VectorRisk

FRTB Solution

FINTECH INNOVATION AWARDS 2016 FINALIST

VectorRisk is an Australian company with customers in Australia, New Zealand, Singapore and the United States that provides cloud based risk software solutions to banks, hedge funds, government and corporate treasuries.

Our risk system calculates market and credit risk exposures in real-time. Our clients have implemented the system as the engine behind credit limit monitoring, collateral stress testing, market VAR and stress, and CVA.

FRTB Solution

[LARGE BANK]

- The foundation of the product is a high performance risk engine.
- Vectorised pricing allows FRTB and CVA to run on large bank portfolios. Over 1 billion valuations per minute (CVA) or 180 million per minute (FRTB) for a mixed portfolio on a moderate Azure cluster (80 CPU cores).
- The architecture fully separates the risk engine from the workflow and GUI via web services. Customers can use the workflow to organize all the calculations for a daily process, or call directly into the risk engine for stateless real-time calculations.
- FRTB calculations are available now for impact assessment or subscription. Our internal model offering is characterised by raw speed. Our standard model offering employs a curve driven, all-inclusive approach to the definition and generation of sensitivities.
- Multi-tenancy cloud solution (Microsoft Azure) vastly reduces IT costs, implementation timeframes and project risk. Private cloud is an option.

[SMALL BANK]

- The pricing and risk analytics are proven inside large banks.
- The workflow is defined around a daily process, with a task list for loading data, running calculations and producing reports. It is simple to use “out of the box”.
- Our FRTB standard model automates the critical step of defining and generating the delta/curvature/vega sensitivities. The sensitivities are applied to the appropriate vertices for the capital calculation.
- Customers can progress to the internal model if warranted by capital savings or other benefits.
- Multi-tenancy cloud solution (Microsoft Azure) vastly reduces IT costs, implementation timeframes and project risk. Put simply, the solution is inexpensive.

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Benchmarks

on Microsoft Azure

FRTB benchmark (internal model – historic simulation 250 path current period, 250 path stress period)		
Desks:	14	(plus 20 parent aggregations up to global IMCC)
Trades:	331,000	(42% swaps, 21% options, 37% FX)
Historic Simulations:	1260	(14 x 3 x 5 x 6. Parent business units use scenario aggregation)
Trade valuations:	2,215,230,420	
Cashflow valuations:	30,050,754,264	
CPU cores:	80	
Run time:	12 MINUTES	

FRTB benchmark (standard model)		
Desks:	14	(plus 20 parent aggregations up to global IMCC)
Trades:	331,000	(42% swaps, 21% options, 37% FX)
Sensitivities:	76,878	(6,372 portfolio + 70,506 trade level vega)
Trade Valuations:	54,872,271	
Cashflow Valuations:	767,525,862	
CPU cores:	80	
Run time:	8 MINUTES	

CVA benchmark (5000 path Monte Carlo):		
Counterparties:	2000	
Trades:	150,000	(60% swaps, 10% options, 30% FX)
Trade valuations:	32,709,985,689	
Cashflow valuations:	698,835,209,270	
CPU cores:	80	
Run time:	22 MINUTES	

Vector Risk analytics always perform full revaluations on every scenario. There is no trade compression.

Analytics with larger scenario sets such as Monte Carlo are better able to utilize vectorization in the pricing library and therefore have comparatively higher valuation throughput.

Trade Load and database caching for the above 331,000 trade portfolio: 30 minutes.

This is a volume test. Full product coverage includes equity, commodity and credit derivatives.

Benchmarks performed in February 2016.

FRTB Model

Highlights

[STANDARD MODEL]

- Our solution breaks the task into two main processes:
  - » Generation of sensitivities for delta/vega/curvature on all the standard model vertices.
  - » Aggregation of the sensitivities using the standard model correlation & aggregation formulae, plus default risk and residual charges.
- The workflow runs the standard model for all business units from desk level to the enterprise total (see Fig. 1).
- Standard model summary report shows the breakdown of capital by desk (see Fig. 2). Detail reports show breakdown by market and risk type (delta, vega, curvature) for any desk or aggregation.
- Sensitivity generation relies on our curve definitions. Each curve has a regular four-part key along with optional sector and liquidity tags. Our stress tests contain curves or curve wild cards and filters for sector and liquidity (see Fig. 3). This allows the stress tests to identify the correct curves to shift for each FRTB sensitivity. Only the trades that are sensitive to these curve shifts will change in value. Vega sensitivities are generated at the individual trade level.
- Default risk charge and residual risk uses an object populated for each trade by the pricing library. The same object is used by Vector Risk's SACCR calculation.

