ActiveViam

# Case Study

## Danske Bank – Leading xVA Innovation with Atoti

# Introduction

Financial industry participants must 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 (xVAs) for credit, debt, funding, margin, and impact on capital generates large volumes of data, which need to be categorized differently on any 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

Danske Bank, Denmark's largest and nearly 150 years old, has used ActiveViam's Atoti for in-memory analytics and data aggregation in its first-line market risk function since 2015. Since then, Atoti has been deployed in other areas of the bank.

When the project began, the xVA desk relied on analyzing CSV files in Excel, which lacked day-to-day comparison, quick drill-down capabilities, and the ability to save views and dashboards.

Danske Bank chose to develop its own approach to xVA rather than using an off-the-shelf solution. Led by Mr. Rasmussen, Head of the xVA Desk, and his team, they created an award-winning pricing library and algorithmic technique for xVA calculations. Impressed by ActivePivot's performance on other desks, the team adapted it for the xVA desk during the build-up phase, taking advantage of the freedom to select technology and design. Their goal was to create a flexible view of xVA calculation outputs.

# A **Unique Desk** with **Specific** Challenges

xVA desks are centralized units managing all valuation adjustments for a bank's entire derivatives portfolio, presenting unique technological challenges. Unlike typical trading desks that handle single trades and specific risk factors, xVA desks oversee the entire derivatives portfolio and its associated inputs. They must master multiple products across all asset classes and manage various risks, including delta, gamma, and vega.

While a typical trading desk might handle 200 trades on a busy day, the xVA desk manages the risk for hundreds of thousands of trades in the bank's swap book, encompassing the activities of all derivatives traders, swap desks, and foreign exchange desks.

Before this project, Danske Bank lacked a system that could comprehensively analyze all books, products, risk types, and clients without prior aggregation into one category. This limitation 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.

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• Currencies
• Buckets
• Tenors
• Counterparty

This is where ActiveViam delivered the most valuable benefits.

• The ability to understand market impacts and make informed decisions. By integrating all analytical outputs at the most granular level with the latest market data, the xVA desk can instantly grasp the impact of market changes as they happen. This capability enables them to explain the profit and loss from the previous day's risk and market variables and drill down to the counterparty level to identify the primary contributors to these changes.

• Shared bookmarks and views across the organization save valuable time. Atoti enables the xVA desk to quickly view risk from various dimensions. All xVA traders and analysts can modify existing dashboards and create new ones on the fly. The Atoti aggregation engine, combined with Danske Bank's comprehensive approach to calculating risk and sensitivities, empowers the xVA desk to investigate any datapoint without waiting for new risk reports from overnight batch processing.

# Enabling Multidimensional Analysis with ActiveViam

Danske Bank implemented its xVA setup using Monte Carlo simulations, enhanced with Adjoint Algorithmic Differentiation (AAD) technology to calculate risk sensitivities. Given the high dimensionality of the xVA challenge, this approach generated vast volumes of data representing the risk of all xVA positions.

Atoti enabled Danske Bank's xVA desk to organize and view these outputs precisely and systematically. It allowed the desk to slice and dice the data, drilling down to any granular level to examine causes, effects, and anomalies. With Atoti, the xVA desk could perform real-time analysis on the derivatives portfolio, achieving the monumental task required.

Danske Bank customized the solution to fit its specific business hierarchies and instrument classifications. Over time, they have evolved and expanded this setup without needing analytical modifications, thanks to the separation of analytics from data within Atoti. This approach reduced upgrade risks and improved agility.

The benefits of using Atoti for xVA at Danske Bank include:

• Enhanced accuracy and speed for pre-deal checks, allowing the xVA desk to analyze the incremental CVA impact of new trades and assess counterparty exposures and their sources.

"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 Big Data challenge of xVA at Danske Bank:

Each xVA number (CVA, FVA, DVA, CoIVA, etc.) is sensitive to multiple factors: between 10 and 20 currencies, several rate curves per currency (3-6), rate volatilities, FX volatilities, and other elements such as inflation, commodities, and equity.

Calculating the risk sensitivities for each xVA involves considerable complexity. For example, multiplying the number of risk sensitivities per xVA results in approximately 3,540 data points. With 7 different xVA numbers per netting set and around 8,000 netting sets, the potential total could reach 200 million risk numbers daily.

However, not all netting sets are exposed to every risk, so the actual number is closer to 1-2 million risk numbers daily.

*"That was the true benefit – to be able to drill down quickly within seconds to create a new report. The ability to look at all the different risks was a huge step for us, saving us a lot of time at every single end of month."*

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

# Why Atoti Excels for xVA

Danske Bank leveraged Atoti to analyze risk on the same day, viewing both total aggregate numbers and quickly slicing the data to examine any desired dimension.

Given the complexity of the xVA process and its susceptibility to errors, the ability to assess risk at a granular level in real time 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 a month - for the full year",* Mr. Rasmussen said.

# Enhanced Analytical Insight and Cost Savings

Atoti empowers Danske Bank xVA analysts to share deep insights into xVA values and risk across the organization without relying on IT resources or needing quants to provide specific risk views.

This rapid conversion of analytical understanding into actionable insights is achieved with low development costs, thanks to Atoti's seamless integration with Danske Bank's custom xVA risk engine, a significant benefit given the constrained technology resources at many banks.

# ActiveViam

## About ActiveViam

Founded by industry experts, ActiveViam understands the data analytics challenges faced by financial institutions across trading desks, risk, and compliance. ActiveViam pioneered the use of high-performance analytics in finance, helping the largest investment banks, asset managers and hedge funds make better decisions, explain results with confidence, and simulate the impact of their decisions. ActiveViam's mission is to deliver train-of-thought analysis on terabytes of data in the most cost-effective way so clients can explain their results with confidence and model the scenarios that will optimize their business. ActiveViam specializes in risk data analytics for one of the fastest moving and most regulated industries with a presence in the world's leading financial marketplaces - London, New York, Singapore, Sydney, Hong Kong, Paris and Frankfurt.

For more information please visit:
**www.activeviam.com**

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