



ActiveViam Case Study

# Danske Bank – Overcoming the xVA Challenge



# INTRODUCTION

Financial industry participants have to actively manage all facets of derivatives pricing that impact the entire banking portfolio from profit and loss to regulatory capital.

The multidimensionality and non-linear payoff structure of derivatives instruments and the need to manage valuation adjustments or “xVAs” for credit, debt, funding, margin, and impact on capital has generated large volumes of data, which need to be categorized differently on a given day.

Precise calculation of the risks affecting these instruments on a daily, weekly, and monthly basis is key to mapping exact costs to specific portfolios and counterparty netting sets.

*“ActiveViam came into play when we realized that the number of market data elements and risk sensitivities and the level of granularity we needed represented a volume of data so huge that we couldn’t deal with it in a timely fashion to explain changes in risk and changes in value”* said Nicki Rasmussen, Head of the xVA Desk.



# ActiveViam and xVA at Danske Bank

Almost a century and a half old, Danske Bank is Denmark's largest bank. Danske Bank has used ActiveViam's signature in-memory analytics and aggregation tool, ActivePivot, to aggregate data on its first-line market risk function since 2015 and it has since been deployed in other parts of the bank as well.

When the project began, the xVA desk was still inspecting the output of CSV files in Excel. This did not allow for day-to-day comparison or the ability to drill down quickly or to save interesting views and dashboards, all of which this project makes possible.

Danske Bank could have used an "off-the-shelf" solution to tackle xVA but instead it developed its own approach. It was led in part by Mr. Rasmussen, Head of the xVA Desk and his team, who created an award-winning pricing library and algorithmic technique to perform xVA calculations. Seeing how well ActivePivot performed on other desks, the team decided to adapt it to the xVA desk during the build-up phase while they were still free to choose the technology and design. Their goal was to create a flexible view of the outputs of xVA calculations.

## An Atypical Desk with Particular Challenges

xVA desks are centralized desks running all the valuation adjustments for the entire universe of a bank's derivatives portfolio.

This poses a unique and atypical set of challenges from a technology standpoint. While a typical trading desk only has to consider a single trade at a time in one product, and its present value and exposure to one risk factor, the xVA desk covers the entire bank's derivatives portfolio and all of the associated inputs. The xVA desk must be a master of many products within all asset classes and manage risk including delta risk (gamma and vega) and sensitivities among others.

An ordinary trading desk may do 200 trades on a busy day. The xVA desk is responsible for the risk of all trades in the bank's swap book (several hundred thousand at a small-to-mid-size bank, for some context), the activity of all derivatives traders, swap desks, and all foreign exchange desks – on any given day.

Up until the project described here, no system existed at Danske Bank that could look across all books, products, risk types and clients without already being aggregated into one of them, which made analysis slower and less intuitive.

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**Nicki Rasmussen**, Head of the xVA Desk at Danske Bank

## How Did They Do It?

Danske Bank coupled its proprietary in-house quantitative pricing library, which produced values for all of its derivatives portfolio risks, with an approach known as Adjoint Algorithmic Differentiation (AAD). This enabled the bank to compute not just the price of instruments but the sensitivities for all related risk factors in parallel. AAD performs computations on thousands of risk buckets producing many volumes of data. Danske Bank is able to calculate and store all the additional results with a performance overhead of only 5-to-6 times the basic valuation (mark-to-market) of the xVA number itself, avoiding the need to produce a risk grid to calculate potentially thousands of stressed valuations.

Instead of reducing the number of risks to look at, Danske Bank increased the volume of risk numbers. The xVA ActivePivot setup at Danske Bank currently has 68 million data points, including unique entries of the main "Measure" in the one cube ("XVAValuesCube"), and 12 million data points in the other cube ("XVARiskCube") to thoroughly view and manage xVA.

The challenge then was how to view and understand this data and be able to dig into the numbers at a granular level across:

- Currencies
- Buckets
- Tenors
- Counterparty

This is where ActiveViam delivered the most valuable benefits.

## Enabling Multidimensional Analysis with ActiveViam

Danske Bank implemented its xVA setup using Monte Carlo simulations, which was extended with the AAD technology to calculate risk sensitivities. Due to the high dimensionality of the xVA challenge, this produced massive volumes of data representing the risk of all xVA positions.

