

The Solvency II regulatory framework calls for a change in behavior of insurers and for a new attitude to risk management. Compliance with Solvency II requirements may have a strong influence on the basic operations of an insurance company, starting from the management system, organizational structure or process adjustments, and ending with product definition, reinsurance set-up or asset management. Explicit definitions of solvency calculations and supervisory reporting combined with demands to data quality and auditability are a vast challenge for IT.

Requirements of the Solvency II regulatory framework are often divided into three pillars similar to the Basel II banking regulations:

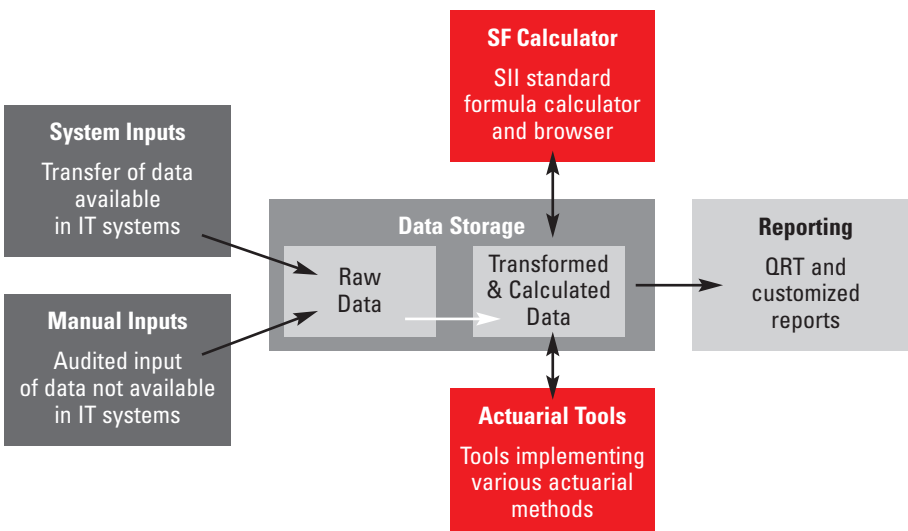
**Pillar 1** – quantitative requirements – defines the calculations (the standard formula or an internal model approved by a supervisor) and requirements for data quality, auditability and traceability.

**Pillar 2** – qualitative requirements – sets out requirements for the governance and risk management of insurers including Own Risk and Solvency Assessment (ORSA).

**Pillar 3** – disclosure and transparency requirements – focuses mainly on supervisory reporting and public disclosure.

In a practical sense, there are two basic, and inevitable, technical impacts for insurers. The first is the obligation to assemble an economic balance sheet and to calculate the standard formula to determine solvency capital requirements and the solvency ratio (that belongs to Pillar 1). The second impact is the obligation to fulfill regulatory reporting requirements that are defined by QRT (Quantitative Reporting Templates – belong to Pillar 3).

Extensive demands for calculations and reporting, together with requirements for a systemic approach and data traceability from inputs to outputs, make an appropriate IT solution quite challenging. Our approach to solving these issues is briefly summarized in the following picture:



All data needed for Solvency II calculations are gathered in the Data Storage, as well as partial results of all computational steps.

A data transfer from the available IT systems is the preferred way of how to get input information for Solvency II calculations. Data are transferred to the raw data area of the data storage and then transformed to the target Solvency II data model. All inputs are handled by ETL (Extract & Transformation & Load) processes and monitored for data quality. In a perfect world, all information needed for Solvency II calculations would be obtained this way.

In actuality, some data may not be available in IT systems, or their proper processing may be too demanding. In this case, audited Manual Inputs is the next best choice. The data are not transferred from systems, but treated manually and saved in the raw data area. Manual data inputs should follow strict rules and workflow.

Actuarial Tools and the Standard Formula Calculator read the input data from the Data Storage, perform calculations and then write back the results. Afterwards all necessary data are ready to be reported.