[INTERNAL MODEL]

- The workflow runs the internal model for all business units from desk level to the enterprise total.
- The FRTB liquidity logic is able to re-use the sector and liquidity tags we set up in the standard model. The system looks sequentially down the list (see Fig. 4) for a curve/sector/liquidity match and uses this to assign curves to one or more liquidity band simulations.
- The changes over VaR are the move to ES 97.5 (average of the tail), the need to run three calculations to scale the current ES to the stress period, single market simulations to limit diversification, across five liquidity bands which are then combined back into the IMCC result (see Fig. 5).
- Full revaluation is used (there is no trade compression). The trade/rate map allows the system to identify all scenarios where a trade's value is affected and only revalue on those paths, substituting the trade's initial value for all other scenarios. This is important because the FRTB calculation space is sparse compared to traditional VaR; any given trade is only active in a subset of the simulations.
- Internal Model Default Risk Charge is based on a simulation of default across the credit references. (See Fig. 4)
- Automated identification of the enterprise historic stress window (the 1 year window that produces the highest expected shortfall out of 10 to 15 years of historic data).

[FRTB CAPITAL]

- The workflow is able to look back over daily results to calculate the final capital number (larger of the average capital over 60 days scaled by a multiplier, or yesterday's capital).
- There is a need to monitor the criteria for each desk's inclusion in the internal model. This emerges from P&L attribution and back testing. Hypothetical and actual P&L need to be uploaded by the bank for this process. Vector Risk includes all of these supporting metrics.