ActivePivot enabled the Danske Bank xVA desk to take all these outputs and view them in a precise and orderly fashion.

ActivePivot allowed the desk to slice and dice the data and drill down to any granular level to examine causes, effects, and anomalies. With ActiveViam's help, the Danske Bank xVA desk was able to perform real-time analysis on the derivatives portfolio in order to achieve the monumental task required of them.

Danske Bank tailored the solution to its specific business hierarchies and instrument classifications (i.e. dimensions within their cubes). They have been able to evolve and expand this through time without having to make any analytical modifications, thanks to the separation of the analytics from the data within ActivePivot. This reduced the risk associated with upgrades and improved agility.

The benefits ActivePivot for xVA has provided to Danske Bank include:

- Improved accuracy and speed for pre-deal checks. The xVA desk can examine the incremental CVA impact of a new trade and assess a counterparty's exposures and their origin. "That was the true benefit for us – to be able to drill down quickly within seconds, not hours or days, to create a new report if something looked odd", Mr. Rasmussen said. "Since requesting development resources to create new bespoke reports was not an option, being able to do so on the desk was a great benefit", he added.

- The ability to understand market impacts and make the best decisions. By feeding all the analytical output of the models at the most granular level, coupled with the latest market data, it allows the desk to immediately understand the impact of market changes as they occur. Using this, the xVA desk is able to explain the profit and loss from the previous day's risk and market variables and drill down to the counterparty level to see which counterparty contributed the most to the change.
- Shared bookmarks and views across the organization save valuable time. ActivePivot provides the xVA desk with the ability to quickly look at risk from all different dimensions. All xVA traders and analysts can modify existing dashboards and create new ones on-the-fly. The ActivePivot aggregation engine coupled with Danske Bank's unique and thorough approach to calculating risk and sensitivities empowers the xVA desk to investigate practically any datapoint they need, without having to wait for a new risk report to be produced from overnight batch processing.

### the Big Data challenge behind xVA at Danske Bank:

Every single xVA number (CVA, FVA, DVA, CoVA etc.) can be sensitive to all currencies (between 10 and 20), for each currency to all rate curves (for instance 3-6 per currency), to all rate volatilities, to all fx volatilities, to inflation, commodity, equity, etc.

In this case, multiplying together the number of risk sensitivities per each xVA easily amounts to  $20 \times (1+6+10 \times 4 \times 3+10 \times 4+10) = 3,540$ . Danske Bank runs 7 different xVA numbers per netting set, and has approximately 8,000 netting sets, so if every netting set had all risks we would expect close to 200M risk numbers a day. Fortunately, not all netting sets have exposure to everything, so the realistic number is closer to 1-2M risk numbers a day.



## Why ActivePivot Works so Well for xVA

A large part of what Danske Bank was able to accomplish with ActivePivot was to look at the risk in the same day – the total aggregate number as well as quickly slice that aggregate to view any desired dimension.

The complexity of the xVA process means it can be prone to errors so the ability to look at risk at a granular level during any time period is a significant milestone in xVA risk management.

*“The ability to look at all the different risks was a huge step for us, saving us a lot of time not just in a single day but for every single end of month - for the full year”, Mr. Rasmussen said.*

## Improved Analytical Understanding and Cost Savings

ActivePivot provides Danske Bank xVA analysts with the ability to share deep insight into xVA values and risk across the entire organization

without the desk relying on IT resources or having to ask a quant to provide a view of a particular slice of risk.

All the analytical understanding is turned into insights very fast, with the additional advantage of low overall development costs thanks to ActivePivot integrating well with Danske Bank custom xVA risk engine, a welcome benefit with technology resources stretched so thin at many banks.

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**Nicki Rasmussen**, Head of the xVA Desk at Danske Bank

# About ActiveViam

ActiveViam provides precision data analytics tools to help organizations make better decisions faster.

ActiveViam started in 2005 with the vision of leveraging in-memory technology to create an analytics platform where businesses could leverage the largest data sets without restrictions, keep them up-to-date in real time and use them to empower their decision makers.

Our goal at ActiveViam, is to let organizations not only make decisions faster, but better; to not only reach their data, but their potential; to not only see their data, but find their way into the future.

ActiveViam is a privately owned company with offices in Paris, London, New York and Singapore.

For more information please visit: [www.activeviam.com](http://www.activeviam.com)

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