## Actuarial Tools

Elaboration of the standard formula calculation involves a lot of inputs which can only be produced using specific calculation tools (e.g. best estimate/fair value of liabilities/assets and their stresses etc.). Our experience shows companies lacking actuarial tools, especially in inadequate verification and documentation, and, frequently, a poor user interface vulnerable to operation risks.

This is why we have created and offer a set of actuarial tools which are always:

- prepared by experienced actuaries who are theoretically well-versed
- validated independently by senior actuaries
- fully documented featuring a User Guide describing how to use the tool and including all the actuarial principles involved as well as an interactive help option
- communicating via a well-designed free to operation risk interface.

In this section, we mention several useful actuarial tools which can help you in the SII calculation process.

### Value of life liabilities

Solvency II calculations require the company to deliver the best estimate/fair value of life liabilities including their stresses (e.g. for market risk or underwriting risk). The calculation of these values requires detailed cash flow projections and stochastic scenario applications. It is very demanding for the SW capability to be run in an acceptable time period.

For this purpose, we offer *Sophas*, a professional actuarial system that is specifically prepared to create robust and fast running cash flow models used primarily for life liability value calculations – including deterministic and stochastic ones – in a user-friendly environment.

### Non-life liabilities

Values of the non-life liabilities (especially the claims reserves) are usually determined using development triangles. A *Claims Reserve Calculator* covers a variety of chain-ladder methods and offers many analytical features for easy and straightforward calculations and results verification.

Where a calculation based on individual (non-aggregated) data is more relevant (e.g. where the claims volatility is high and where reinsurance and cover limits are important) we can also provide you with a tailor made models applying deterministic as well as stochastic approach.

### The value of financial instruments and their stress testing

We offer the *Asset Model* tool which allows you to calculate and stress the market values of financial instruments (e.g. for the purpose of the market risk calculation) and project monthly developments of corresponding variables (cash flows, market values, amortized costs, accrued interests and other book figures, PL and BS and other reporting figures, duration, convexity and other assets characteristics, yield indicators, etc.).

Since the calculation of the above-mentioned figures needs at least the current yield curve (typically the risk free) and its simulation using an economic scenario generator (ESG) we also offer the following tools:

### Yield Curve Fitting

*Yield Curve Fitting* tool generates the portfolio yield curve based on market data (price, yield to maturity, etc.) of the relevant (typically “risk free”) assets.

### Economic Scenario Generator

- ESG – Yield Curve Simulation* is an application designed to provide you with risk neutral interest rate scenarios applying approved techniques optimized for short run-time and including sophisticated features improving the speed of convergence of the follow-up actuarial calculations
- ESG – Yield Curve Calibration* – calibrated parameters to be used in the simulation tool (ESG – Yield Curve Simulation) are the results of this tool.

As a supplement to all of these tools, the Actuarial Functions add-in to MS Excel, which lets you easily create actuarial figures (in a form of functions), is available.

Input data - List of Financial Instruments of Current Portfolio												
Valuation Date		30.6.2011		Fill in the last day of month								
Basic Currency for the Outcomes		EUR										
ID	Name	ISIN	Type of the Instrument	Fix or float for bonds or swaps	Day Count Convention	Face Value (PV)	Exchange Differences On Valuation Date	Income % (p.a.) (coupon, dividend,...)	Coupon Spread % (p.a.) for float	Income freq.	Income month	Maturity
1	Fix bond GBP	111	Bond	Fix	30E/360	3 400 000	-714 570	4,00%		1		2.5.2015
2	Fix bond EUR	112	Bond	Fix	30E/360	4 107 620	0	4,00%		1		2.5.2015
3	Float bond USD	113	Bond	Float	30E/360	300 000 000	-19 546 378	3,00%	1,00%	4		26.9.2015
4	Float bond EUR	114	Bond	Float	30E/360	2 8 645 718	0	3,00%	1,00%	2		26.9.2015
5	Deposit EUR	115	Deposit		30E/360	1 000 000	0	1,70%		1	12	12.1.2015
6	Savings account EUR	116	Savings account		30E/360	87 152	0	2,30%		1	8	16.2.2015
7	Government T-bills EUR	117	Government T-bills		30E/360	3 000 000	0	1,30%		2	2	1.3.2015
8	Current account USD	118	Current account		30E/360	5 000 000	-309 303	0,00%		1	11	26.5.2013
9	Deposit EUR	119	Deposit		30E/360	246 457	0	0,00%		2	4	21.6.2013
10	Share USD	120	Share		30E/360	10 000 000	-2 819 767	1,00%		1	4	
11	Share EUR	121	Share		30E/360	1 643 848	0	0,00%		4	3	

