expand all" and "Collapse all" buttons.

On the right side, the "Realization characteristics" section contains four plots: CDF, PDF, Scatter plot, and QQ plot. Below these plots are two tables summarizing risk measures and dependency measures.

Risk measure/property	Value selection 1	Value selection 2
1 Shortfall 99% [m USD]	11287	11287
2 VaR 99.5% [m USD]	8741	8741
3 Std [m USD]	2392.6	2393
4 Kurtosis	15.2	15.2
5 Shortfall 99%/Std	4.7	4.7

Dependency measure	Value
1 Correlation	1.00
2 Relative cosf 99% (2 to 1)	1.0
3 Relative cosf 99% (1 to 2)	1.0

ICAM in Numbers

- More than 500 data classes (tables) with about 5'000 data attributes (columns) in total
- About 60 tasks (transformations, pre-processing, etc.)
- About 280 classes for risk factors, loss functions, etc. in ICAM
- Currently about 200 data validation rules – number still growing
- About 450 unit tests
- About 80'000 lines of code
- About 20 user interfaces for risk exploration, as-if calculations, education, etc.

Conclusion and Summary

- Swiss Re has developed a professional enterprise application with MATLAB
 - the key goals transparency, flexibility, maintainability were achieved by making extensive use of what MATLAB offers, e.g. graphical user interfaces, object-oriented programming, unit tests, data exploration tools, profiler, debugger, etc.
- Forward-looking plans
 - further model development
 - internal (and external) trainings
 - explore potential cloud migration

MATLAB is an excellent all-in-one solution for developing and maintaining Swiss Re's complex internal risk model ICAM.



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