FIGURE 1: VECTOR RISK DAILY WORKFLOW – TASK LIST SHOWING STANDARD MODEL

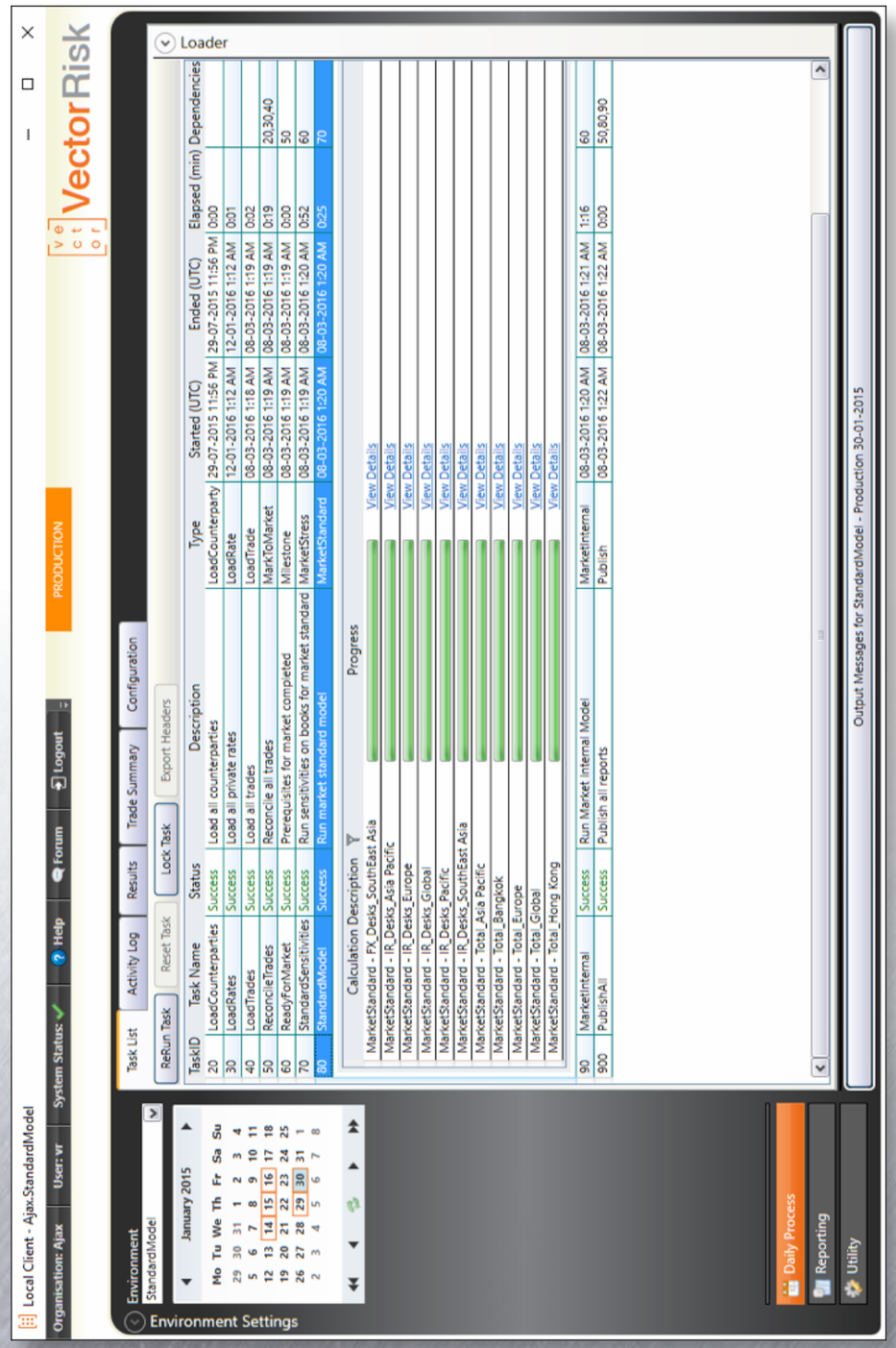

FIGURE 2: STANDARD MODEL SUMMARY REPORT

Market Standard Summary Report

Organisation: Demo
Environment: FRTB
Currency: USD
Date: 30 Jan 2015

Market: **Total**
Risk Type: **Total**

Regions / Products	IR_Desks	CD_Desks	Equity_Desks	Commodity_Desks	FX_Desks	Total
Bangkok	56,633	1,921,659	-	-	2,113,431	3,630,302
Kuala Lumpur	577,259	-	-	-	2,345,540	2,083,530
Singapore	821,896	-	-	6,841,162	2,782,375	8,890,767
Hong Kong	228,822	-	3,585,841	-	4,056,571	7,519,831
SouthEast Asia	1,407,376	1,921,659	3,585,841	6,841,162	6,181,845	16,948,736
Sydney	878,940	-	5,105,775	2,560,070	4,448,889	11,401,983
Tokyo	42,042	1,138,032	-	-	6,440,196	6,529,357
Pacific	895,108	1,138,032	5,105,775	2,560,070	8,456,968	15,393,332
Asia Pacific	2,129,368	3,059,691	6,898,709	9,401,232	10,526,728	25,901,189
London	779,629	17,377,012	6,319,740	-	4,238,550	26,401,945
Europe	779,629	17,377,012	6,319,740	-	4,238,550	26,401,945
Global	2,709,128	19,727,295	8,141,211	9,401,232	12,044,489	40,692,566

Run Date: 2016-03-08 01.54 AM (UTC)