Iteration	alpha	alpha min	alpha max	sigma	sigma min	sigma max	gamma	Max iterations
27	0.018139481579080	0.005840437325413	SSE: 0.000510681329659					
28	0.014537952553470	0.005529127547293	SSE: 0.000459726511195					
29	0.014532670459294	0.005591122477694	SSE: 0.00044590271126					
30	0.014531779316449	0.005587564925346	SSE: 0.000444538557584					
31	0.0145323995566177	0.005589981965512	SSE: 0.000444500251152					
32	0.013095322726498	0.005492344925375	SSE: 0.000438619632285					
33	0.013095624268013	0.005488107538099	SSE: 0.000438540431427					
34	0.013095627973895	0.005488162372586	SSE: 0.000438540417565					

Year	Month	Day	Face Value (PV)	Exchange Differences	Income % (p.a.)	Coupon Spread % (p.a.)	Income freq.	Income month	Maturity
2011	6	30	3 400 000	-714 570	4,00%		1		2.5.2015
2011	6	30	4 107 620	0	4,00%		1		2.5.2015
2011	6	30	300 000 000	-19 546 378	3,00%	1,00%	4		26.9.2015
2011	6	30	2 8 645 718	0	3,00%	1,00%	2		26.9.2015
2011	6	30	1 000 000	0	1,70%		1	12	12.1.2015
2011	6	30	87 152	0	2,30%		1	8	16.2.2015
2011	6	30	3 000 000	0	1,30%		2	2	1.3.2015
2011	6	30	5 000 000	-309 303	0,00%		1	11	26.5.2013
2011	6	30	246 457	0	0,00%		2	4	21.6.2013
2011	6	30	10 000 000	-2 819 767	1,00%		1	4	
2011	6	30	1 643 848	0	0,00%		4	3	

## Standard Formula Calculator

The *Standard Formula Calculator* assembles the economic balance sheet and computes the own funds on the one hand, on the other it computes values for all risks required by the standard formula thus completing solvency capital requirements. Minimum capital requirements and resulting solvency ratios are evaluated too, of course.

The calculator has defined sets of inputs and outputs. Both inputs and outputs are supposed to be stored in the Data Storage and can be read/written directly from/to the database. Communication via text files is available too. Inputs have a level of granularity that keeps all computations traceable and consistent within the calculator. Outputs are defined in a manner that is compliant with QRT reports. This means that figures related to the standard formula demanded by QRT are submitted by the calculator. Moreover, an enhanced set of items can be returned by the calculator, if needed.

There are three modes of usage of the calculator:

**Preview mode** – the input data is read by the calculator from the Data Storage without saving results. Then all inputs, partial and final results can be seen and browsed. Thus, the entire standard formula is superbly visualized, showing “the story” from inputs to outputs and enabling the user to check all the figures.

**Calculation mode** – writes results back to the database or saves them to text files. In this mode the calculator acts as a pure calculation engine or an external module, seen from the viewpoint of the Data Storage.

**Free mode** – enables the user to save the standard formula as a standalone MS Excel file. This file contains the input data, has no connection to the Data Storage and can be freely edited making it a perfect tool for sensitivity analysis within the standard formula.