FIGURE 3: SAMPLE DEFINITIONS USED TO GENERATE STANDARD MODEL SENSITIVITIES

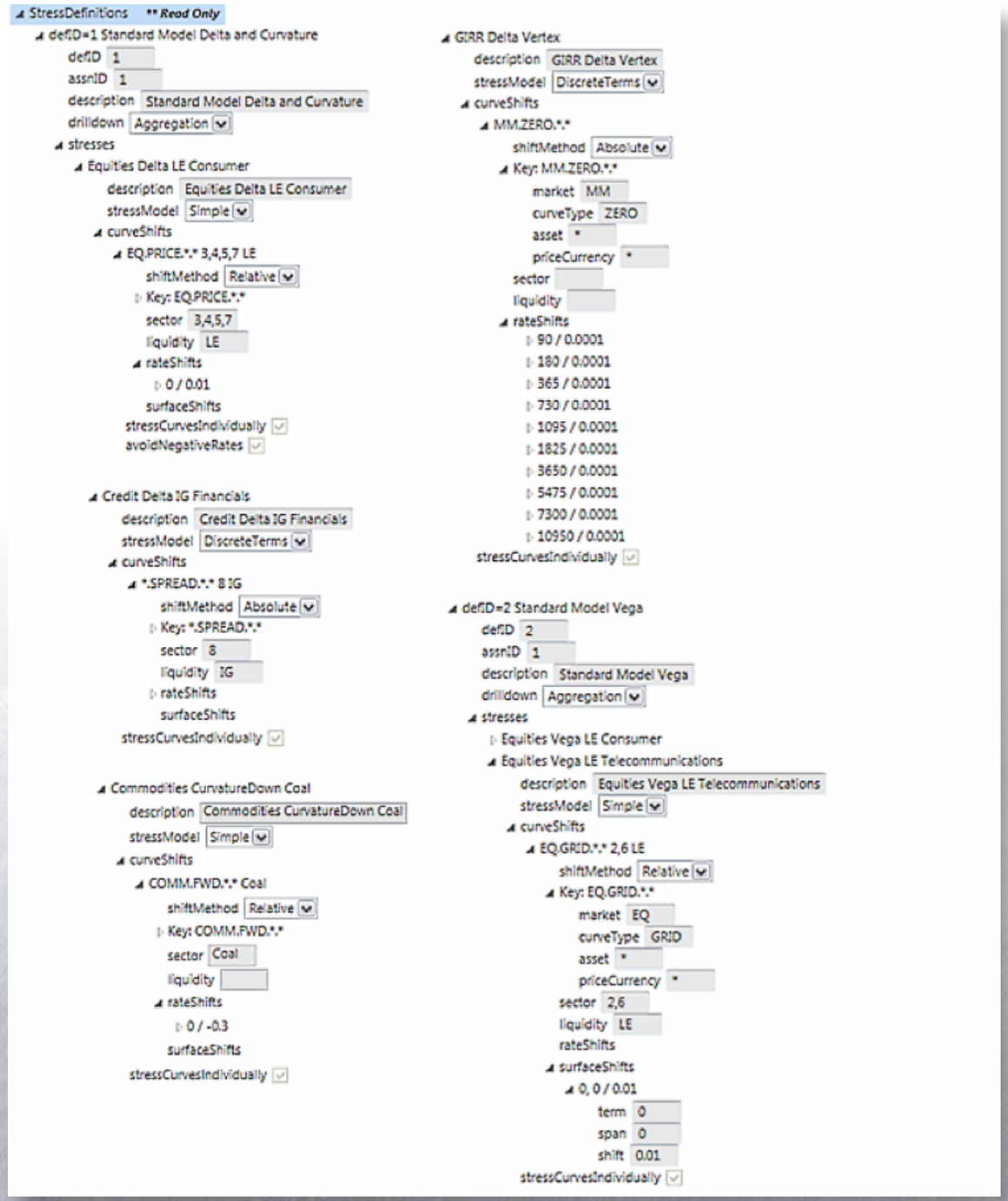

FIGURE 4: INTERNAL MODEL DEFAULT RISK CHARGE EXAMPLE

FIGURE 5: MARKET INTERNAL RESULT

Calculation Summary

Parameter	Value
Business Unit	Total|Global
Calculation Method	Historic
Base Currency	USD
Reporting Currency	USD
Exchange Rate	1.00
Portfolio Mtm	10,556,292.52
Diversification Ratio	0.50
IMCC	9,216,250.31

Main Results

Factor Set	ESRS	ESRC	ESFC	IMCC (C)
Total	7,138,574.86	7,186,055.09	7,669,591.81	7,669,591.81
Commodity	137,218.48	148,912.06	148,912.06	148,912.06
Credit	441,165.89	474,154.29	439,668.11	439,668.11
Equity	1,720,748.90	1,849,750.79	1,849,750.79	1,849,750.79
FX	1,214,448.33	1,026,942.40	1,026,970.14	1,214,481.13
Interest	7,110,096.72	6,728,926.91	6,728,926.91	7,110,096.72

Detail Results

Factor Set	Liquidity	ESRS	ESRC	ESFC
Total	10	5,042,867.25	5,164,668.35	5,297,487.85
Total	20	5,001,126.78	4,956,795.96	5,115,042.75
Total	40	438,372.57	339,552.57	779,170.47
Total	60	129,788.81	144,187.30	650,285.60
Total	120	128,737.84	143,521.52	650,082.39
Commodity	10	39,611.56	42,987.21	42,987.21
Commodity	20	39,611.56	42,987.21	42,987.21
Commodity	40	39,611.56	42,987.21	42,987.21
Commodity	60	39,611.56	42,987.21	42,987.21
Commodity	120	39,611.56	42,987.21	42,987.21
Credit	10	127,353.62	136,876.55	126,921.25
Credit	20	127,353.62	136,876.55	126,921.25
Credit	40	127,353.62	136,876.55	126,921.25
Credit	60	127,353.62	136,876.55	126,921.25
Credit	120	127,353.62	136,876.55	126,921.25
Equity	10	1,600,938.53	1,734,586.46	1,734,586.46
Equity	20	630,805.00	642,433.61	642,433.61
Equity	40	3,797.13	4,088.10	4,088.10
Equity	60	3,797.13	4,088.10	4,088.10
Equity	120	0.00	0.00	0.00
FX	10	774,203.76	661,149.61	661,156.83
FX	20	774,203.76	661,149.61	661,156.83
FX	40	371,552.04	300,310.73	300,342.27
FX	60	0.00	0.00	0.00
FX	120	0.00	0.00	0.00
Interest	10	5,027,597.60	4,758,069.85	4,758,069.85
Interest	20	5,027,597.60	4,758,069.85	4,758,069.85
Interest	40	17.45	13.83	13.83
Interest	60	17.45	13.83	13.83
Interest	120	0.00	0.00	0.00

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