Overall the Standard Formula Calculator is a simple, comfortable tool providing clearly defined and auditable calculations. It enables input data verification in the context of the standard formula and browsing through all partial results. Moreover there is the possibility of additional sensitivity analysis.

Balance sheet	Solvency II value	Statutory accounts value
<b>Excess of assets over liabilities</b>	66 353	98 142
<b>Total assets</b>	353 296	368 497
<b>Total liabilities</b>	286 943	270 355
<b>1000 Assets</b>	<b>353 296</b>	<b>368 497</b>
1001 Goodwill	0	0
1002 Deferred acquisition costs	0	0
1003 Intangible assets	5 443	5 443
1004 Deferred tax assets	0	0
1005 Pension benefit surplus	0	0
1006 Property, plant & equipment held for own use	0	0
1007 <b>Investments (other than assets held for index-linked and unit-linked fi</b>	286 430	301 631
1008 Property (other than for own use)	0	0
1009 Participations	0	0
1010 Equities - listed	22 343	21 224
1011 Equities - unlisted	0	0
1012 Government Bonds	201 221	220 765
1013 Corporate Bonds	45 322	42 098
1014 Structured notes	0	0
1015 Collateralised securities	0	0
1016 <b>Investment funds</b>	17 544	17 544
1017 including equities in invested funds	0	0
1018 including government bonds in invested funds	17 544	17 544
1019 including corporate bonds in invested funds	0	0
1020 including property in invested funds	0	0
1021 including derivatives in invested funds	0	0
1022 including other financial assets in invested funds	0	0

Counterparty default risk			
<b>SCR<sub>let</sub></b>	6 750		
<b>SCR<sub>type 1</sub></b>	3 877	<b>SCR<sub>type 2</sub></b>	3 336
<b><math>\sigma</math> / LGD<sub>type 1</sub></b>	3,41%	<b>LGD<sub>reco3m</sub></b>	1 554
<b>LGD<sub>type 1</sub></b>	37 879	<b>LGD<sub>other</sub></b>	12 914
<b><math>\sigma</math></b>	1 292		
<b>V</b>	1 670 075		
<b>V<sub>incr</sub></b>	912 285		
	<b>PD</b>	<b>LGD</b>	
	0,050%	28 177	
	0,500%	45	
	1,200%	1 874	
	1,570%	7 783	
<b>V<sub>intm</sub></b>	757 791		
	<b>PD</b>	<b>LGD<sup>2</sup></b>	
	0,050%	557 937 091	
	0,500%	2 025	
	1,200%	3 512 531	
	1,570%	60 572 428	

### Are the tools everything you need for Solvency II calculations?

The Actuarial Tools provide a bunch of sophisticated calculations. They are the heart of Solvency II. The value of life and non-life liabilities, the value of financial instruments and a related set of stressed values are the basic figures with a crucial effect on the value of own funds, SCR and resulting solvency ratios. The creation of proper models within the tools is a serious stuff for advanced actuaries. Running these models is very demanding in terms of computation time, mainly in the case of life liabilities and their stressing.

The Standard Formula Calculator collects the figures from Actuarial Tools and adds more calculations to evaluate the own funds, SCR, MCR and solvency ratios. Though particular calculations within the calculator may not be as sophisticated as those in the Actuarial Tools, all together they form an extensive complex that smartly solves a huge conglomeration of the SCR “spider”. All substantial figures of Solvency II calculations can be found in the calculator.

Is Solvency II finished at this point? Definitely no.

Here is just where IT stuff actually begins:

- to collect the data needed as inputs
- to save them in a proper form together with partial results of successive calculations
- to put together the final data set for QRT reports
- to implement the reports themselves
- to create an automated computation process that will be run periodically in the future
- to set up the workflow of this process which consists of many heterogenous tasks
- to minimize a human factor in the process
- to deal the data quality
- to ensure the data lineage – the ability to declare a proper flow of the data among the calculations from inputs to outputs

Addressing these issues might be even more demanding than the preparation of Solvency II calculations on their own. The final IT solution asks further more than ad-hoc Solvency II computation on ad-hoc collected data.

<b>Data processing and reporting</b>		<b>Successful implementation of Solvency II calculations</b>
<p>Solvency II requirements for obligatory reporting are defined by QRT (Quantitative Reporting Templates). Very roughly divided, there are two kinds of figures in these reports – those that report the standard formula (and are submitted to the Data Storage by the Standard Formula Calculator) and those that are not a part of the standard formula calculation (and have to be maintained in the Data Storage in addition). In other words – QRT demand more complex information to be stored in the Data Storage than the information needed for the standard formula computation.</p> <p>Technically there are at least three basic questions concerning data processing and reporting:  How to implement the Data Storage?  How to get all necessary information into the Data Storage?  What technology should be used to deploy the reporting over the Data Storage?</p>	<p>Our belief is that the answers to these questions should reflect the overall situation of an insurance company and should follow its IT architecture. Therefore, we believe that a customized IT project based on preferred technologies is the most suitable approach to finding a satisfactory solution that will have adequate maintenance in the future.</p> <p>The implementation of the Data Storage and overlaying reporting is, essentially, the deployment of our general Solvency II logical data model and reporting templates on selected technologies. Adastra, as a supplier, is technologically independent and supports all major database technologies as well as reporting and BI tools.</p> <p>The task of filling the Data Storage with the required set of data is far more demanding. It has to reflect the individual system set-up of the insurance company in question. A detailed description of all data needed as inputs for all actuarial tools, the Standard Formula Calculator and QRT reports that we supply together with our Solvency II data model acts, in fact, as the definition of a specific IT project that deals with the input data. The project should begin with an analytical phase to define the exact scope of the implementation part of the project.</p>	<p>We believe that a comprehensive set of tools, together with well-trained specialists – actuaries and business/IT consultants – are key ingredients of successful implementation of Solvency II calculations.</p> <p>Our tools and templates are the result of long term development. A team of senior actuaries, insurance business consultants and IT specialists stands beside the creation of the tools. We are ready to deliver not only the tools, but also the know-how needed to prepare the input data and to fully understand all aspects of Solvency II or other related actuarial calculations. We can deliver a complete tailor-made solution as well as supply the missing pieces to the puzzle of your Solvency II solution.</p> <p>The described approach solves the mandatory Solvency II calculations and data processing from A to Z. The proposed architecture can be extended by a partial or a full internal model and/or other useful actuarial calculations and/or comprehensive internal corporate reporting allowing the customer to achieve more business value from the considerable investment made in mandatory Solvency II calculations.</p>

**The overview of tasks needed to fulfill Solvency II mandatory calculations and reporting:**

- value of life liabilities and its stressing
- value of non-life liabilities and its stressing
- value of financial instruments and its stressing
- yield curve fitting
- generation of economic scenarios
- assembling of economic balance sheet
- evaluation of own funds
- standard formula SCR calculation
- MCR calculation
- consistent data storage
- automation of data processing
- dealing the data quality and auditability
- QRT implementation

Do you have all these points covered? Do those pieces work together? Are you ready to build an effective risk management solution above it?

**Who we are and what makes our offer unique?**

We are a joint venture of the large international consultancy company and the dynamic actuarial firm with the unique know-how. We are actuaries, business and IT consultants, who have put a significant effort into development of a real-world Solvency II solution.

Our solution covers:

- Actuarial Tools
  - Sophas
  - Claims Reserve Calculator
  - Asset Model
  - Yield Curve Fitting
  - ESG – Yield Curve Simulation
  - ESG – Yield Curve Calibration
- Standard Formula Calculator
- Complete description of input data
- Mapping to QRT reports
- Logical data model that glues all parts together
- Deployment of the data storage and reports on preferred technologies
- IT and actuary consultations dealing with your individual situation

Our solution is modular, so we are able to deliver it whole or just the parts you need. We cover all aspects of Solvency II calculations and we can mix a package of tools and services to suit your needs.



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